| BME-029 |

B.Tech. MECHANICAL ENGINEERING (COMPUTER INTEGRATED MANUFACTURING)

ꗡꗡ073   Term-End Examination

June, 2018

BME-029 : ROBOTICS

Time : 3 hours   *Maximum Marks : 70*

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

1. (a)   How does one decide the introduction of a robot for a particular job ? Give suitable examples.

   (b)   Discuss in brief, the various components of a robot manipulator.   *5+5*

2. (a)   Describe the advantages and disadvantages of a pneumatic actuator.

   (b)   What is capacitive proximity sensor ? State the advantages of capacitive proximity sensors.   *5+5*

3. (a) How are robots used in the field of medical science and defence ? Give suitable examples.

(b) Explain the criteria for the selection of sensors in robots. *5+5*

4. (a) The coordinates of a point q_{abc} are given by $[7, 5, 3]^T$ which is rotated about the OX-axis of the reference frame OXYZ, by an angle of 60°. Determine the coordinates of the point q_{xyz}.

(b) Consider the following coordinate transformation matrix which represents a fundamental rotation. What is the axis of rotation (1, 2 or 3), and what is the angle of rotation ? *5+5*

$$R = \begin{bmatrix} 0{\cdot}500 & 0 & -0{\cdot}866 \\ 0 & 1 & 0 \\ 0{\cdot}866 & 0 & 0{\cdot}500 \end{bmatrix}$$

5. (a) Explain the use of homogeneous transformation matrix in robotic applications.

(b) Define and illustrate the link and joint parameters. Explain their uses. *5+5*

6. Explain the Lagrange–Euler formulation for dynamic analysis of a robot arm, with the help of a sample two-link manipulator. **10**

7. (a) Discuss trajectory planning with respect to PTP robot considering modified· constant velocity motion of the joint.

   (b) A joint in a PTP robot rotates from an initial angle of 5° to a final angle of 65° in 5 sec with a constant maximum velocity of 12 deg/sec. Determine the position of the joint in 1, 2, 3, 4 secs, and plot the results. **5+5**

8. (a) The differential equation describing a joint in a robotic manipulator is given below :

   $$2 \cdot 5 \frac{d^2 y}{dt^2} + 20 \frac{dy}{dt} + 40y = 0$$

   Determine the delay time.

   (b) Explain advantages and limitations of PID Control. **5+5**

9. (a) Discuss the programming methods used in robots mentioning their specific field of application.

   (b) Describe different· types of offline programming methods of robots. **5+5**

10. Write short notes on any *four* of the following : $4 \times 2\frac{1}{2} = 10$

(a) Sensitivity and Linearity in Transducers

(b) Feedback Control

(c) DH Parameter Matrix

(d) Degrees of Freedom

(e) Actuators