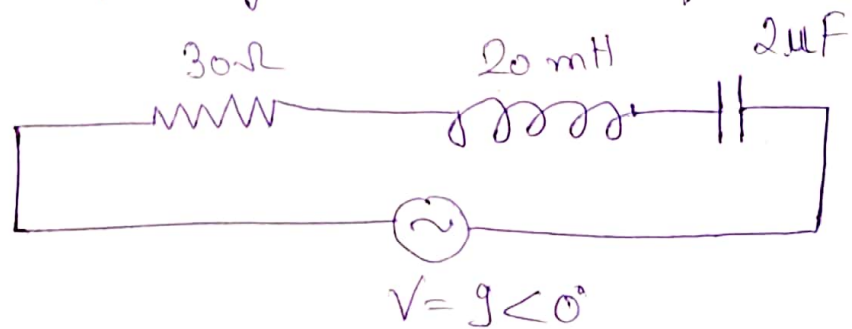


Electrical Science Lab Assignment

Experiment No. 10,

Q-1- Calculate the resonant frequency, the current at resonance, the voltage across the inductor and capacitor at resonance, the quality factor and the bandwidth of the circuit. Also sketch the corresponding current waveform for all frequencies.



Solution:

$$\text{Resonant frequency} = \frac{1}{2\pi\sqrt{LC}} = \frac{1}{2\pi\sqrt{20 \times 10^{-3} \times 2 \times 10^{-6}}}$$

$$\therefore \text{frequency, } f = \underline{795.774 \text{ Hz}}$$

At resonance, the current is $\frac{V}{R} = \frac{9}{30} = 0.3 \text{ Amp.}$

At resonance,

Voltage across inductor $\Rightarrow V = I \cdot X_L = I \cdot \omega L$

$$\omega = 2\pi f \therefore V = I \cdot 2\pi f L$$

$$X_L = 2\pi f L = 2\pi \times 795.774 \times 20 \times 10^{-3}$$

$$= 99.99\Omega$$

$$V_L = 0.3 \times 99.99 \angle 90^\circ$$

$$\boxed{V_L = 29.997 \angle 90^\circ}$$

Voltage across the capacitor at resonance, $V = I(-jX_C)$

$$X_C = \frac{1}{2\pi f C} = \frac{1}{2\pi \times 795.774 \times 2 \times 10^{-6}} = \frac{10^6}{10^4} = 100 \Omega$$

$$V_C = 0.3 \times 100 \angle -90^\circ$$

$$\boxed{V_C = 30 \angle -90^\circ}$$

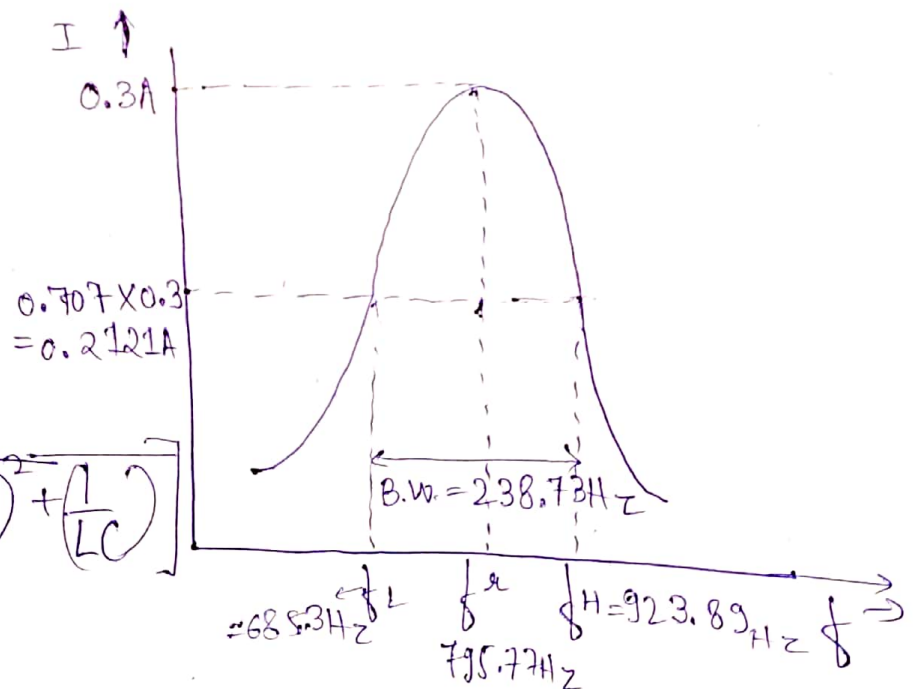
$$\text{Quality Factor} \Rightarrow \frac{1}{R} \sqrt{\frac{L}{C}} = \frac{1}{30} \sqrt{\frac{20 \times 10^{-3}}{2 \times 10^{-6}}} = \frac{10}{3} = 3.33$$

