ECE 2101L
Electrical Circuit Analysis II Laboratory

Lab 10
Resonance Circuits

Prelab

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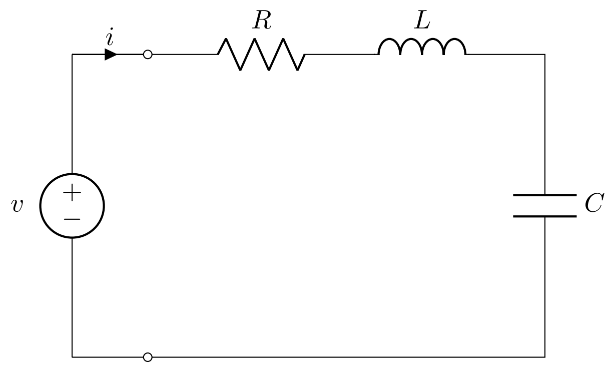
April 13, 2020

1 Theory of electrical resonance

According to *Fundamentals of Electric Circuits (2017)*, **Resonance** is a condition in an RLC circuit in which the capacitive and inductive reactances are equal in magnitude, thereby resulting in a purely resistive impedance. **Series Resonance** is therefore resonance in a series RLC circuit while **Parallel Resonance** is resonance in a parallel RLC circuit. The **Resonance Frequency** for both series and parallel RLC circuit is $\omega_0 = \frac{1}{\sqrt{LC}}$ rad/s. [1]

2 Series and parallel resonance in RLC circuits



The input impedance of the above circuit is

$$Z = R + \left(\omega L - \frac{1}{\omega C}\right) j$$

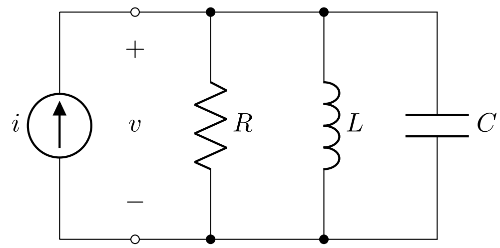
The resonance frequency is

$$f_0 = \frac{1}{\sqrt{LC}} \text{ rad/s} = \frac{1}{2\pi\sqrt{LC}} \text{ Hz}$$

The current under resonance is

$$i(t) = \frac{v(t)}{Z} = \frac{v(t)}{R + \left(\omega_0 L - \frac{1}{\omega_0 C}\right) j} = \frac{v(t)}{R + \left(\sqrt{\frac{L}{C}} - \sqrt{\frac{L}{C}}\right) j} = \frac{v(t)}{R}$$

The magnitude of $i(t)$ under resonance will be smaller comparing to normal condition as the magnitude of Z is at its largest value, therefore $i(t)$ is smallest at resonance frequency comparing to other frequencies.



The input impedance of the above circuit is

$$Z = \frac{1}{\frac{1}{R} + \left(\omega C - \frac{1}{\omega L}\right) j}$$

The resonance frequency is

$$f_0 = \frac{1}{\sqrt{LC}}\,\text{rad/s} = \frac{1}{2\pi\sqrt{LC}}\,\text{Hz}$$

The voltage under resonance is

$$v(t) = i(t)Z = \frac{i(t)}{\frac{1}{R} + \left(\omega_0 C - \frac{1}{\omega_0 L}\right) j} = \frac{i(t)}{\frac{1}{R} + \left(\sqrt{\frac{C}{L}} - \sqrt{\frac{C}{L}}\right) j} = i(t)R$$

The magnitude of $v(t)$ under resonance will be larger comparing to normal condition as the magnitude of Z is at its largest value, therefore $v(t)$ is largest at resonance frequency comparing to other frequencies.

References

[1] C.K. Alexander and M.N.O. Sadiku. *Fundamentals of Electric Circuits*. COLLEGE IE OVERRUNS. McGraw-hill Education, 2017. ISBN: 9781259251320. URL: `https://books.google.com/books?id=e4-gjwEACAAJ`.