Register No.:   ……………………………   Name:   ………………………………………………………

# SAINTGITS COLLEGE OF ENGINEERING (AUTONOMOUS)

(AFFILIATED TO APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY, THIRUVANANTHAPURAM)

**FIFTH SEMESTER B.TECH DEGREE EXAMINATION (Regular), DECEMBER 2022**
**ROBOTICS AND AUTOMATION**

**(2020 SCHEME)**

**Course Code:**   20RBT301

**Course Name:**   Introduction to Robotics

**Max. Marks:**   100                                    **Duration: 3 Hours**

## PART A
### *(Answer all questions. Each question carries 3 marks)*

1.  Outline the anatomy of a robotic manipulator.
2.  Describe the features of SCARA and PUMA robot.
3.  Determine fundamental rotation matrix by 60 degree about y axis.
4.  Explain the mapping of mobile coordinates into fixed coordinate of frames with suitable expression.
5.  Distinguish between path and trajectory of a robotic manipulator.
6.  Differentiate between point to point and continuous path planning.
7.  Evaluate Velocity Jacobian and Potential Energy Expression.
8.  Draw the block diagram of single axis PID Controller.
9.  Define the term stroke and reach of a robot arm.
10. List the application of robot in defense and security.

## PART B
### *(Answer one full question from each module, each question carries 14marks)*
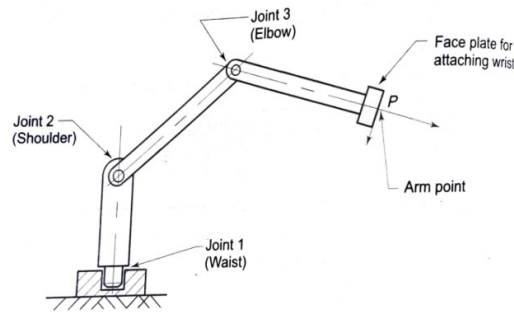
### MODULE I

11. a)  Describe different configuration of robotic manipulator with diagram.   (10)

    b)  Enumerate the selection and design consideration of grippers in robot.   (4)

### OR

12. a)  Explain different mechanical and magnetic gripper of end effectors.   (10)
    b)  Analyze 3R Concurrent wrist with diagram.   (4)

### MODULE II

13. a)  Derive the kinetic model a 3 DOF articulated robot.   (14)

**OR**

14. a) Demonstrate Screw transformation with example. (7)
    b) Examine the general properties of solutions in inverse kinematics. (7)

**MODULE III**

15. a) The second joint of an arm manipulator is to move from an initial position of 20 degrees to a final position of 68 degrees in 4 seconds. Assume that the joint starts and finishes at zero velocity. Find the (10) cubic polynomial that satisfies this motion. Calculate the position, velocity and acceleration of this joint at intervals of 1 second.
    b) Explain Cartesian Space Planning (4)

**OR**

16. a) Enumerate the steps in trajectory planning. (7)
    b) Describe linear segments with parabolic blends. (7)

**MODULE IV**

17. a) Derive dynamic model of 1 DOF planar manipulator. (7)
    b) Explain Computed torque control with block diagram. (7)

**OR**

18. a) Explain Euler Lagrange equation for dynamic modeling. (4)
    b) Enumerate PD-Gravity Control of a robotic arm. (10)

**MODULE V**

19. a) Describe any four Industrial applications of robot. (9)
    b) Outline key issues for locomotion in robot. (5)

**OR**

20. a) Identify the selection of robot in terms of number of axes, work volume, Accuracy and Precision. (6)
    b) Construct the kinetic model of a differential drive robot. (8)

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