19EEB102 / ELECTRIC CIRCUIT ANALYSIS

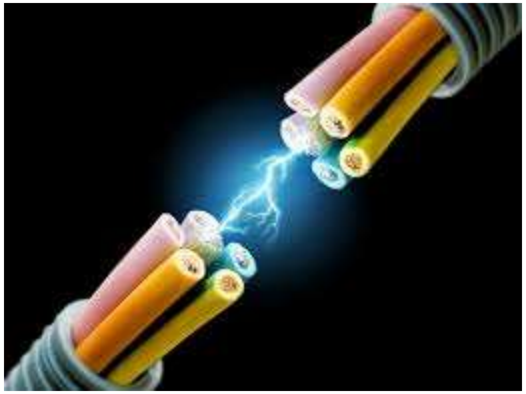
I YEAR / II SEMESTER

UNIT-IV: RESONANCE

PARALLEL RESONANCE -1

TOPIC OUTLINE

- Resonance in Electric Circuit
- Parallel Resonance



Resonance In Electric Circuits

- Any passive electric circuit will resonate if it has an inductor and capacitor

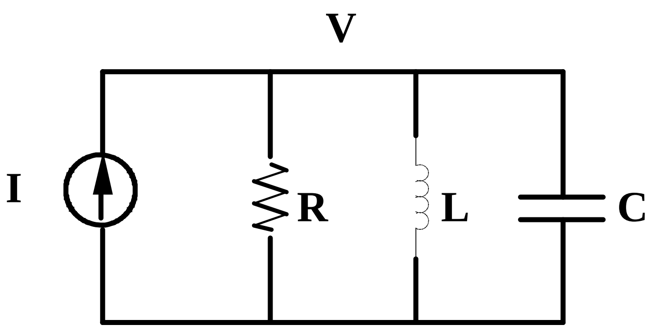
- Resonance is characterized by the input voltage and current being in phase. The driving point impedance (or admittance) is completely real when this condition exists

- In this presentation we will consider
(a) series resonance and
(b) parallel resonance

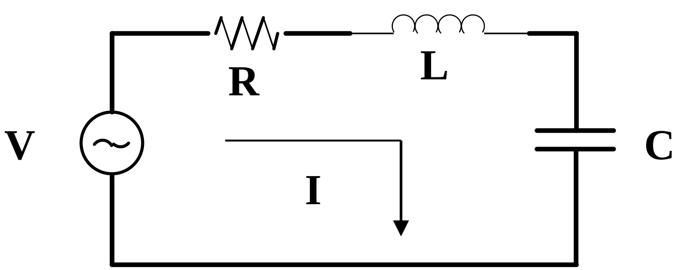
Parallel Resonance

Background

Consider the circuits shown below:



$$I = V\left[\frac{1}{R} + jwC + \frac{1}{jwL}\right]$$



$$V = I\left[R + jwL + \frac{1}{jwC}\right]$$

Resonance

Duality

$$I = V\left[\frac{1}{R} + jwC + \frac{1}{jwL}\right] \qquad V = I\left[R + jwL + \frac{1}{jwC}\right]$$

We notice the above equations are the same provided:

$$I \longleftrightarrow V$$

$$R \longleftrightarrow \frac{1}{R}$$

$$L \longleftrightarrow C$$

If we make the inner-change, then one equation becomes the same as the other.

For such case, we say the one circuit is the dual of the other.

Parallel Resonance

Background

What this means is that for all the equations we have derived for the parallel resonant circuit, we can use for the series resonant circuit provided we make the substitutions:

$$R \quad \textit{replaced be} \quad \frac{1}{R}$$

$$L \quad \textit{replaced by} \quad C$$

$$C \quad \textit{replaced by} \quad L$$

Parallel Resonance

Parallel Resonance

$$w_o = \frac{1}{\sqrt{LC}}$$

$$Q = \frac{w_o L}{R}$$

$$BW = (w_2 - w_1) = w_{BW} = \frac{R}{L}$$

$$w_1, w_2 = \left[\frac{\mp R}{2L} + \sqrt{\left(\frac{R}{2L}\right)^2 + \frac{1}{LC}} \right]$$

$$w_1, w_2 = w_o \left[\frac{\mp 1}{2Q} + \sqrt{\left(\frac{1}{2Q}\right)^2 + 1} \right]$$

Series Resonance

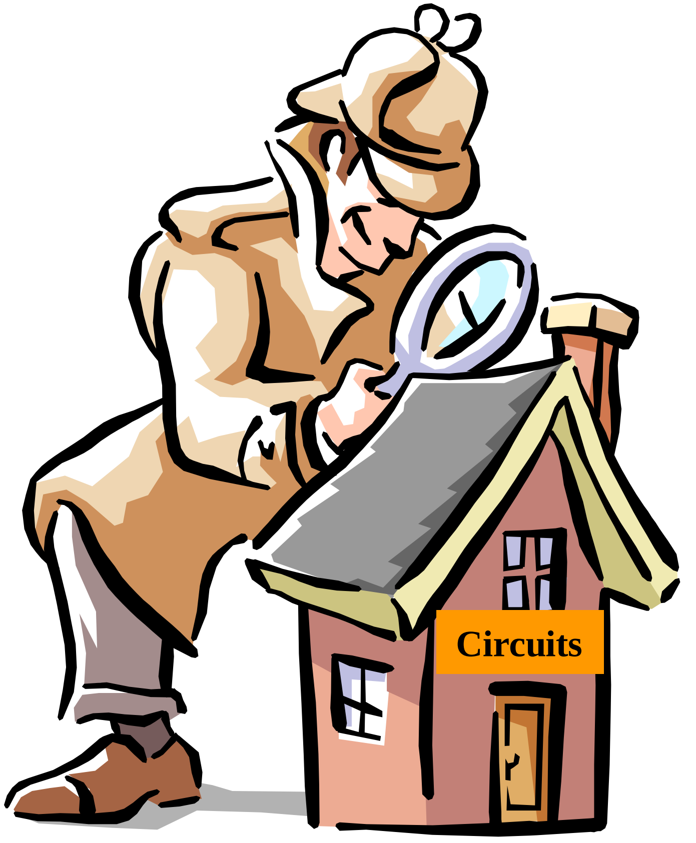
$$w_o = \frac{1}{\sqrt{LC}}$$

$$Q = w_o RC \qquad Q = \frac{w_o L}{R}$$

$$BW = w_{BW} = \frac{1}{RC} \qquad BW = \frac{f_r}{Q}$$

$$w_1, w_2 = \left[\frac{\mp 1}{2RC} + \sqrt{\left(\frac{1}{2RC}\right)^2 + \frac{1}{LC}} \right]$$

$$w_1, w_2 = w_o \left[\frac{\mp 1}{2Q} + \sqrt{\left(\frac{1}{2Q}\right)^2 + 1} \right]$$



Thank you