BME-029

B.Tech. MECHANICAL ENGINEERING (COMPUTER INTEGRATED MANUFACTURING)

□□9□3 **Term-End Examination**

December, 2016

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) With the help of a block diagram, explain the functions of a robotic vision system and the devices used in the same system.

   (b) What are the "laws of Robotics" ? *5+5*

2. (a) Discuss the advantages and disadvantages of hydraulic actuators in a robot.

   (b) Sketch a robot arm in cylindrical co-ordinates. *5+5*

3. (a) What are the different types of internal sensors ? Explain their functional details.

   (b) Explain the selection methodology of actuators and sensors for a robotic system. *5+5*

4. (a) Describe the point-to-point and continuous path planning.

   (b) Discuss the purpose and importance of feedback control system. *5+5*

5. (a) What do you understand by position analysis ? Describe the method to solve a direct problem.

   (b) What is 'Lagrangian' ? How is Lagrangian correlated with forces in the links of a kinematic chain ? *5+5*

6. (a) Differentiate between a robot and CNC machine tools.

   (b) Using block diagrams, define forward and inverse kinematics of a robot. How are they useful for a robot ? *5+5*

7. (a) Explain the relationship of robotics with industrial automation and illustrate the same with a suitable example.

   (b) What are the advantages of using robots in industry ? *5+5*

8. (a) Which of the Denavit-Hartenberg (DH) parameters are variable for a revolute joint ? Which are the variable DH parameters for a prismatic joint ?

(b) 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 and what is the angle of rotation ?   5+5

9. (a) Differentiate between on-line and off-line Robot programming with the help of suitable examples.

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

10. Write short notes on any *five* of the following : 5×2=10

(a) Programmable Logic Controller

(b) RPL

(c) Serial Chain Robot

(d) Robot Safety

(e) Transducer

(f) SCARA-type Robot