Resonance in RLC Circuits

Aim:

1) Study the phenomenon of resonance in RLC circuits.
2) Determine the resonant frequency and bandwidth of the given network using a sinusoidal response.

Apparatus:

1. Ac power supply
2. Resistors
3. Capacitors
4. Inductors
5. Voltameter
6. Ammeter
7. White board

Theory:

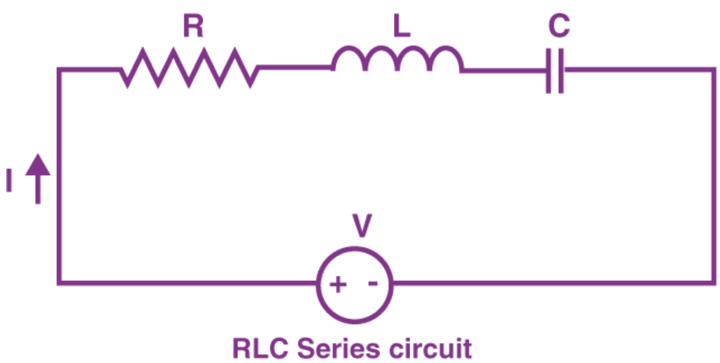
A resonant circuit, also called a tuned circuit consists of an inductor and a capacitor together with a voltage or current source. It is one of the most important circuits used in electronics. For example, a resonant circuit, in one of its many forms, allows us to select a desired radio or television signal from the vast number of signals that are around us at any time. A network is in resonance when the voltage and current at the network input terminals are in phase and the input impedance of the network is purely resistive.

An AC circuit is in resonance when the input current is in phase with the supply voltage thus behaving as a purely resistive circuit. A diagram of the series resonant circuit is shown in Figure 1. The resonant frequency can be calculated using the equation (1). As can be noticed the resonant frequency does not depend on the resistance value.

$$f_0 = \frac{1}{2\pi\sqrt{LC}} \quad Hz \quad also: \ |X_L| = |X_C| = \omega L = \frac{1}{\omega C} \ \Rightarrow \omega^2 = \frac{1}{LC} \tag{1}$$

The magnitude of the circuit current I varies with the frequency f of the supply voltage Vin according to the equation (2). A typical variation of this current vs. frequency is shown in Figure 2. As can be seen from the graph, in a series resonant circuit the current reaches its maximum value at resonant frequency. At resonance the magnitude of the current is limited just by the circuit resistance, and can reach very high values if this resistance is small as can be seen from Figure 2

$$|I| = \frac{|V_{in}|}{\sqrt{R^2 + \left(\omega L - \frac{1}{\omega C}\right)^2}}$$



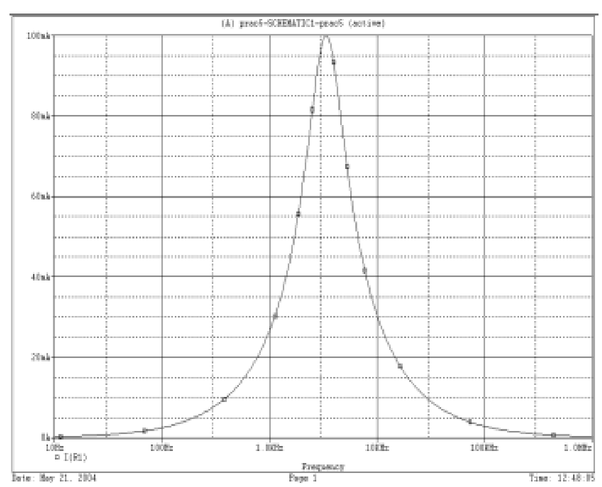


Fig. (1)

Fig. (2)

Method:

1. Connect the circuit as shown in Fig. (1).
2. Switch on the function generator.
3. Record the current when change the frequency and repeat this step.
4. Make table between current & frequency.
5. Plot the graph between the frequency (in X axis) and the current (in Y axis).
6. From the graph find the Resonant Frequency (f_0).

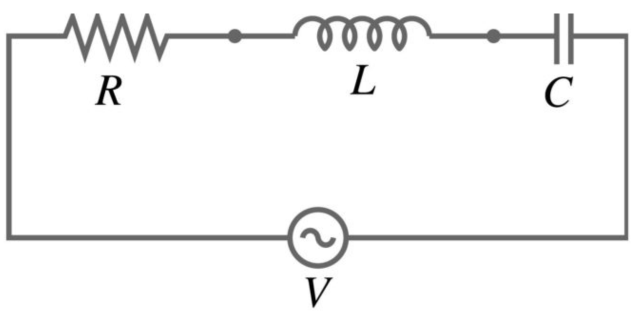
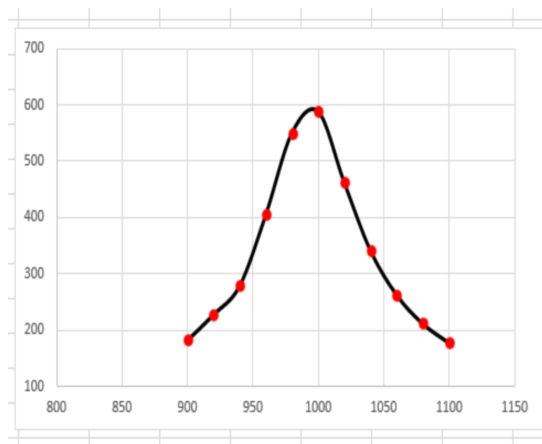


Fig. (1).

Results:

F (Hz)	I (mA)



Resonant Frequency (f_0) =