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

SAINTGITS COLLEGE OF ENGINEERING (AUTONOMOUS)

(AFFILIATED TO APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY, THIRUVANANTHAPURAM)

SIXTH SEMESTER B.TECH DEGREE EXAMINATION (R), MAY 2024

(2020 SCHEME)

Course Code : 20RBT382

Course Name: Introduction to Mobile Robotics

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

PART A

(Answer all questions. Each question carries 3 marks)

1. Identify three applications of underwater robots.
2. List the key design challenges for a mobile robot.
3. Differentiate holonomic and nonholonomic robots.
4. Explain the two kinematic constraints for robotic wheel types.
5. Differentiate proprioceptive and exteroceptive sensors with examples.
6. List out and brief any six typical sensor characteristics.
7. Compare configuration space and workspace of a mobile robot.
8. Explain the challenges in robot localization.
9. List out any three characteristics of a swarm robot.
10. Compare the Bug1 and Bug2 algorithm used for obstacle avoidance in mobile robots.

PART B

(Answer one full question from each module, each question carries 14 marks)

MODULE I

11. a) Explain the different factors affecting the choice of wheel for wheeled locomotion. (10)
    b) Suggest the types of robots that can be used in unstructured environments. Justify the answer. (4)

OR

12. Differentiate legged and wheeled mobile robots. Relate how leg configuration affects stability of legged robots. (14)

MODULE II

13. a) Write short note on i) degree of mobility ii) degree of maneuverability iii) degree of steerability. How these terms are related? Support with necessary equations. (8)

b) Derive the Newton Euler dynamic model of differential drive robot. (6)

OR

14. a) Derive the kinematic model of differential drive robot. (7)
    b) Compare the rolling constraints of a Swedish wheel with that of steered standard wheel. (7)

MODULE III

15. a) Explain the working of GPS. List the limitations in using GPS for localization in mobile robots. (7)
    b) Compare the different image sensors used in digital camera. (7)

OR

16. a) Identify sensors for finding orientation and inclination of robot. Describe the working principle of any one such sensor. (7)
    b) Assume a robot with a sonar ranger. The ranger has a maximum distance of 7.5m. Assume the speed of sound to be 300 m/s. What is the frequency with which we can get information from the sonar ranger? (7)

MODULE IV

17. a) Illustrate the significance of SLAM in mobile robotics. Describe it mathematically. (10)
    b) Compare global and local path planning. (4)

OR

18. a) Illustrate A* algorithm to find the shortest path between two nodes. (7)
    b) Derive an error model for Odometric position estimation. (7)

MODULE V

19. a) Compare and contrast local dynamic window approach and global dynamic window approach in obstacle avoidance. (7)
    b) Design a controller for differential drive mobile robot to move to a given target point. (7)

OR

20. a) Compare a mobile manipulator with a fixed manipulator in terms of their degrees of freedom. List any three applications for mobile manipulators. (7)
    b) Design a controller for differential drive mobile robot to follow a straight line. (7)

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