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

SAINTGITS COLLEGE OF ENGINEERING (AUTONOMOUS)

(AFFILIATED TO APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY, THIRUVANANTHAPURAM)

SECOND SEMESTER M.TECH DEGREE EXAMINATION (R,S), MAY 2024
ROBOTICS AND AUTOMATION
(2021 Scheme)

Course Code: **21RA203**

Course Name: **Control, Programming and Calibrations of Robots**

Max. Marks: **60**   **Duration: 3 Hours**

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

1. Illustrate the role of Inverse Jacobean Matrix in task space control.
2. Explain the concept of Instantaneous Centre of Rotation in a mobile robot.
3. Illustrate the concept of image interpretation.
4. Develop a program to create a python dependent package 'Marshmallow' in a workspace 'Opensource' in a directory 'Android'.
5. Differentiate the terms localization and navigation.
6. Illustrate the dynamics of a simple rigid link using Lagrangian equation.
7. Classify the calibration methods used in robotics.
8. Describe the techniques behind laser-based calibration.

PART B
(Answer one full question from each module, each question carries 6 marks)

MODULE I

9. Illustrate the concept of Computed Torque Control with sketches.   (6)

OR

10. a) Illustrate the role of stepper motors in robotic drives.   (3)
     b) Illustrate in short about compliant motion control.   (3)

MODULE II

11. Design and setup a bicycle model of a mobile robot.   (6)

OR

12. Model a trajectory planning of a mobile robot using linear segment with parabolic blending.   (6)

MODULE III

13. Explain the advantages of vision-based control of robot manipulators, and list the limitations.   (6)

OR

14. a) Explain the concept of Region based segmentation. (3)
    b) Describe in detail about the concept of POSE estimation. (3)

MODULE IV

15. Model a VAL program to move an RRR Robot with following steps (6)

    a. First three joints to be rotated by 200, 400, and -600 respectively.
    b. The end effect moves to appoint 20mm apart from a point P, measured along z axis in negative direction.
    c. The end effector reaches the point P in a straight line.
    d. The speed limit of end effector is fixed at 50 in/sec.
    e. The operation c is happening at 75% of the maximum permissible speed
    f. Close the gripper.

OR

16. a) Describe the role of Robot Operating System (ROS) in robotics. (3)
    b) Classify online robot programming and offline robot programming. (3)

MODULE V

17. a) Differentiate between the terms reactive navigation and map based navigation. (3)
    b) Explain the reason behind keeping the linear velocity constant for a robot with unicycle model to follow a straight line. (3)

OR

18. Illustrate Monte Carlo Localization and Kalman Filter, with examples. (6)

MODULE VI

19. a) Differentiate between kinematic calibration and non-kinematic calibration. (3)
    b) Summarize the concept of homing process in calibration. (3)

OR

20. a) Describe how the process of robot calibration is different from adaptive control. (3)
    b) Explain the role of correction step during the process of robot calibration. (3)

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