Manan Madan
20180103087

Assignment (TDM)

Prob

$$C = \frac{A\varepsilon}{3.6\pi d}$$

$$C = \frac{\partial C}{\partial d} = \frac{-A\varepsilon}{3.6\pi d^2}$$

given $A = 5cm^2$

$d = 1mm = 0.1cm$

$$S = \frac{5 \times 1}{3.6 \times \pi \times 10^{-2}}$$

$S = -442.1 \; pF/cm$

Prob

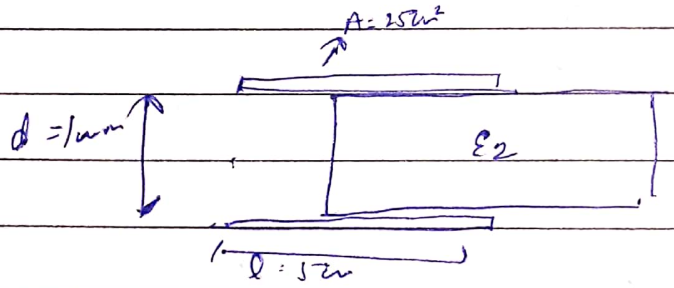
$$C = \frac{A_0}{3.6\pi d}$$

$$S = \frac{\partial C}{\partial d} = \frac{-A\varepsilon}{3.6\pi d^2}$$

$A = \frac{\pi}{4}(2)^2 = \pi \, cm^2$ $\quad \varepsilon = 1$ for air

$S = -444 \; pf/cm.$

8.3



$$C = \frac{\varepsilon_0 w}{d}\left(\varepsilon_2 l - (\varepsilon_2 - \varepsilon_1)x\right]$$ $\quad w =$ width $= 5cm$

here $\quad \varepsilon_2 = 1 \quad \varepsilon_0 = 1$

Case 1 $\quad x = 0$

$$C = \frac{5}{0.1}\left[4 \times 5 - (4-1)0\right] = 1000pf = 1nf$$

Case 2 $x = 2.5$

$C = \frac{5}{0.1}[4\times5 - (3\times2.5)] = 625\ pF$

Case 3 $C = \frac{5}{0.1}[4\times5 - (3\times6)] \therefore 250\ pF$

emf at cold junction or potentiometer

$= 815 \times 0.041 = 33.415\ mV$

Q12.4 a) Sensitivity of thermocouple $= \frac{20.68}{400-0} = 0.0517\ mV/s$.
Reference Junction of 0°c is being used at 25°c.

$E_{corr} = 0.0517 \times 25 = 1.293\ mV$.

b) Indicated emf b/w hot & reference junction at 25°c
$= 8.92\ mv$.
Difference of temp b/w hot & cold junction
$= \frac{8.92}{0.0517} = 172.53°C$

Reference junction temp at 25°c
$172.53 + 25 = 197.53°C$.

Exercise

Q12.5) Sensitivity $= \frac{45.14}{1100-0} = 0.041\ mV/°c$

the temp. diff b/w hot & cold junction
is $840 - 25° = 813°c$

9.3 $V_{out} = V_{in}\left(\frac{1}{1+\frac{R_y}{R_1}} - \frac{1}{1+\frac{R_g}{R_2}}\right)$

$R_T max = 1.68\, e^{3050\left[\frac{1}{2.96} - \frac{1}{298}\right)} = 4.288\ k\Omega$

$R_T min = 1.68\, e^{3050\left(\frac{1}{372} - \frac{1}{298}\right)} = 0.76\ k\Omega$

$V_{out}\ max = 1.037\ V$

$V_{out}\ min = 0.0076\ V$

$V_{ideal} = \left(\frac{V_{max}\, I}{I_{max} - I_{min}} - \frac{V_{max}\, I_{min}}{I_{max} - I_{min}}\right)$

$= 0.24\ V$

$V_{12°c} = 0.225$

~~Vn = 0.225~~

non linearity $= \frac{0.225 - 0.24}{1.03} \times 100 = 1.456\%$

b) $R_T\ max = \frac{1}{1+\frac{R_y}{R_{4max}}} + \frac{1}{1+\frac{R_3}{R_2}} = \frac{2}{3}$

$R_T\ min = \frac{1}{1+\frac{R_y}{R_{4min}}} + \frac{1}{1+\frac{R_3}{R_2}}$

c) Range = ~~V_{max}~~ $V_c\,min - V_c\,max$

$$= 1.037 \times \frac{1}{1+R_4\,max} - 0.0 \times \frac{1}{1+R_4\,min}$$

~~0.0.811~~

$$\boxed{\text{Range} = 0 - 0.06V}$$

1.4 $$0 = V_c\left(\frac{1}{1+\frac{R_4}{R_{0^\circ C}}} - \frac{1}{1+\frac{R_3}{R_2}}\right)$$

$$0.5 = V_s\left(\frac{1}{1+\frac{R_4}{R_{25^\circ C}}} - \frac{1}{1+\frac{R_3}{R_2}}\right)$$

$$1.0 = V_s\left(\frac{1}{1+\frac{R_4}{R_{50^\circ C}}} - \frac{1}{1+\frac{R_5}{R_2}}\right)$$