$$\boxed{QF = \frac{10}{3} = 3.33}$$

$$\text{Bandwidth} = \frac{f}{Q} = \frac{795.77 \times 3}{10} = 238.731 \text{ Hz}$$

$$\boxed{B.W = 238.731 \text{ Hz}}$$

Waveform \Rightarrow



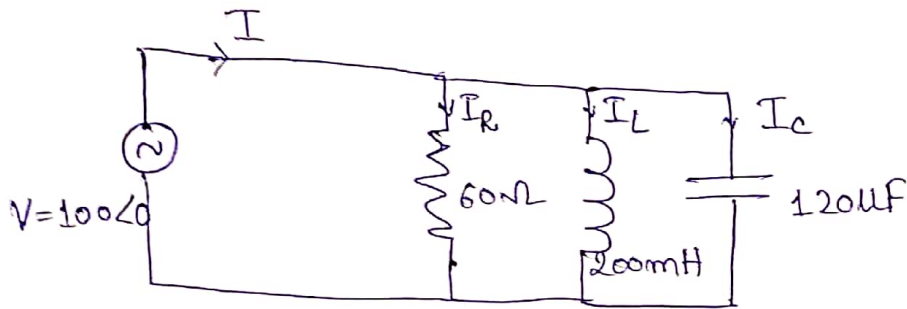
$$f_L = \frac{1}{2\pi} \left[\frac{-R}{2L} + \sqrt{\left(\frac{R}{2L}\right)^2 + \frac{1}{LC}} \right]$$

$$= 685.3 \text{ Hz}$$

$$f_H = \frac{1}{2\pi} \left[\frac{R}{2L} + \sqrt{\left(\frac{R}{2L}\right)^2 + \frac{1}{LC}} \right]$$

$$= 923.89 \text{ Hz}$$

Question 2 - Calculate the resonant frequency, the quality factor, and the bandwidth of the circuit, the circuit current at resonance.



Solution :- Resonant frequency, $f_H = \frac{1}{2\pi\sqrt{LC}}$

$$f_H = \frac{1}{2\pi\sqrt{200 \times 10^{-3} \times 120 \times 10^{-6}}} = 32.48 \text{ Hz}$$

$$\text{Quality factor} = (Q.F.) = R\sqrt{\frac{C}{L}} = 60\sqrt{\frac{120 \times 10^{-6}}{200 \times 10^{-3}}} = 60\sqrt{6 \times 10^{-4}}$$

$$\boxed{Q.F. = 1.46}$$

$$\text{Bandwidth} = \frac{1}{2\pi RC} = \frac{10^6}{2 \times \pi \times 60 \times 120} = 22.10 \text{ Hz}$$

$$\boxed{B.W. = 22.1 \text{ Hz}}$$

$$\text{At resonance, current} \Rightarrow I = \frac{V}{R} \\ = \frac{100}{60} = 1.66 \text{ Amp}$$

$$\boxed{I_R = 1.66 \text{ Amperes}}$$