School of Engineering and Applied Science (SEAS), Ahmedabad University

Name: _____ Roll no.: _____

B. Tech. (Mech, CSE): Semester 5,7
Subject Name: Mobile Robots, Let's Build One! Mid Term Exam (Winter Sem :2024); Marks:20 , Wt.:20 %
February 21, 2024, Wednesday, 02.00 PM – 03.30 PM

Instructions:

1 All questions are compulsory.
2 Figures to the right indicate full marks.
3 Return your question papers.
4 Support your answer with illustrations, whenever necessary

Q-1. A discrete-time system is given as:

$$x_{k+1} = max\{0, \quad 5 - x_k\}$$

If the system starts at $x_0 = 10$, what will be the state of the system? [1]

Q-2. Consider a unicycle robot with dynamics

$$\dot{x} = v\cos\varphi$$

$$\dot{y} = v\sin\varphi$$

$$\varphi = \omega$$

If the two inputs of v and ω are constant, what will the robot do? [1]

Q-3. One way of modeling epidemics is to describe how the fraction of infected individuals evolves over time. Let I be that fraction, with the model being

$$\dot{I} = \beta I(1 - I) - \rho I$$

Here, the constants β and ρ are the infection and recovery rates, respectively. What are the possible equilibrium points to this system (values for I when the fraction of infected individuals is not changing)? [2]

Q-4. What is NOT the possible solution of this differential equation? Prove it. [2]

$$\ddot{x}(t) = -\omega^2 x(t)$$

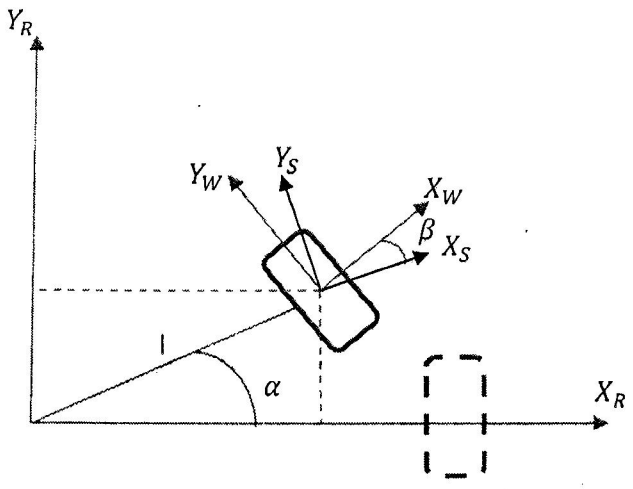
1. $x(t) = \sin(\omega t)$;
2. $x(t) = \omega\sin(\omega t) - \cos(\omega t)$;
3. $x(t) = \cos(\omega t)$;
4. $x(t) = e^{-\omega t}$;

Q-5. If we convert this general dynamic system into a State-Space form, what would be our A, B and C matrices? *input is p and output is f* [3]

$$m\ddot{f} = \alpha\dot{f} + \beta f + cp$$

Q-6. Name the two types of sensor errors. What is the difference between accuracy and precision? [2]

Q-7. What is the no sliding constraint for the wheel that moves perpendicular to the X_R axis? [2]



Q-8. If the measured distance with a range finder is 19.5m but the real distance is 20m, what is the error and accuracy of sensor? [1]

Q-9: Using laser for range finding, what are the three different approaches available. Explain each in a few sentences. [3]

Q-10: Explain the stereovision, use illustration and explain the parameters. [3]

All the best
