Solution-2 EC-202

1. Let R_3 is changed to $R_3+\Delta R_3$, $R_1 = R_2 = R_3 = R_4 = 120\,\Omega$

$$V_0 = V_s \frac{R_2 R_3}{(R_2+R_3)^2}\left(\frac{\Delta R_3}{R_3}\right)$$, Gauge factor = 2.1

$$20\times10^{-3} = \frac{10 \times \cancel{(120)^2}}{4\times \cancel{120^2}}\left(\frac{\Delta R_3}{R_3}\right)$$

$$\frac{\Delta R_3}{R_3} = 8\times10^{-3}$$, Gauge factor $= \dfrac{\left(\frac{\Delta R_3}{R_3}\right)}{\epsilon_t}$

$$\text{Strain} = \frac{8\times10^{-3}}{2.1} = \underline{\underline{3.8\times10^{-3}}}$$

Sol^n 2

Bridge supply voltage $V_s = E$

$E = ?$ Strain Gauge resistance = $1000\,\Omega$

Gauge factor = 2.1

(a). In balance cond^n total current supplied by supply

$= 20\,mA \times 2 = 40\,mA$

equivalent resistance offered to supply $= (1000+1000)\,||\,(1000+1000)$

$= 1000\,\Omega$

$E = 40\times10^{-3}\times1000$

$= 40$ Volt

(b) In the arrangement R_1 & R_3 measures axial strain and R_2 & R_4 measures the circumferential strain

$$\text{Axial strain in cylinder} = \frac{\text{Force}}{\text{Young modulus} \times \text{area}}$$

$$= \frac{10^5}{2.07 \times 10^{11} \times 2 \times 10^{-4}}$$

$$= 2.415 \times 10^{-3}$$

$$\frac{\Delta R}{R} = \text{Strain} \times \text{Gauge factor} = 2.415 \times 10^{-3} \times 2.1$$

~~Voltag~~ Thevenin voltage across current detector $= (V_o)_{Th}$

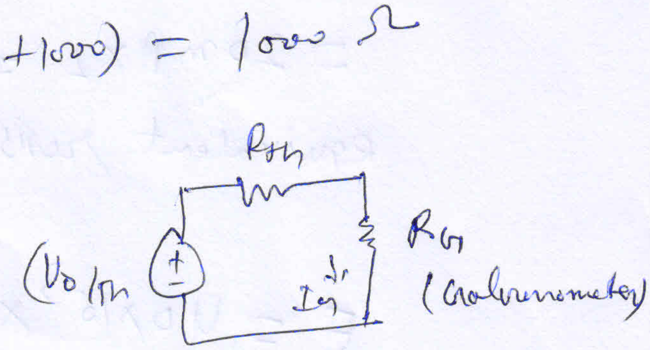
$$(V_o)_{Th} = \frac{V_s\,(R_2 R_3)}{(R_2 + R_3)^2}\,\frac{\Delta R}{R}$$

$$(V_{oTh}) = \frac{40 \times \cancel{R^2}}{4\,\cancel{R^2}}\,\frac{\Delta R}{R} = \frac{40 \times 2.45 \times 10^{-3} \times 2.1}{4}$$

$$(V_{oTh}) = 5.145 \times 10^{-2} \text{ volt}$$

$$(R_{Th}) = (1000 + 1000) \,||\, (1000 + 1000) = 1000\ \Omega$$

$$I_G = \frac{(V_o)_{Th}}{(R_{Th} + R_G)} = \frac{5.145 \times 10^{-2}}{1000 + 500}$$



$$= 3.4 \times 10^{-5}\ A$$

With signal enhancement factor $I_G = 2.6 \times 3.4 \times 10^{-5}$

$$= 8.8 \times 10^{-5}\ \text{Amp}$$

Sol^n 3 $V_{Th} = V_{Bd} - V_{ac} = 5V \times \left(\frac{100}{100+200} - \frac{1000}{1000+1005} \right)$

$= 2.77 \text{ mV}$

$R_{Th} = (100 \| 200) + (1000 + 1005) = 734\,\Omega$

$I_g = \frac{V_{Th}}{R_{Th} + R_g} = \frac{2.77 \text{ mV}}{734 + 100} = \underline{3.32\,\mu A}$

Galvanometer deflection $\Rightarrow d = 3.32\,\mu A \times \frac{10\text{mm}}{\mu A}$

$\boxed{d = 33.2 \text{ mm}}$

Sol^n 4:- at Balance cond^n

Real part $32.7 \times 100 = (1.36 + R_4)\,100 \Rightarrow R_4 = \underline{31.34\,\Omega}$

Imaginary $L_1 \times 100 = L_4 \times 100 \Rightarrow L_1 = L_4 = \underline{\underline{47.8 \text{ mH}}}$

Sol^n 5:- $R_3 = 240\,\Omega$

$L_3 = C R_2 R_4 = \underline{\underline{0.12 \text{ H}}}$

Sol^n 6:- $f = 50\,Hz$, $\omega = 314.2$ rad/sec

$$R_1 = \frac{\omega^2 \times (0.38\times10^{-6})^2 + 833 \times 16800 \times 1000}{1+\omega^2\, 833^2\,(0.38\times10^{-6})^2}$$

$$= \underline{\underline{210\,\Omega}}$$

$$L_1 = \frac{\omega^2 \times 1000 \times 3.8\times10^{-6}}{1+\omega^2\, 833^2 \times (0.38\times10^{-6})^2} = \underline{\underline{6.38\,H}}$$

Sol^n 7:-

$r_1 = 3.65\,\Omega$, $C_1 = 0.7112\,\mu F$

dissipating factor $D_1 = \omega C_1 r_1 = \underline{0.007}$

Sol^n 8:- $C = 259.3\,pF$

$r = 0.429\,M\Omega$, $P.f. = \omega r C_2 = \underline{0.035}$

Sol^n 9:-

(a) $R = \underline{\underline{100\,\Omega}}$

(b) $f = \underline{\underline{796\,Hz}}$