Using the eq^n in question

$$R_\theta = 0.0585\, e^{\left(\frac{3260}{\theta}\right)}$$

$$R_{0^\circ C} = 0.0585\, e^{\left(\frac{3260}{273}\right)} = 8.96\,K\Omega$$

$$R_{25°c} = 0.0585\, e^{\frac{3260}{298}} = 3.26\, k\Omega$$

$$R_{50°c} = 0.0585\, e^{\frac{3260}{323}} = 1.40\, k\Omega$$

For the thermistor to be approximately linear ~~the o/p~~ at max I/P the O/P should be max and and min I/P the O/P should be min

and from solving the above eqns we get

$$\boxed{\begin{aligned} R_2 &= 1000\,\Omega \\ R_3 &= 265\,\Omega \\ R_4 &= 2370\,\Omega \end{aligned}}$$

~~Vs = ?~~ and now for min non-linearity we get

$$\boxed{V_s = 243\, V}$$

8.7 a) slope = $\frac{\cancel{27393} - 0}{\cancel{500} - 0}$

$= \cancel{54.786}$

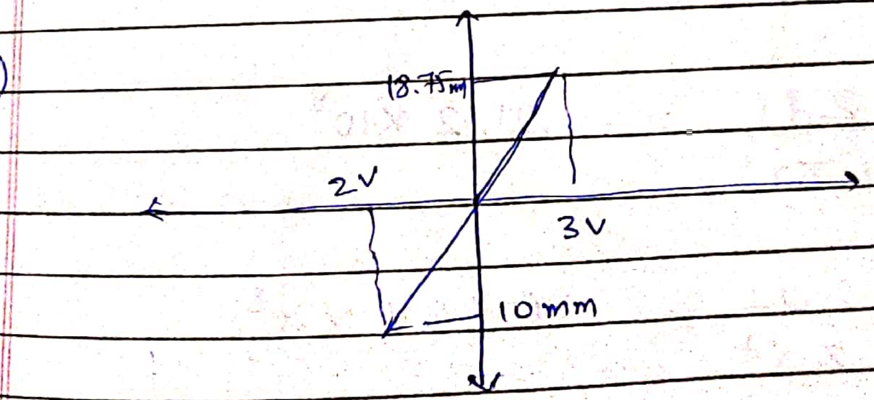
83 Sensitivity = $\frac{5}{25}$ = 0.2 V/mm.

a) V = 0.2 × 18.75 = 3.75V

for 18.75 mm V = 3.75 V

at -10mm V = -2 V.

b)



2 Sensitivity (LVDT) = $\frac{6}{0.4}$ = 15 V/mm

Resolution of the voltmeter = $\frac{10}{100} \times \frac{1}{10}$ = 0.01 V

Inductive sensing element:

@ Ans 1)

$$R_{core} = \frac{R}{\mu_0 \mu_c r^2} = \frac{4 \times 2}{100 \times 1.2 \times 10^{-6} \times 10^{-2}}$$

$$= 6.6 \times 10^8$$

$$R_{armature} = \frac{R}{\mu_0 \mu_A \omega t}$$

$$= \frac{4}{1.2 \times 10^{-6} \times 100 \times 0.1 \times 0.5}$$

$$= 0.66 \times 10^8$$

$$R_{gap_1} = \frac{2d_1}{\mu_0 \pi r^2} = 21.2 \times 10^8$$

$$R_{gap_2} = \frac{2d_2}{\mu_0 \pi r^2} = 0.636 \times 10^8$$

$R_{T_1} = 28.5 \times 10^8$ $\quad R_{T_2} = 7.95 \times 10^8$

$L_1 = \frac{n^2}{R_{T_1}} = 0.087$ mH $\quad L_2 = 0.05$ mH

Ans 2)

(i) $\text{sensitivity} = \frac{\text{fsd}}{\text{displacement}} = \frac{\cancel{6}\,1.5\text{ V}}{\cancel{1}\times 10^{-4}}$

$= 1.5 \times 10^{4}$ V/m

$= 15000$ V/m

(ii) $\text{Resolution} = \frac{1}{\text{total counts}} \times \text{fsd} = \frac{1}{1000} \times 10 = 0.01\text{V}$

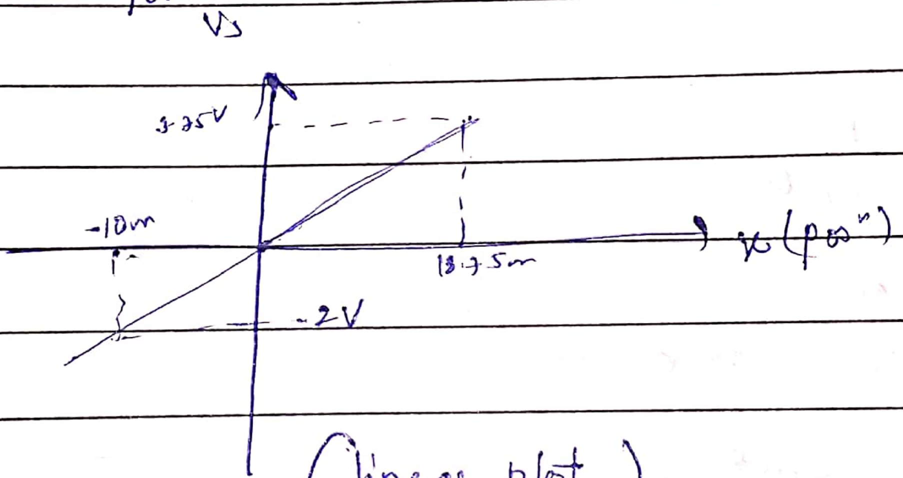
Q3) sensitivity $= \frac{5}{25} = 0.2$ V/mm

a) $V = 0.2 \times 18.75 = 3.75$ V

for 18.75 mm $V = 3.75$ V

& for -10mm $V = -2$V

b)



(linear plot)