F. Y. B. Tech Academic Year 2020-21

Trimester: **Subject:** Basics of Electrical and Electronics Engineering

Name ---------- **Division ---------**

Roll No ---------- **Batch ----------**

Experiment No: 8

Name of the Experiment: Finding Resonant Frequency of series R-L-C circuit

Performed on: **----------**

Submitted on: **----------**

Aim : Finding Resonant Frequency of series R-L-C circuit

Objective

To understand the resonance in series R-L-C circuit and to find out resonant frequency of given R-L-C circuit

Components and equipment required

Components	Specifications
Signal Generator	Audio frequency range
AC Ammeter	0-1 A
R-L-C circuit board	Component values given below

Theory

In the series R-L-C circuit, when inductive reactance X_L equals the capacitive reactance X_C circuit is called as series resonance circuit. Circuit behaves like a resistive circuit and the resulting current is in phase with the applied voltage. Circuit power factor is unity. At

resonance, the equivalent impedance of the circuit consists of only resistive components due to cancelling out the reactive components. At this condition circuit draws the maximum current shown in Fig.4 due to minimum impedance of the circuit as shown in Fig.3. As X_L is directly proportional to frequency and X_C is inversely proportional to frequency, we can obtain the resonance of any R-L-C circuit by varying its frequency. The frequency, at which this condition occurs, is known as resonance frequency f_r of that circuit. The magnitude of the resonating frequency can be calculated using eq.(1)

$$f_r = \frac{1}{2\pi\sqrt{LC}} \tag{1}$$

During series resonance, voltage magnification is observed. Voltage across the capacitor or inductor is multiple times the supply voltage. This can be observed using the term Q factor or Quality factor of the circuit which is given by eq. (2)

$$Q = \frac{\omega L}{R} = \frac{L}{R\sqrt{LC}} = \frac{1}{R}\sqrt{\frac{L}{C}} \tag{2}$$

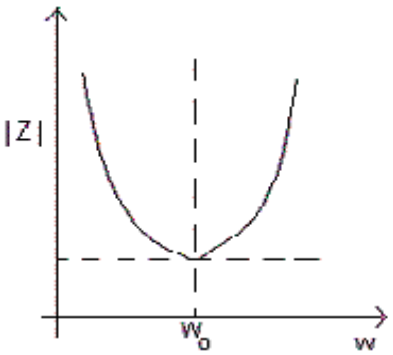


Fig.2: Impedance vs frequency

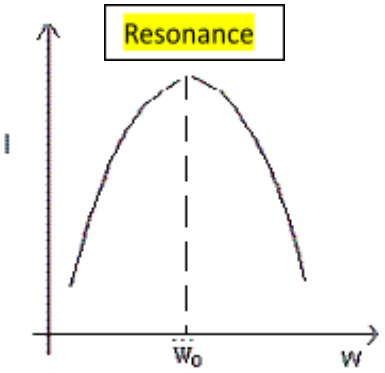
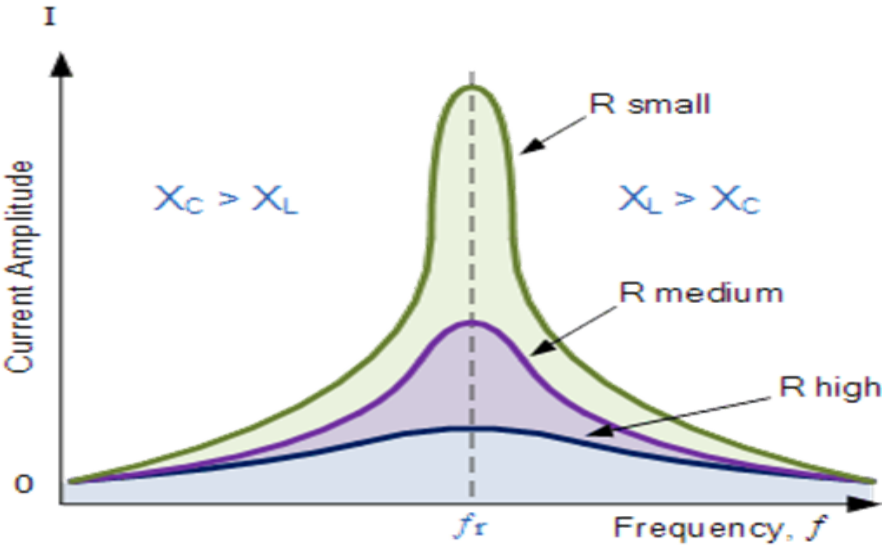
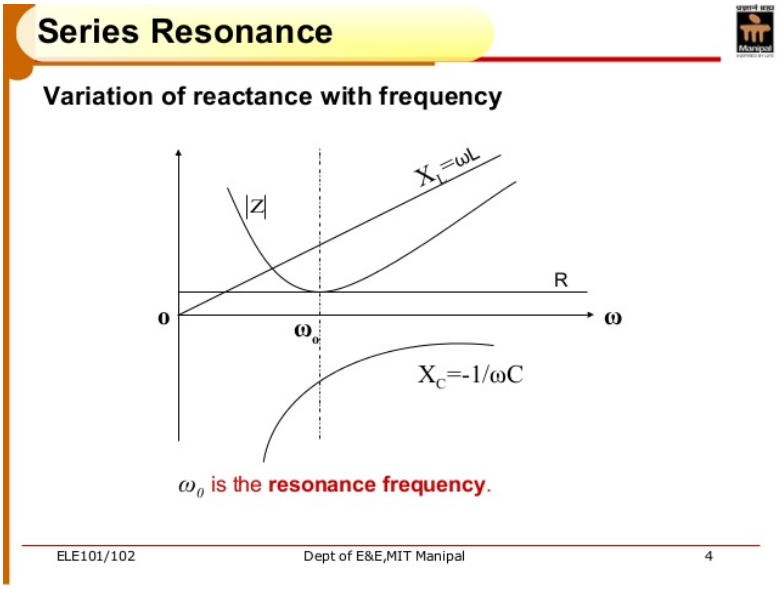


