



INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal-500043, Hyderabad

B.Tech VI SEMESTER END EXAMINATIONS (REGULAR) - JULY 2023

Regulation: UG-20

ROBOTICS

Time: 3 Hours

(MECHANICAL ENGINEERING)

Max Marks: 70

Answer ALL questions in Module I and II
Answer ONE out of two questions in Modules III, IV and V
All Questions Carry Equal Marks
All parts of the question must be answered in one place only

MODULE – I

1. (a) Draw and explain the following types of robot configuration.
 - i) Cartesian Robot
 - ii) Cylindrical Robot. [BL: Understand| CO: 1|Marks: 7]
- (b) Outline fixed automation in detail along with illustrating an example. Write its advantages and disadvantages. [BL: Understand| CO: 1|Marks: 7]

MODULE – II

2. (a) Illustrate about the forward kinematics and inverse kinematics with a neat sketch. [BL: Understand| CO: 2|Marks: 7]
- (b) A vector $v = 3i + 2j + 7k$ is rotated by 60° about the z-axes of the reference frame. It is then rotated 30° about the x-axes of the reference frame. Find the rotation transformation. [BL: Apply| CO: 2|Marks: 7]

MODULE – III

3. (a) Enumerate the Jacobian matrix and write the importance of it. Explain about joint interpolation motion along with its algorithm. [BL: Understand| CO: 3|Marks: 7]
- (b) A single-link robot with a rotary joint is motionless at $\theta = 20^\circ$. It is desired to move the joint in a smooth manner to $\theta = 100^\circ$ in 3 seconds. Find the coefficients of a cubic that accomplishes this motion and brings the manipulator to rest at the goal. [BL: Apply| CO: 3|Marks: 7]
4. (a) Illustrate about joint space and cartesian space trajectory planning by specifying their advantages and disadvantages. [BL: Understand| CO: 4|Marks: 7]
- (b) The first joint of a 6-axis robot goes from an initial angle of 30° to a final angle of 75° in 5 seconds. Using a third-order polynomial, calculate the joint angle at 1, 2, 3, and 4 seconds. [BL: Apply| CO: 4|Marks: 7]

MODULE – IV

5. (a) Compare the characteristics of Hydraulic, pneumatic and electric actuators. With a neat sketch discuss the working of an optical encoder. [BL: Understand| CO: 5|Marks: 7]

- (b) Describe the working principle of triangulation range sensor with neat sketch and also outline the advantages.

[BL: Understand| CO: 5|Marks: 7]

6. (a) Outline the construction and working principle of stepper motor and write its advantages and disadvantages.

[BL: Understand| CO: 5|Marks: 7]

- (b) Suggest an appropriate sensor for initiating the robot manipulator action based on the arrival of a part along the conveyor belt and explain its working principle.

[BL: Understand| CO: 5|Marks: 7]

MODULE – V

7. (a) Classify work cell control. Explain pick-and-place robots for machining operation of plastic moulding.

[BL: Understand| CO: 6|Marks: 7]

- (b) Outline the general considerations in robot material handling? Illustrate the advantages and disadvantages of industrial robots.

[BL: Understand| CO: 6|Marks: 7]

8. (a) List the features of robot in machine unloading applications. Discuss about robotic arc welding process.

[BL: Understand| CO: 6|Marks: 7]

- (b) Write the capabilities, features and benefits of spot-welding robot. Discuss about the industrial robot's role in assembly operation.

[BL: Understand| CO: 6|Marks: 7]

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