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

SAINTGITS COLLEGE OF ENGINEERING (AUTONOMOUS)

(AFFILIATED TO APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY, THIRUVANANTHAPURAM)

SEVENTH SEMESTER B.TECH. DEGREE EXAMINATION (R), DECEMBER 2023
ROBOTICS AND AUTOMATION
(2020 SCHEME)

Course Code : 20RBT411

Course Name: Mobile Robotics

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

PART A

(Answer all questions. Each question carries 3 marks)

1. Explain SLAM for a point robot.
2. Explain the application and control of stepper motors in mobile robots.
3. Describe the two types of canonical reflectors.
4. Describe how color histograms can be used to represent objects.
5. Define the term Configuration Space of a robot.
6. Summarize the modules that make up the classic horizontal decomposition of a control system.
7. Explain visibility graph with necessary diagrams.
8. Explain the main drawback of the artificial potential field method.
9. Distinguish between metric maps, topological maps and perceptual maps.
10. What are the key difficulties with sensor-based servo control?

PART B

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

MODULE I

11. Derive the solution of the forward and inverse kinematics problems for a 3D robot limb. (14)

OR

12. a) Explain the fundamental problem of localization of a point robot. Derive the expected location of the robot after making N motions from some start position (x0, y0). (8)
    b) Describe the considerations for static and dynamic stability of a limbed robot with the minimum number of legs required for each. (6)

MODULE II

13. a) Explain data fusion using Kalman filter. (10)
    b) Explain any two techniques to obtain depth information. (4)

OR

14. a) Explain range sensing using sonar. (7)
    b) What is active vision? Describe any two techniques for active vision. (7)

MODULE III

15. a) Explain the motor schema and behaviour-based systems in robot control with necessary diagrams. (7)
    b) Explain hybrid control architectures for robot control with suitable examples. (7)

OR

16. Explain the various vertical decomposition techniques for system control with necessary examples and diagrams. (14)

MODULE IV

17. a) Describe the Voronoi diagram technique of constructing a discrete search space with necessary diagrams. What are the disadvantages of path planning using Voronoi diagrams? (8)
    b) Explain the application of the vector field histogram (VFH) algorithm to searching a continuous search space. (6)

OR

18. a) Describe with pseudocode and diagrams, the application of the Bug 1 algorithm in planning a path from start S to target T in the presence of obstacles. (8)
    b) How is spatial uncertainty tackled in path planning for mobile robots? (6)

MODULE V

19. Describe with necessary diagrams the various techniques for non-geometric localization based on perceptual structure. (14)

OR

20. a) Describe global localization using visibility polygons. (7)
    b) Explain the use of landmarks in pose estimation. (7)

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