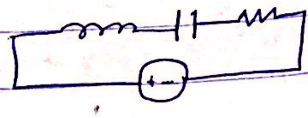
* Exp 11: Series and parallel Resonant Circuits

Series Resonance:-



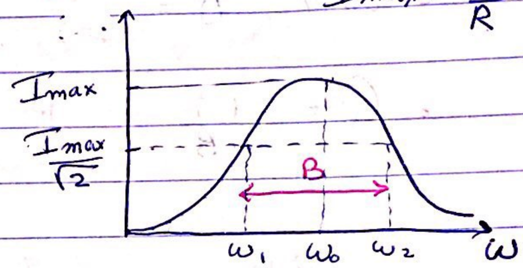
→ Resonance occurs at min impedance and zero phase and at it : I_m is Max

- Resonance in RLC circuits occurs when inductive & capacitive reactances are equal in Magnitude but 180 in phase. ($X_C = X_L$)

$$\frac{1}{\omega C} = \omega L$$

$$\omega_0 = \frac{1}{\sqrt{LC}}$$ Resonant frequency

$$I_{max} = \frac{V_m}{R}$$



and $I_m = \dfrac{V_m}{\sqrt{R^2 + \left(\omega L - \frac{1}{\omega C}\right)^2}}$

and $\theta = -\tan\left(\dfrac{\omega L - \frac{1}{\omega C}}{R}\right)$

when $I = \frac{1}{2^{0.5}} I_m \Longrightarrow$ Band width $= B = \omega_2 - \omega_1 = \frac{R}{L}$

Where $\omega_{2,1} = \sqrt{\left(\frac{R}{2L}\right)^2 + \frac{1}{LC}} \pm \frac{R}{2L}$

$\omega_{2,1} \Rightarrow$ 3 dB frequences (half power frequencies) occur when $I_m = \frac{I_{max}}{\sqrt{2}}$

* Quality factor: $Q = \frac{\omega_0}{B} = \frac{1}{R}\sqrt{\frac{L}{C}}$

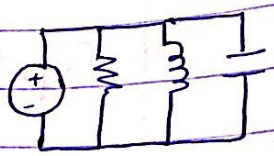
Now: $V_{R\,max}$ is when $\omega = \omega_0$

$V_{L\,max}$ at $\omega = \dfrac{\omega_0}{\sqrt{1 - \frac{R^2 C}{2L}}}$

$V_{C\,max}$ at $\omega = \omega_0\sqrt{1 - \frac{R^2 C}{2L}}$

Parallel Resonance:-

in this Case



- $V_m = \dfrac{I_m}{\sqrt{\frac{1}{R^2} + \left(\omega C - \frac{1}{\omega L}\right)^2}}$ and $\theta = -\tan\left(R\left(\omega C - \frac{1}{\omega L}\right)\right)$

- $\omega_0 = \dfrac{1}{\sqrt{LC}}$

- $\omega_{2,1} = \sqrt{\left(\dfrac{1}{2RC}\right)^2 + \dfrac{1}{LC}} \pm \dfrac{1}{2RC}$

- and $B = \dfrac{1}{RC}$.

- $Q = \dfrac{\omega_0}{B} = R\sqrt{\dfrac{C}{L}}$

Note, inductive $\Rightarrow$ $X_L > X_C$

capacitive $\Rightarrow$ $X_C > X_L$