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BME-029

B. TECH. MECHANICAL ENGINEERING (COMPUTER INTEGRATED MANUFACTURING) (BTME)

Term-End Examination

December, 2019

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 are the robots classified based on geometry ? 5

   (b) State the major subsystems of a robot and their functions. Show these subsystems on a sketch. 5

2. (a) What do you understand by "degree of freedom" of robot ? Explain. 5

   (b) With the help of neat sketches, discuss the common robot configurations. 5

3. (a) Explain the following terms with reference to a robot : 5

   (i) Repeatability

   (ii) Accuracy

   (b) Discuss various types of sensors used in robots. 5

4. (a) Explain the working principle of an end effector with the help of neat sketch and give its important applications. 5

   (b) What are the industrial applications of robots ? 5

5. (a) The co-ordinates of a point q_{abc} is given by [7, 5, 3] which is rotated about the OX-axis of the reference frame OXYZ by angle of 60°. Determine the co-ordinates of the point q_{xyz}. 5

   (b) Explain Lagrange-Euler formulation for a robot arm. 5

6. (a) Consider the following co-ordinate 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

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

(b) With the help of a block diagram, explain the functions of a robotic vision system and the devices used. 5

7. (a) Differentiate between On-line and Off-line Robot Programming with the help of suitable examples. 5

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

8. (a) What is the order of a trajectory that has to satisfy position, velocity and acceleration constraints at the initial and final points ?

5

(b) Explain in brief the meaning and concept of "Static and dynamic analysis of a manipulator". Differentiate between static and dynamic part of analysis. 5

9. (a) What is programming by simulation ? Explain. 5

(b) Describe feadback control system in a robot. What are the paremeters to be controlled ? 5

10. (a) When are hydraulic actuators preferred in robots ? Write the differences between Stepper motor and DC servo motor. 5

(b) Describe the non-industrial application of robots. 5