Fig.3: Current vs frequency





Procedure

1) Connect the circuit as shown in Fig.1
2) Give 5V peak to peak amplitude sinusoidal input from the signal generator.
3) Change the frequency and obtain the maximum current in the circuit. Vary frequency from 800 Hz to 2800Hz. Note down this reading at resonant frequency.
4) Adjust frequencies for six equally spaced readings above and below the resonant frequency and note down corresponding current values on AC ammeter.

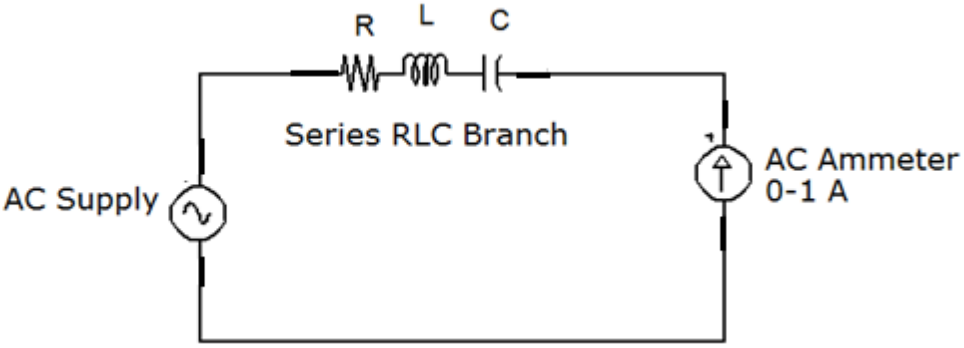


Fig. 1: Series R-L-C Circuit

Observations

1) **Components used in the series circuit:**

i) L =_____mH ii) C =_____ µF iii) R =_____Ω

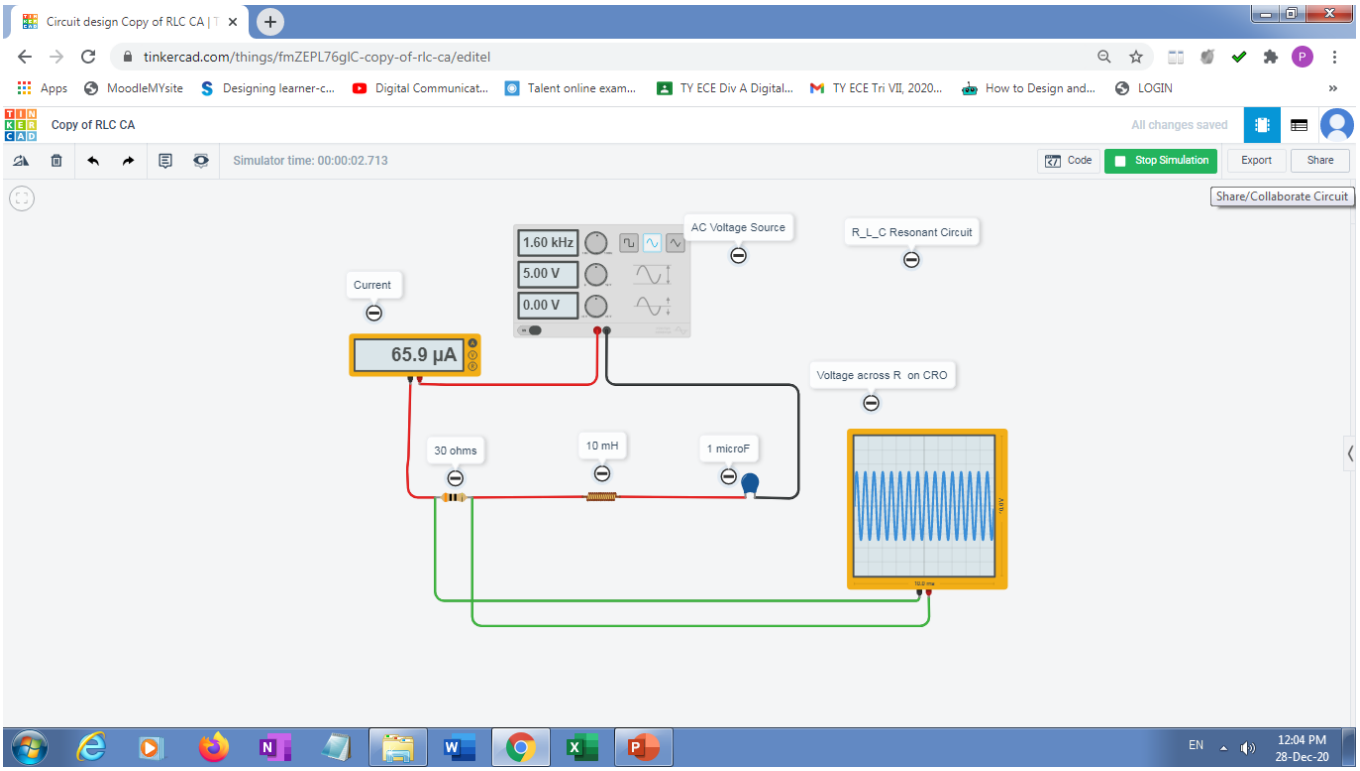
Use the components as follows:

R= 30 Ohms, L=10 mH, C=1 microF

2) **Observation Table**

Sr. No	Frequency (Hz)	AC Voltage across R (V) (Proportional to theAC current in the circuit)
1	800	
2	900	
3	1000	
4	1100	
5	1300	
