

2023/2024

Mechatronics System Design: Mid-Sem, 28/02/2025.

- Answer all the questions (Total 40 marks).
- Time: 90 min.
- Calculator is allowed.
- Assume if any data found missing and mention your assumption in the answer.

Q.1) Explain the working of a MEMS-Gyro with necessary equations? (4 marks)

$$\gamma_{xy} \propto \omega_x + (1-\alpha) \omega_y$$

Q.2)

- a) Derive the relation between strain (e_L) and change in resistance (ΔR) of a strain gauge (draw the necessary diagram)? (4 marks)
- b) For an applied stress of 0.5 Newtons, find ΔR for the following strain gauge parameters? (4 marks)

- Length, $l = 25$ cm
- Width, $w = 6$ cm
- Thickness, $t = 0.3$ cm
- Young's Modulus, $E = 70 \times 10^9$ N/m²
- Gauge factor, $G = 2.1$
- Nominal resistance, $R = 100$ Ω

$$\frac{\Delta R}{R} = G e_L$$

$$\frac{\Delta R}{R} = (1 + 2\nu) \frac{\sigma}{E} = \frac{0.5}{70 \times 10^9}$$

$R =$

$$\gamma_x + K_y = G_y$$


$$\frac{\Delta R}{R} + K = G$$

Q.3) Explain the working of one active and one passive range measuring system with the necessary equations? (3+3 = 6 marks)

Q.4) With appropriate differential equations and diagram, explain the working of a DC motor? (3 marks)

Electrical
mechanical

Q.5) With necessary equations, explain the working of an airspeed sensor? (3 marks)

$$\frac{\Delta P}{\rho} = \frac{V^2}{2} \quad \frac{\Delta P}{\rho} = \frac{V^2}{2} \quad \frac{\Delta P}{\rho} = \frac{V^2}{2}$$


Q.6) Differentiate between the higher pair and the lower pair with suitable examples? (3 marks)

Q.7) Define planar and spatial mechanisms with appropriate illustrations? (3 marks)

Q.8) Define degrees of freedom and calculate the mobility for the given mechanisms in Figure (1) and Figure (2) using Grueblers and Kutzbach's equation? (5+5 = 10 marks)

$$12(N-1-f) + \sum f_i$$

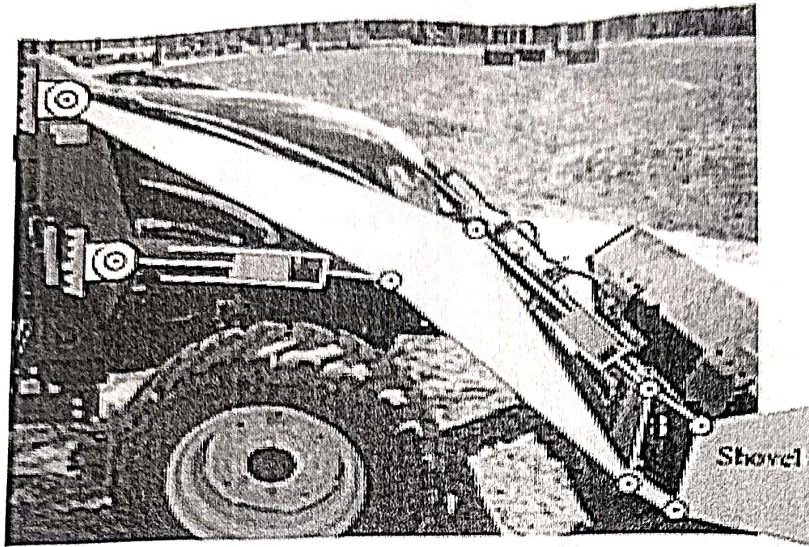


Figure 1: Mechanism 1

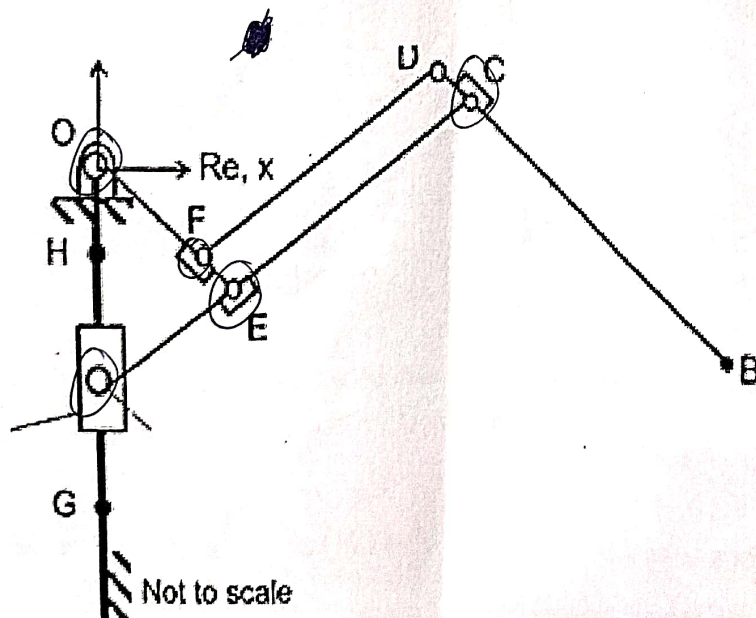


Figure 2: Mechanism 2