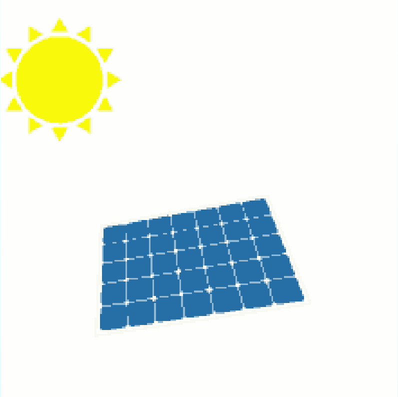
Three Branch Parallel RLC circuits



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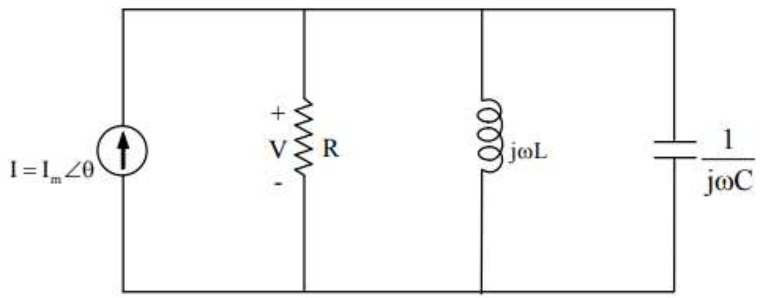

Fig. 5.9 Parallel RLC Circuit

Parallel RLC is the dual of series RLC. Fig. 5.9 shows the three branch parallel RLC circuit.

The circuit admittance is, $Y = \frac{I}{V} = \frac{1}{R} + j\omega C + \frac{1}{j\omega L}$

$$\text{(or)}\ Y = \frac{1}{R} + j\left(\omega_C - \frac{1}{\omega L}\right)$$

Resonance occurs when imaginary part of Y is zero,

$$\omega C - \frac{1}{\omega L} = 0 \Rightarrow \frac{1}{X_C} - \frac{1}{X_L} = 0 \Rightarrow X_L = X_C$$

(or)

$$\Rightarrow \omega_0 L = \frac{1}{\omega_0 C} \Rightarrow \omega_0 = \frac{1}{\sqrt{LC}}\ \text{sec.}$$

The resonant frequency in Hz is $f_0 = \frac{\omega_0}{2\pi} = \frac{1}{2\pi\sqrt{LC}}$ Hz

The voltage Vs frequency curve is shown in fig. 5.10. At resonance, parallel LC acts like open circuit. So, the entire current flows through R. Also, I_C & I_L can be much more than source current at resonance.

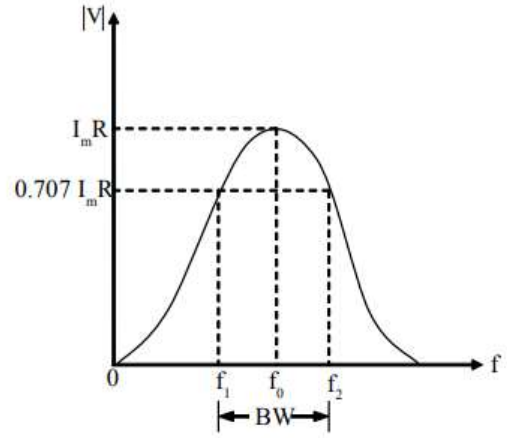

Fig. 5.10 Voltage Vs frequency curve

By comparing Z in series RLC and Y in parallel RLC & replacing R, L, C with $1/R, 1/L, 1/C$,

$$\therefore\ \omega_1 = -\frac{1}{2RC} + \sqrt{\left(\frac{1}{2RC}\right)^2 + \frac{1}{LC}}; \qquad \omega_2 = \frac{1}{2RC} + \sqrt{\left(\frac{1}{2RC}\right)^2 + \frac{1}{LC}}$$

$$\text{Bandwidth, } BW = \omega_2 - \omega_1 = \frac{1}{RC}$$

$$\text{Quality factor, } Q = \frac{\omega_0}{B} = \omega_0 R_C = \frac{R}{\omega_0 L}$$

For high Q-circuits, $(Q \geq 10)$

$$\omega_1 \simeq \omega_0 - \frac{BW}{2};\ \omega_2 \simeq \omega_0 + \frac{BW}{2}$$

Thank You