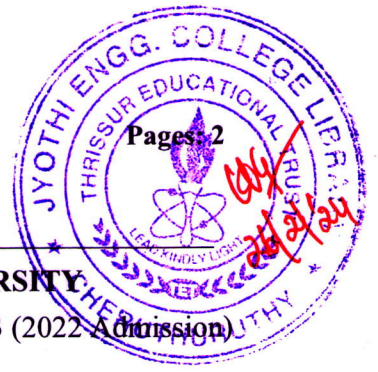


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Reg No.: \_\_\_\_\_

Name: \_\_\_\_\_

**APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY**

Third Semester B.Tech (Minor) Degree Examination December 2023 (2022 Admission)

**Course Code: RAT 281**

**Course Name: BASICS OF ROBOTICS**

Max. Marks: 100

Duration: 3 Hours

**PART A**

*Answer all questions. Each question carries 3 marks*

Marks

1. Distinguish between robot manipulator and mobile robots. (3)
2. List out any three applications of robots in industries. (3)
3. Classify the types of sensors used in robotics. (3)
4. Write about any two key elements of a vision sensor. (3)
5. Classify different types of grippers used in manipulators (3)
6. Explain the properties of a SCARA Robot. (3)
7. Distinguish between Joint space trajectory and task space trajectory (3)
8. Enumerate the DH parameters used in robot kinematics. (3)
9. What is transfer function and what is the need of state space representation? (3)
10. What are the importance and need of analysing the robot dynamics? (3)

**PART B**

*Answer any one full question from each module. Each question carries 14 marks*

**Module 1**

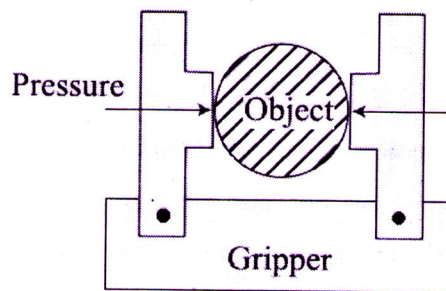
11. a. With the help of neat diagram explain the anatomy of robot. (9)
- b. Explain the role of sensors and actuators in a robot manipulator. (5)
12. a. Investigate any four non-industrial applications of robotics. (10)
- b. Draw the work volume of a Cartesian coordinate robot. (4)

**Module 2**

13. a. Illustrate the components of a vision sensor system with the help of a block diagram. (8)
- b. List out and explain any four factors involved in selecting suitable sensors for a robot? (6)
14. Explain any four types of electric actuators used in robotics? (14)

**Module 3**

15. With the help of neat sketches illustrate the different configurations of robot in detail? (14)
16. a. Consider an object held by a parallel-fingered gripper as shown in the figure. (8)  
Compute the gripper force required to hold the object between the two contact surfaces, if the weight of the object is 100 kg, the coefficient of friction  $\mu$  is 0.3 and acceleration due to gravity is  $9.81\text{m/s}^2$ .



- b. Explain the role of magnetic grippers in manipulators. (6)

**Module 4**

17. With the help of neat sketches explain the algorithm for D-H representation of a robotic arm. (14)
18. a. The base joint of a robot moves from  $\theta_i=30^\circ$  to  $\theta_f=120^\circ$  in 5 seconds following a cubic polynomial trajectory. Identify the trajectory and compute the position of the base joint at 3 seconds. (10)
- b. Give one example of each for the point to point trajectories and continuous trajectories. (4)

**Module 5**

19. a. Explain the working of PID controller for the control of a single link manipulator. (8)
- b. What are the limitations of linear controllers in controlling a robotic arm? (6)
20. a. What the role of Euler Lagrange formulation in robot dynamics? (5)
- b. Derive the dynamics equations of a 1 DOF Robotic arm by applying Euler Lagrange formulation. (9)