Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

(A constituent unit of MAHE, Manipal)

II SEMESTER M.TECH. (INDUSTRIAL AUTOMATION AND ROBOTICS)

END SEMESTER EXAMINATION, MAY 2024

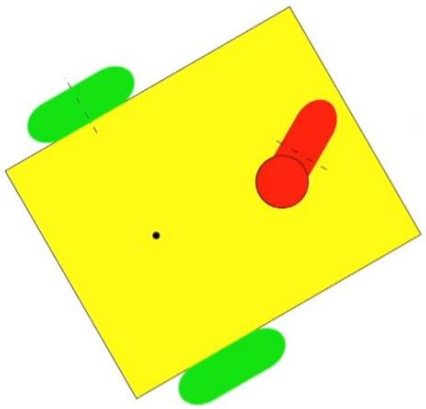
SUBJECT: MOTION CONTROL AND PATH PLANNING SYSTEM [MTE 5215]

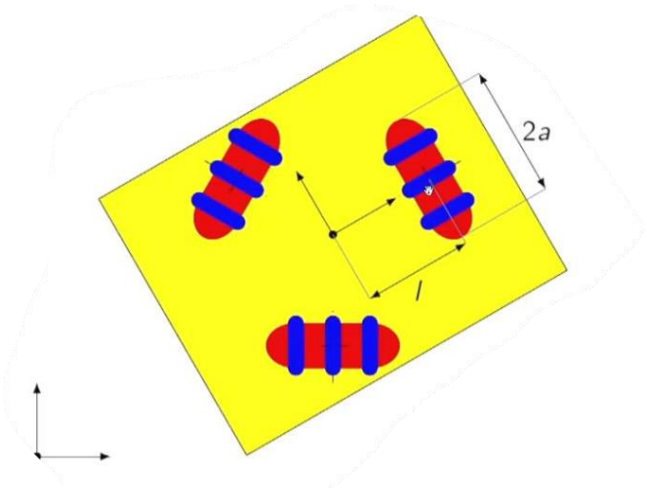
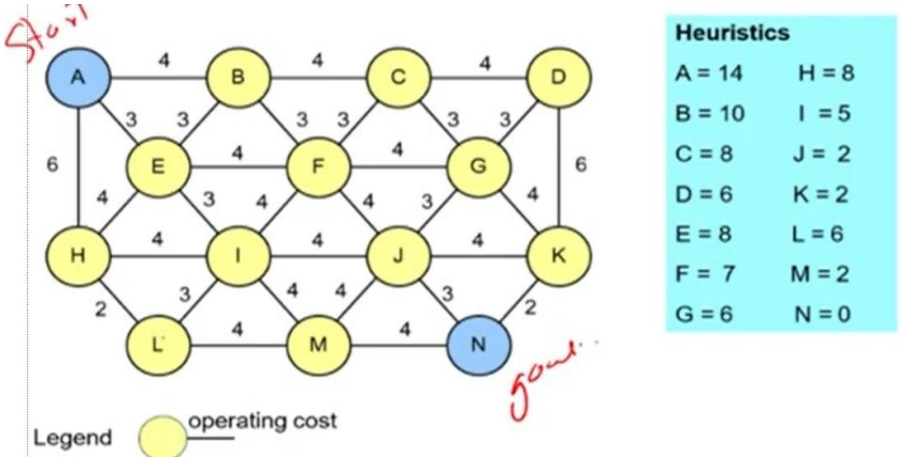
Date: 03-05-2024 **Time: 9:30 AM – 12:30 PM**

Time: 3 Hours **MAX. MARKS: 50**

Instructions to Candidates:

- Answer **ALL** the questions.
- Data not provided may be suitably assumed

Q. No.		M	CO	PO	LO	BL
1A.	Interpret the importance of autonomous navigation for a flying robot, utilizing sensors such as accelerometers, gyroscopes, and the Global Positioning System (GPS).	**5**	**1**	**4**	**1**	**4**
1B.	Analyse the angular velocity of the robot based on the pure rolling condition of a tricycle wheel configuration robot using a generalised wheel kinematic equation having the front wheel as an active wheel given in fig 1B.  Figure 1B.	**3**	**2**	**5**	**1**	**4**
1C.	Illustrate the wheeled mobile robots according to the structure of various locomotion mechanisms with neat sketches	**2**	**2**	**4**	**1**	**3**
2A.	Execute the wheel configuration matrix of an omni wheel directional robot having the values of the angle α1=30, α2=150, α1=310 where the radius of	**5**	**2**	**5**	**1**	**3**

	the wheel is given as 3cm and the distance between both the vehicle and wheel frames is given as 5cm as given in fig 2A.  **Figure 2A.**					
2B.	Classify the locomotion mechanism based on various factors and parameters	**3**	**3**	**4**	**2**	**3**
2C.	Analyse the significance of Dynamic Balance Margin and Zero Moment point in legged Robots?	**2**	**3**	**5**	**2**	**4**
3A.	Examine the A* path planning algorithm for the below nodes and vertices as given in fig 3A.  Figure-3A	**5**	**4**	**5**	**1**	**4**
3B.	Outline the key components for odometry in robotics. Evaluate the impact of sensor fusion on improving state estimation accuracy.	**3**	**4**	**4**	**1**	**3**

3C.	Demonstrate the application of particle filters in mobile robotics by providing examples of real-world scenarios where they have been successfully implemented.	**2**	**5**	**1**	**2**	**3**
4A.	Implement the process of building a map and computing a mobile robot's location in a simulated environment. Compare and contrast different algorithms used in building a map and computing a mobile robot's location.	**5**	**4**	**5**	**1**	**3**
4B.	Describe Bayesian Filtering for Location Estimation with the help of equations and neat schematic diagrams.	**3**	**5**	**2**	**2**	**4**
4C.	Infer the real time applications for Kalman Filter implementation with neat schematic diagrams and equations.	**2**	**5**	**4**	**1**	**4**
5A.	Explain the concept of SLAM and its importance in the field of robotics. Explain how lighting conditions, such as shadows, reflections, and glare, impact the performance of Visual SLAM algorithms.	**5**	**5**	**5**	**2**	**5**
5B.	Analyze the Markov Decision Process for prediction and correction steps when incorporating sensor observations. Explain with the relevant example how the filter predicts the state and corrects the estimate based on new sensor data.	**3**	**5**	**1**	**1**	**4**
5C.	For Localization strategies for autonomous mobile robots identify different filtering techniques used. Explain each strategy with flowchart and neat diagrams. List the disadvantages of Bayes' filter when compared to other filtering techniques.	**2**	**4**	**4**	**2**	**3**