Numerical Examples on Sensors:

1) L.V.D.T. with secondary voltage of 5V is having total travel span of ± 25mm. Find the output voltage if,

i) core is 15mm from centre towards S2

ii) core is 10mm from centre towards S1

iii) Find the movement if output voltage is 1.5V

→

i) $V_S = 5V$

Total travel = 25mm

$d = -15mm$

$\therefore V_O = \frac{5 \times (-15)}{25}$

$\therefore V_O = -3V$

ii) $d = 10mm$

$\therefore V_O = \frac{5 \times 10}{25}$

$\therefore V_O = 2V$

iii) $V_o = 1.5V$

$d = ?$

$$V_o = \frac{V_s \times d}{\text{Total travel}}$$

$$\therefore 1.5 = \frac{5 \times d}{25}$$

$$\therefore \boxed{d = 7.5\ mm} \text{ towards } S_1$$

2) A thermocouple with sensitivity 45 μV/°C is inserted in an oven. Its cold junction is at ambient temperature of 25°C. The output voltage of thermocouple is 45mV. Find the temperature of oven.

→ $C = 45\ \mu V/°C$

$T_2 = 25°C$

$V_o = 45\ mV$

$$V_o = C[T_1 - T_2]$$

$$45 \times 10^{-3} = 45 \times 10^{-6} (T_1 - 25)$$

$$\therefore \boxed{T_2 = 1025°C}$$

3) The RTD inserted in oven has resistance 160Ω. Its resistance at 0°C is 100Ω and its resistance temperature coeff. is 0.00392 Ω/Ω/°C. Find the temperature of oven.

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$R_T = 160\Omega$

$R_0 = 100\Omega$

$\alpha_0 = 0.00392\ \Omega/\Omega/°C$

$R_T = R_0(1 + \alpha_0 T)$

$\therefore 160 = 100(1 + 0.00392 \times T)$

$\therefore \boxed{T = 153.06°C}$

4) A thermistor with material constant 100 is placed in an oven, has resistance 5kΩ. Its resistance at 25°C is 10kΩ. Determine temperature of oven.

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$R_T = 5000\Omega$

$R_0 = 10000\Omega$

$\beta = 100$

$$R_T = R_0 e^{\beta\left(\frac{1}{T} - \frac{1}{T_0}\right)}$$

$$\therefore \quad 5000 = 10000\, e^{100\left(\frac{1}{T} - \frac{1}{25}\right)}$$

$$\therefore \quad \boxed{T = 30.24^\circ C}$$

5) A strain gauge with gauge factor of 4 has resistance of 120 Ω when unstrained. If strain gauge undergoes change in length from 0.25 mm to 0.255 mm. Determine the new resistance.

→ G.F. = 4

$R = 120\,\Omega$

$l = 0.25$ mm

$dl = 0.255 - 0.25 = 0.005$ mm

Now,

$$\frac{dR}{R} = G.F.\left(\frac{dl}{l}\right)$$

$$\therefore \quad \frac{dR}{120} = 4\left(\frac{0.005}{0.25}\right)$$

$$\therefore \quad dR = 9.6\,\Omega$$

$$\therefore \quad R_{new} = dR + R = 129.6\,\Omega$$

$$\therefore \quad \boxed{R_{new} = 129.6\,\Omega}$$