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MANIPAL INSTITUTE OF TECHNOLOGY

(A constituent unit of MAHE, Manipal)

DEPARTMENT OF MECHATRONICS VII SEMESTER B.TECH. (MECHATRONICS) END SEMESTER EXAMINATIONS, [Nov] [2022] SUBJECT: ROBOT PATH PLANNING AND MOBILE ROBOTS

SUBJECT CODE: MTE 4061

DATE: 30/11/2023

Time:3 Hrs.

MAX. MARKS: 50

Instructions to Candidates:

- ✤ Answer ALL the questions.
- ✤ Missing data if any can be suitably assumed.

Q. No	Question	Μ	CO	PO	LO	BL
1A.	Illustrate the significance of autonomous navigation for a flying robot, employing sensors like accelerometers, gyroscopes, and the Global Positioning System (GPS).	5	CO1	1,2	1	3
1 B .	Emphasize the fundamental concepts involved in the inertial navigation technique of strap-down algorithm	3	CO1	1,2	1	3
1C.	Identify the example of a wheel skidding situation in the real- time application of an autonomous mobile robot.	2	CO1	2,3	1	3
2A.	Analyze the angular velocities of four-wheel skid drive assuming the sequence of wheels from the right top corner in an anti- clockwise direction for consideration using a generalized wheel kinematic equation. Refer the figure 2A given below: $\int_{a}^{2l} \int_{2d}^{2d} \int_{2d}^{2d} Figure 2A$	5	CO2	2,3	2	4
2B.	To plan robot paths, analyze the environment using the precise	3	CO4	1,2	1,2	4
	cell decomposition method for the below figure.			,	,	

	start					
	goal					
	Figure 2B					
2C.	Illustrate about terms admissibility and completeness of algorithms.	2	CO4	1,2	2	3
3A.	Analyze the dynamics of a bipedal robot with 7 degrees of freedom as it navigates a staircase. Evaluate its stability through a two-phase analysis of its dynamic gait. Assume all necessary parameters and present them in a well-organized manner with a neat sketch.	5	CO3	1,2	1	4
3B.	Evaluate the distinctions between holonomic and non-holonomic robots while elucidating their significance.	3	CO3	1,2	1	4
3C.	Outline the fundamental steps of path planning in a two- dimensional space.	2	CO3	1,2	1	3
4A.	Evaluate the approach of enhancing the comprehension of the intricacies inherent in two-dimensional path planning, particularly when considering the earliest Bug algorithms. Identify and delineate the distinctive features of these algorithms to shed light on their unique contributions and characteristics	5	CO3	1,2	1	4
4B.	Analyze the development of the configuration space for a 2R manipulator equipped with two distinct actuator joints	3	CO3	1,2	1	4
4C.	Implement the methodology for effective navigation in an environment without relying on GPS or external motion capture cameras	2	CO3	1,2	1	3
5A.	Analyze the key components and decision points within the visibility graph construction process, emphasizing the critical thinking and analytical skills required to optimize path planning. How does this approach contribute to a deeper understanding of the algorithm's efficiency and effectiveness in navigating complex environments with a neat sketch?	5	CO4	1,2	2	4
5B.	Illustrate the obstacles and challenges encountered in	3	CO4	1,2	1	3
	implementing a path planning method known as potential fields.					
5C.	Elucidate the fundamental concepts and connections within the probabilistic roadmaps, emphasizing its role in optimizing navigation in complex environments	2	CO4	1,2	1	3