6	1400	
7	1500	
8	1600	
9	1700	
10	2000	
11	2200	
12	2500	
13	2800	

Tinkercad simulation of R_L_C series RESONANT circuit with Voltage across R being observed on oscilloscope.



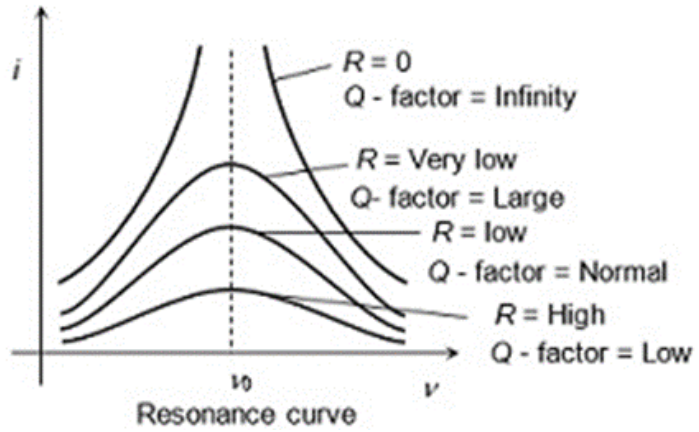
Graph and Calculations

1) Plot graph of Current I vs. Frequency f
2) Mark resonant frequency f_r from the graph.
3) Calculate resonant frequency f_r and Q factor using eq.(1) and (2)

Result:

	Resonance Frequency (KHz)
Practical Value	
Theoretical Value	

Conclusion: _____



Resonance curve

Post-Lab Questions

1) Derive the expression for resonance frequency.
2) Explain the reactance curves (X_L vs f and X_C vs f) for series circuit.
3) Give applications of resonant circuits.

Note: Students are instructed to do all necessary calculations and answer the questions on separate sheets and attach them.

Extra learning resources:

https://youtu.be/AUirtqrm-o0

https://youtu.be/C8o2UpqzuKI