

Code: ME7T4B

**IV B.Tech - I Semester – Regular/Supplementary Examinations
October - 2019**

**ROBOTICS
(MECHANICAL ENGINEERING)**

Duration: 3 hours

Max. Marks: 70

PART – A

Answer *all* the questions. All questions carry equal marks

11 x 2 = 22 M

1. a) List out various joint types of robot.
- b) What are the applications involving tools as end effectors?
- c) Differentiate Forward kinematics & Inverse kinematics.
- d) Write Homogeneous transformation matrix for Rot (y, 90°).
- e) What are the differential motions of a frame?
- f) Why do we derive dynamic equations of motion of robot?
- g) What is the purpose of optical interrupter?
- h) Differentiate path planning and trajectory planning.
- i) What is the resolution of absolute encoder, if it has 'n' number of tracks?
- j) Name few robot Programming languages
- k) List out the applications of robots in assembly.

PART – B

Answer any **THREE** questions. All questions carry equal marks.

$$3 \times 16 = 48 \text{ M}$$

2. a) How would you classify robots? Briefly explain. 8 M
- b) Summarize the features of pneumatic, hydraulic and electric actuators for industrial robots. 8 M
3. a) A point $P(7, 3, 1)^T$ is attached to a frame F_{noa} and is subjected to the following transformations. Find the coordinates of the point relative to the reference frame at the conclusion of transformations. 8 M
- (i) Rotation of 90° about the z-axis
 - (ii) Followed by a translation of $[4, -3, 7]$
 - (iii) Followed by a rotation of 90° about the y-axis
- b) Derive D-H matrix for forward kinematic analysis. Also, obtain forward kinematic model of a typical 3 DOF (RRP) manipulator arm. 8 M
4. a) Derive transformation matrix for differential rotation about a general axis 'q'. 8 M
- b) Find the effect of a differential rotation of 0.1 rad about the y-axis followed by a differential translation of $[0.1, 0, 0.2]$ on the given frame B. 8 M

$$B = \begin{bmatrix} 0 & 0 & 1 & 10 \\ 1 & 0 & 0 & 5 \\ 0 & 1 & 0 & 3 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

5. a) What is Slip sensor? Explain any one such sensor with neat sketches. 8 M
- b) Discuss in detail non-contact type proximity sensors used in robot manipulator. 8 M
6. a) Classify the industrial applications of robots. 4 M
- b) Discuss the role of robot applications in the following industrial processes. 12 M
- i) Material transfer
 - ii) Assembly tasks
 - iii) Spray painting