Section (7)

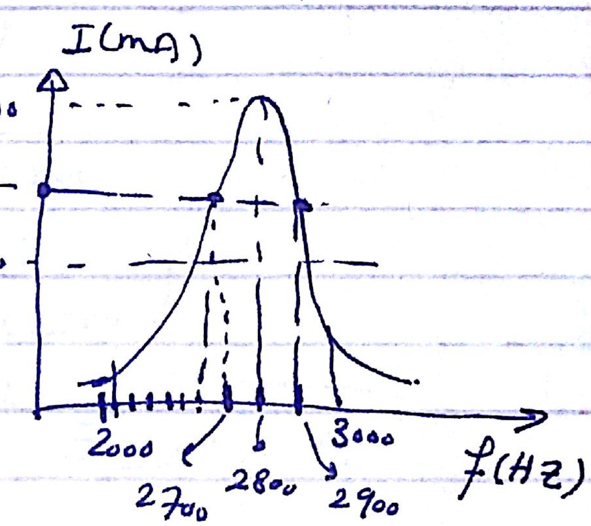
MidTerm - Solution

Question (1)

a- Determine The Quality Factor and Bandwidth For a series Resonance Circuit whose response Curve is shown in Figure 1.

b- For $C = 10pF$, determine L, and R and Applied Voltage.

Solution



$\frac{I_{max}}{\sqrt{2}} = 141$

→ fr from Curve at 2800 Hz

→ $\omega_0 = 2\pi \times 2800 = 17952.9$ rad/s

∴

→ BW at $I = \frac{200}{\sqrt{2}} = 141$ mA

∴ $F_1 = 2700$ Hz

$F_2 = 2900$ Hz

∴ $\boxed{\text{Bandwidth} = 2900 - 2700 = 200\text{ Hz}}$ → (1)

or $BW(\text{rad/s}) = 200 \times 2\pi = 1256.6$ rad/s

∴ $\boxed{Q = \frac{\omega_0}{B} = \cancel{\frac{1256.6}{17952.9}} \;\cancel{or}\; \frac{2800}{200} \text{ or } \frac{17952.9}{1256.6} = 14}$

→ (2)

- b - $C = 10pF$

$$\omega_{o\,rad/s} = \frac{1}{\sqrt{LC}} \quad \text{or} \quad f_r = \frac{1}{2\pi\sqrt{LC}}$$

$$2800 = \frac{1}{2\pi\sqrt{L \times (10 \times 10^{-12})}}$$

$$2\pi \times 2800 = \frac{1}{\sqrt{L(10 \times 10^{-12})}}$$

$$\sqrt{L(10 \times 10^{-12})} = \frac{1}{2\pi \times 2800}$$

$$L * (10 \times 10^{-12}) = \left(\frac{1}{2\pi \times 2800}\right)^2$$

$$\boxed{L = \frac{(1/2\pi \times 2800)^2}{10 \times 10^{-12}} \simeq 323.1\ H}$$

غيرمنطقي بس ماعلينا :)

Now $B_{rad/s} = R/L$ or $B_{Hz} = \frac{R}{2\pi L}$

$$1256.6 = \frac{R}{323.1} \quad \therefore \boxed{R \simeq 406\,k\Omega}$$

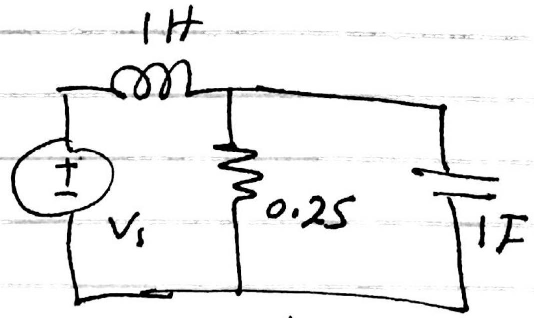
$$V = I_{max} R = (200\,mA)(406\,k\Omega)$$

$$\boxed{V = 81.19\ KV}$$

رقم خرافي :)

Q(2) a- Find the Transfer Function v_o/v_i of Circuit (2)

b- Determine of The Circuit is LPF or HPF



a- $T.F \Rightarrow H(\omega) = \frac{v_o}{v_i}$

$$\frac{V_o}{V_i} = \frac{R // X_c}{X_L + R // X_c} \Rightarrow$$

$$R // X_c = \frac{R\left(\frac{1}{j\omega C}\right)}{R + \frac{1}{j\omega C}} \Rightarrow \frac{R}{1 + j\omega RC}$$

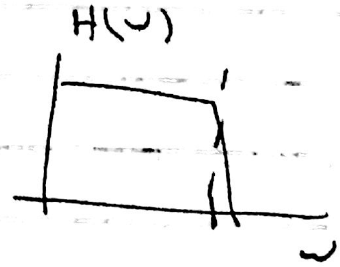
$$= \frac{R / 1 + j\omega RC}{j\omega L + R / 1 + j\omega RC}$$

$$= \frac{R}{R + (j\omega L)(1 + j\omega RC)} = \frac{R}{R + j\omega L - \omega^2 RLC}$$

a- $$\frac{v_o}{v_i} = \frac{1}{(1 - \omega^2 LC) + j\frac{\omega L}{R}} = \frac{1}{(1 - \omega^2) + j4\omega} \quad \#$$

b- for $\omega = 0 \longrightarrow H(\omega) = 1$

$\omega = \infty \longrightarrow H(\omega) = 0$



∴ It is low pass Filter

لزيادة التأكيد نحسب ω_0 (Transient stage)
المرحلة الانتقالية من الـ High للـ low

$$H(\omega) = \frac{1}{\sqrt{2}}$$

اضافي

to calculate $H(\omega_0)$

$$H(\omega_0) = \frac{1}{\sqrt{2}} H_{max} = \frac{1}{\sqrt{2}}(1)$$

$$\therefore \frac{1}{\sqrt{2}} = \frac{1}{\sqrt{(1-\omega^2)^2 + (4\omega)^2}}$$

$$\therefore 2 = (1-\omega^2)^2 + (4\omega)^2$$

$$2 = 1 + \omega^4 - \underline{2\omega^2} + \underline{16\omega^2}$$

$$\therefore \omega^4 + 14\omega^2 - 1 = 0$$

$$x^2 + 14x - 1 = 0 \qquad , x = \omega^2$$

$$x = \frac{-14 \mp \sqrt{(14)^2 - 4(-1)}}{2}$$

$$= \frac{-14 \mp \sqrt{200}}{2}$$

$$= 0.071 \quad \text{or} \quad -14.07 \;\; \text{X refused}$$

$$\therefore \omega^2 = 0.071 \qquad \boxed{\omega = 0.2665}$$

$$H(\omega_r) = \frac{1}{\sqrt{2}}$$