Mechatroncis System Design: Quiz I, 31/01/2024.

- *Answer all the questions (5+5+5+5=20 marks).*
- *Time: 45 min (10:30 am to 11:15 am) .*
- *Calculator is allowed.*
- *Assume if any data found missing and mention your assumption in the answer.*

Q.1) Find the solution $y(t)$ of the following differential equation

$$\frac{dy(t)}{dt} + 2y(t) = 5u(t) \tag{1}$$

for

- Case A: $u(t) = 1$ and $y(0) = 10$
- Case B: $u(t) = 2\,sin(2\pi t)$ and $y(0) = 10$

Q.2) With appropriate equations and diagrams, explain the working of an accelerometer?

Q.3) The initial position of a ground robot is (0,0). The ground robot is moving at a constant speed (measured by a wheel encoder) and at a constant yaw angle $\psi = 30^0$. The number of pulses (N_p) measured by the wheel encoder in one second is 20. If the diameter of the wheel is 10 *cm* and the number of magnetic poles of the encoder magnet is 3, find the position of the ground robot after 10 seconds? Assume no gear is used between wheel and the motor of the ground robot.

Q.4) Explain the general structure of a measurement system? Given one example explaining each one of the four elements of a measurement system.