A **Reg. No. :**

Duration: Three hours   Maximum: 100 Marks

Answer ALL Questions

PART A - (10 x 1 = 10 Marks)

1. Which of the following is NOT a basic component of a robot?   CO1- U

    (a) Power supply   (b) Manipulator

    (c)   Sensor   (d) Transformer

2. What is the purpose of sensors in a robot?   CO1- U

    (a) To lift heavy objects   (b) To provide feedback from the environment

    (c) To reduce power consumption   (d)   To increase weight

3. Kinematics is the study of: CO1- U

    (a) Forces on a moving body   (b)   Motion without considering forces

    (c) Thermodynamics of motion   (d) Control of robots

4. Which of the following is used to perform rotation and translation in a single   CO1- U
    step?

    (a) Translation matrix   (b) Rotation matrix

    (c) Jacobian matrix   (d) Homogeneous transformation matrix

5. Which of the following best defines manipulator dynamics?   CO1- U

    (a) Study of sensor integration in robots

    (b) Study of position and orientation

    (c) Study of motion under the influence of forces and torques

    (d) Study of the programming of robotic arms

6. Which of the following is NOT an assumption in robot dynamics modeling?   CO1- U

    Rigid links   No friction   Ideal joints   Elastic deformation of links

7. Which of the following is the main goal of trajectory planning in robotics?   CO1- U

    (a) Minimizing robot weight   (b) Ensuring smooth motion between points

    (c) Reducing cost of the robot   (d) Increasing the number of joints

8. The main objective of robot control is to:

    (a) Reduce energy consumption   (b) Ensure the robot follows desired trajectories

    (c) Increase robot mass   (d) Simplify hardware design

9. Which of the following is NOT a type of robot actuator?   CO1- U

    (a) Electric motor   (b) Hydraulic cylinder

    (c) Pneumatic cylinder   (d) Transformer

10. The device at the end of a robot arm that interacts with the environment is called: CO1- U

    (a) Actuator   (b) End effector   (c) Controller   (d) Manipulator

<div align="center">PART – B (5 x 2= 10 Marks)</div>

11. Explain the main features of a robot.   CO1- U

12. Explain four Denavit–Hartenberg (D-H) parameters?   CO1- U

13. State the difference between kinematics and dynamics of a robot manipulator.   CO1- U

14. Illustrate Cartesian space trajectory planning preferred?   CO1- U

15. Explain the purpose of a rack and pinion mechanism?   CO1- U

<div align="center">PART – C (5 x 16= 80Marks)</div>

16. (a) Apply the three laws of robotics to an industrial robot working in a hazardous environment. Justify safety mechanisms required.   CO2- App   (16)

<div align="center">Or</div>

    (b) Apply knowledge of robot classification, workspace, control, and safety to design a robotic system for medical surgery assistance, justifying each design choice.   CO2- App   (16)

17. (a) Apply inverse kinematics on a spatial robot manipulator with 3 degrees of freedom and determine all possible joint solutions for a given target point.   CO2- App   (16)

<div align="center">Or</div>

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(b) Apply the concept of composite transformation matrices to describe a robotic arm's complete movement from base to tool frame.   CO2- App   (16)

18. (a) Apply the Lagrange-Euler formulation to derive the equations of motion for a robotic manipulator, illustrating the process with a 2-link planar arm example.   CO3- App   (16)

Or

(b) Apply dynamic modeling principles to analyze challenges in flexible robot structures and propose modifications to rigid-body models for soft robots with justification.   CO3- App   (16)

19. (a) Apply trapezoidal velocity profile trajectory planning to a joint movement task and discuss how acceleration/deceleration phases ensure smoothness.   CO4 -App   (16)

Or

(b) Apply ROS in a warehouse environment: Explain how a robot can detect obstacles with LiDAR and replan paths dynamically.   CO4 -App   (16)

20. (a) Apply the concept of actuators to suggest suitable types for assembling small electronic components and justify your choice.   CO4 -App   (16)

Or

(b) Apply design considerations to suggest sensors, actuators, and power systems suitable for underwater robotic pipeline inspection.   CO4 -App   (16)

U7307