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MANGALORE INSTITUTE OF TECHNOLOGY & ENGINEERING

(A Unit of Rajalaxmi Education Trust®, Mangalore)
Autonomous Institute affiliated to VTU, Belagavi, Approved by AICTE, New Delhi
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Model Question Paper

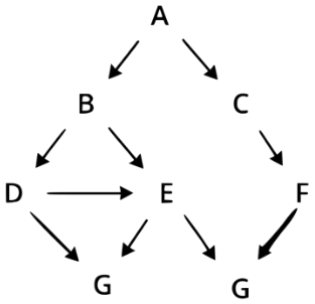
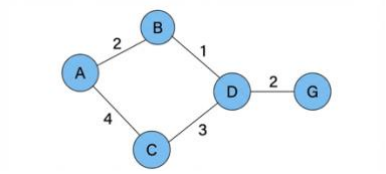
Sixth Semester BE Degree Examination

Autonomous Mobile Robots

Time: 3 Hours(180 Minutes) **Max. Marks: 100**

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. M: Marks, L: RBT (Revised Bloom's Taxonomy) level, C: Course outcomes.

		Module -1	M	L	C
Q1	a.	Describe the major components of a mobile robot system architecture.	10	L2	CO1
	b.	Compare legged, wheeled, and aerial mobile robots.	10	L2	CO1
		OR			
Q2	a.	Explain the key challenges that differentiate mobile robots from fixed base industrial manipulators.	10	L2	CO1
	b.	Explain with neat sketch, the different wheel configurations used in mobile robots.	10	L2	CO1
		Module- 2			
Q3	a.	Illustrate the basic scheme of sensors in a mobile robot system, showing the flow from sensing to perception and decision-making.	10	L2	CO2
	b.	Classify sensors used in mobile robots into proprioceptive and exteroceptive sensors, with suitable examples for each category.	10	L2	CO2
		OR			
Q4	a.	Define sensor noise and uncertainty. How do these affect perception and navigation in mobile robots?	10	L2	CO2
	b.	Compare vision-based sensing with range-based sensing for obstacle detection and environment understanding.	10	L2	CO2
		Module - 3			
Q5	a.	A mobile robot starts at pose $(x_0, y_0, \theta_0) = (1.0\text{ m}, 2.0\text{ m}, 30°)$. The robot moves with a linear velocity of 0.5 m/s and an angular velocity of 0.2 rad/s for 10 seconds. Determine its final position and orientation.	10	L3	CO3
	b.	A differential drive robot has wheel radius r = 0.1m and distance between wheels L = 0.5 m. The angular velocities of left and right wheels are 4 rad/s and 6 rad/s, respectively, calculate the linear velocity of the robot, angular velocity of the robot, and radius of curvature of the robot's trajectory.	10	L3	CO3
		OR			
Q6	a.	A mobile robot has two fixed standard wheels and one passive caster wheel. Determine its degree of mobility, degree of steerability, and overall maneuverability.	10	L3	CO3
	b.	A differential drive robot must follow a circular path of radius 2 m at a linear speed of 0.6 m/s. Given that the wheel radius = 0.1 m and wheel separation L = 0.5 m, compute the required angular velocity of the robot, and the individual angular velocities of the left and right wheels.	10	L3	CO3

Module - 4					
Q7	a.	For the graph given below, apply BFS to find a path from A to G. 	10	L3	CO4
	b.	Using the same graph, apply DFS to find a path from A to G.	10	L3	CO4
OR					
Q8	a.	A robot environment is represented by a weighted graph shown in the figure below. If the start node is A and goal node is G, apply Djikstra's algorithm to determine the optimal path and total cost. 	10	L3	CO4
	b.	A robot operates in a high-dimensional configuration space. If the number of sampled nodes = 200, and the probability of connecting nearby nodes = 0.15, determine the expected number of edges. For the obtained values, illustrate how randomized graph is constructed.	10	L3	CO4
Module – 5					
Q9	a.	Define swarming in the context of mobile robotics. Explain how swarm behavior emerges from local interactions.	10	L2	CO5
	b.	Describe the characteristics of autonomous agents in a multi-robot system.	10	L2	CO5
OR					
Q10	a.	Describe common methods used for aggregation and collision avoidance in swarm robots.	10	L2	CO5
	b.	Differentiate between direct and indirect communication among mobile robots.	10	L2	CO5

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