Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

Sixth Semester B.Tech Degree Regular and Supplementary Examination June 2023 (2019 Scheme)

Course Code: AIT304

Course Name: ROBOTICS AND INTELLIGENT SYSTEM

Max. Marks: 100 Duration: 3 Hours

PART A

Answer all questions, each carries 3 marks. Marks

1	State the three laws of a robot and give its applications.	(3)
2	What are the three degrees of freedom associated with the arm and body motion of a robot?	(3)
3	Define the term sensor, and differentiate the same from the transducer.	(3)
4	Compare CCD camera with CMOS Camera.	(3)
5	Give the importance of image processing analysis in robotic vision applications.	(3)
6	Define the terms Steerability, and Maneuverability.	(3)
7	What do you mean by Robot Localization? And list out the challenges in localization.	(3)
8	State the applications and advantages of SLAM robots.	(3)
9	Differentiate breadth-first search and depth-first search algorithms.	(3)
10	What do you mean by control decomposition?	(3)

PART B

Answer one question from each module, each carries 14 marks.

Module I

11	a)	Explain the four basic robot configurations classified according to the coordinate system.	(10)
	b)	Sketch a robot wrist and indicate 3 DOF associated with the wrist.	(4)

OR

12	a)	Briefly explain the dynamic characteristics of robots.	(8)
	b)	What is the work envelope of a robot? Sketch two views to indicate the work envelope of a Cartesian robot.	(6)

Module II

13 a) A mobile robot is designed for unidirectional motion with constant velocity. Design a mechanism to make the robot move in forward and reverse directions with controllable speed and suggest the sensors and motion control drives required to achieve the same. (10)

b) Differentiate Stepper Motor and Servomotor concerning the construction and applications. (4)

OR

14 a) Describe the characteristics of sensors. Explain any one sensor used in robotics with the help of neat diagrams. (7)

b) Explain the working of the touch sensor used in robotic applications with a neat sketch. (7)

Module III

15 a) Derive the equation for the representation of a pure translation with respect to frame movement in space. (8)

b) Write a short note on the following (6)

i. Pre-Processing ii. Segmentation and iii. Recognition.

OR

16 a) A Frame B is rotated 90° about the z-axis, then translated 2 and 4 units relative to the n and o-axes respectively, then rotated another 90° about the n-axis, and finally, 90° about the y-axis. Find the new location and orientation of the frame. (8)

$$B=\begin{pmatrix} 0 & 1 & 0 & 1 \\ 1 & 0 & 0 & 1 \\ 0 & 0 & -1 & 1 \\ 0 & 0 & 1 & 1 \end{pmatrix}$$

b) What is an omnidirectional robot? Explain two configurations to set up an omnidirectional robot. (6)

Module IV

17 a) Apply the concept of Accurate Odometry and Error Modelling for a Mobile Robot with a neat sketch. (7)

b) Discuss in detail about the Map representation and list the current challenges in map representation (7)

OR

18 a) How the probabilistic map based localization can be achieved? And suggest the best filtering method for achieving the same. (10)

b) List and explain the Decomposition strategies used in map representation. (4)

Module V

19 a) A neural network can be trained to process sensory data from cameras, Lidar sensor, or other sensors. The network learns to identify objects, obstacles, and landmarks and generates appropriate actions based on this information. Through iterative training and feedback, the neural network can improve its navigation capabilities, adapting to various environments and optimizing its path planning, obstacle avoidance, and decision-making processes of a robot. Summarise the above with suitable sketches. (10)

b) Explain Dijkstra's algorithm with a suitable example. (4)

OR

20 a) Discuss the concept of Modularity for code reuse and sharing. (8)

b) Give the assumption to be made while applying the Bug algorithm for obstacle avoidance. (6)

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