

**B.Tech. MECHANICAL ENGINEERING
(COMPUTER INTEGRATED
MANUFACTURING)**

Term-End Examination

December, 2015

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) Briefly describe the historical development of Robotics.
- (b) Explain the various types of robotic subsystems. 5+5
2. (a) What are the various types of industrial applications of Robotics ?
- (b) Describe the safety issues in Robotics. 5+5
3. (a) Explain the relationship of Robotics with industrial automation and illustrate the same with a suitable example.

- (b) Differentiate between on-line and off-line robot programming with the help of suitable examples. 5+5
4. (a) Explain the various wrist configurations in robots.
- (b) The co-ordinates of a point q_{abc} is given by $(8, 6, 4)^T$ which is rotated about the OX-axis of the reference frame OXYZ by an angle of 60° . Determine the co-ordinates of the point q_{xyz} . 5+5
5. (a) Write how the robots can be used in medical surgery.
- (b) Discuss the Lagrange-Euler formulation for a robot arm. 5+5
6. (a) Explain in brief the advantages of PID control.
- (b) What is programming by simulation ? 5+5
7. (a) A PTP robot with a revolute joint moving with a velocity of 15 deg/sec , traverses from an initial position of 15° to a final position of 75° . Determine the position and velocity at the end of 1, 2, 3 and 4 seconds. The range of initial and final position is covered in 5 secs with a finite acceleration of 6 deg/sec^2 .
- (b) Why is the use of gears recommended for robot transmission ? 5+5

8. (a) Define the 'workspace' of any robot. What are the various types of workspaces ?
- (b) What are the various criteria for selecting a robot ? 5+5
9. (a) Identify the different types of end-effectors used in robots and their applications.
- (b) What is a proximity sensor ? Name three techniques for designing proximity sensors. 5+5
10. (a) Consider the following co-ordinate transformation matrix, which represents a fundamental rotation :

$$R = \begin{bmatrix} 0.500 & 0 & -0.866 \\ 0 & 1 & 0 \\ 0.866 & 0 & 0.500 \end{bmatrix}$$

What is the axis of rotation (1, 2 or 3), and what is the angle of rotation ?

- (b) Discuss the criteria of selection of drive systems for the robots, highlighting the merits and demerits of the system. 5+5