*Sensors Assignments #1

فاطمة محمد أبو عصبة
201911043

Q1:-

$\boxed{1-}$ $V_D = \frac{R_2 U_2}{R_1 + R_2}$

$\Rightarrow V_{Dmin} = \frac{(2.2k\Omega)(10V)}{(4k\Omega)(2.2k\Omega)} = \boxed{3.548V}$

$V_{Dmax} = \frac{(8.4k\Omega)(10V)}{(4k\Omega)(8.4k\Omega)} = \boxed{6.77V}$

$\boxed{2-}$ $P = \frac{U^2}{R_2}$

$P = \frac{(3.548)^2}{2.2k\Omega} = 5.7219\ mw$

$P = \frac{(6.77)^2}{8.4k\Omega} = 5.45629\ mw$

$P_{max} = 5.45629mw$

$\boxed{3-}$ for $R_2 = 2.2K\Omega$

$$R_{eq} = R_1 \parallel R_2$$

$$= \frac{(4K\Omega)(2.2K\Omega)}{(4K\Omega)+(2.2K\Omega)} = \boxed{1.4194K\Omega}$$

for $R_2 = 8.4K\Omega$

$$R_{eq} = R_1 \parallel R_2$$

$$= \frac{(4K\Omega)(8.4K\Omega)}{(4K\Omega)+(8.4K\Omega)} = \boxed{2.7097K\Omega}$$

The Range of output impedance will be from $\boxed{1.4194K\Omega}$ to $\boxed{2.7097K\Omega}$

Q2:- For $4\frac{1}{2}$ digit DVM, we can measure from 0-19999

on a 200 mV scale, The DVM measure from 0-19999

So the smallest measureable change is 0.1 mV or

$100 \mu V$.

$$100 \mu V = \frac{(120)(10)}{120+120} - \frac{R_4(10)}{120+R_4}$$

$$100 \mu V = \frac{1200}{240} - \frac{R_4(10)}{120+R_4}$$

$$100 \mu V = \frac{144000 + 1200R_4 - 2400R_4}{28800 + 240R_4}$$

$$\Rightarrow \quad R_4 = 119.9952\,\Omega$$

$$\Delta R_4 = R_4 - R_4'$$

$$\Delta R_4 = 120 - 119.9952$$

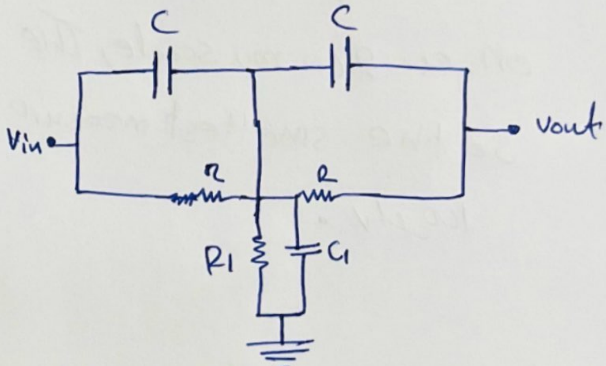
$$\Delta R_4 = 0.0048$$

Q3:-

$$f_n = 0.785 f_c$$

$$240 = 0.785 f_c$$

$$\boxed{f_c = 305.732 \text{ Hz}}$$



⇒ if we pick $c = 0.01 \mu f$

$$f_c = \frac{1}{2\pi RC}$$

$$305.732 = \frac{1}{(2\pi)(R)(0.01 \times 10^{-6})}$$

$$\boxed{R = 52.057 \Omega}$$

$$R_1 = \frac{\pi R}{10} = \frac{3.14 \times 52.057}{10} = \boxed{16.3542 \text{ k}\Omega}$$

$$C_1 = \frac{10C}{\pi} = \frac{C(10)\ (0.01 \times 10^{-6})}{\pi} = \boxed{0.0318 \mu F}$$

$$f_H = 4.57 f_c$$

$$f_H = (4.57)(305.732)$$

$$\boxed{f_H = 1397.195 \text{ Hz}}$$

$$f_L = 0.187 f_c$$

$$\boxed{f_L = 57.172 \text{ Hz}}$$

*fH is the frequency will down 3 dB below then 1397.195 Hz

Q4:-

$80\% = 0.8$

$1 - 0.8 = 0.2$

a-

High pass frequency at 120 Hz by factor 0.2

$$\left|\frac{V_{out}}{V_{in}}\right| = \frac{(f/f_L)}{\sqrt{1+(f/f_L)^2}}$$

$$0.2 = \frac{(120/f_L)}{\sqrt{1+(120/f_L)^2}}$$

$$\sqrt{1+(120+f_L)^2} = \frac{600}{f_L}$$

$$1+(120+f_L) = \frac{600^2}{f_L^2}$$

$$f_L^2 + (120)^2 = (600)^2$$

$$f_L^2 = 345600$$

$$\boxed{f_L = 587.88\,Hz}$$

$\Rightarrow$

b-

low pass will reduce 1 MHz By factor 0.2

$$0.2 = \frac{1}{\sqrt{1+(10^6/f_H)^2}}$$

$$1 = 0.2 \times \sqrt{1+(10^6/f_H)^2}$$

$$1 = 0.04 \times (1 + (10^6/f_H)^2)$$

$$1 = 0.04\,(1+(10^{12}/f_H^2))$$

$$1 = 0.04 + \frac{4\times10^{10}}{f_H^2}$$

$$0.96 = \frac{4\times10^{10}}{f_H^2} \Rightarrow f_H^2 = 4.167\times10^{10}$$

$$\boxed{f_H = 204124.145\,Hz}$$

C-

$r = 0.01$, $R_l = 120k\Omega$

$$r = \frac{R_H}{R_L} \Rightarrow 0.01 = \frac{R_H}{120k\Omega}$$

$$\Rightarrow \boxed{R_H = 1200\,\Omega}$$

$$f_L = \frac{1}{2\pi R_H C_H}$$

$$587.88 = \frac{1}{2\pi\ 1200\ C_H}$$

$$C_H = 2.256 \times 10^{-7}\ F$$

$$f_H = \frac{1}{2\pi R_L C_L}$$

$$204124.145 = \frac{1}{2\pi\ (120k\Omega)\ C_L}$$

$$\boxed{C_L = 6.497 \times 10^{-12}\ F}$$