EE1302: INTRODUCTION TO ELECTRICAL ENGINEERING

LABORATORY 03

NAME : NADHA M.J

REG No. : EG/ 2021/ 4686

SEMESTER: 01

DATE : 05/10 /2022

Table 1.1: Summative Laboratory Form

Semester	01
Module Code	EE1302
Module Name	Introduction to Electrical Engineering
Lab Number	03
Lab Name	RLC Circuits
Lab conduction date	2022.09.28
Report Submission date	2022.10.05

Contents

List of Tables

List of Figures

1 Observation

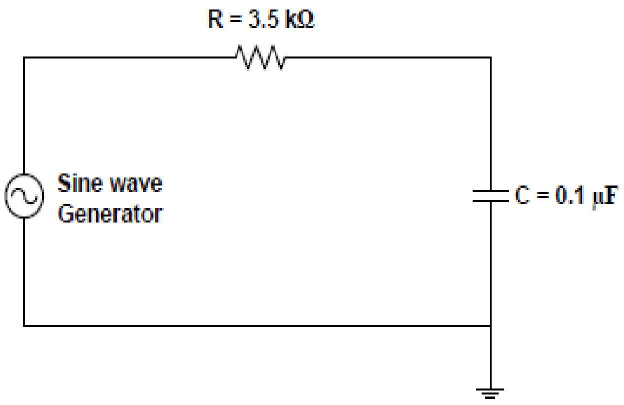

Figure 1.1 : Series RC Circuit

Table shows the experimental values of the RC circuit

Table 1.1 : Experimental values of Series RC Circuit

Parameter	**200Hz**		**1kHz**	
	Theoretical Value	**Experimental Value**	**Theoretical Value**	**Experimental Value**
V_S rms (V)		1.47		1.4
V_C rms (V)		1.27		0.576
V_R rms (V)		0.569		1.25
I_S rms (mA)		-0.11		0.27
∅ (Degrees)		-63		-24.1
Xc		7963.2		1591.97
Z_{Total}		8692.4		3845.1

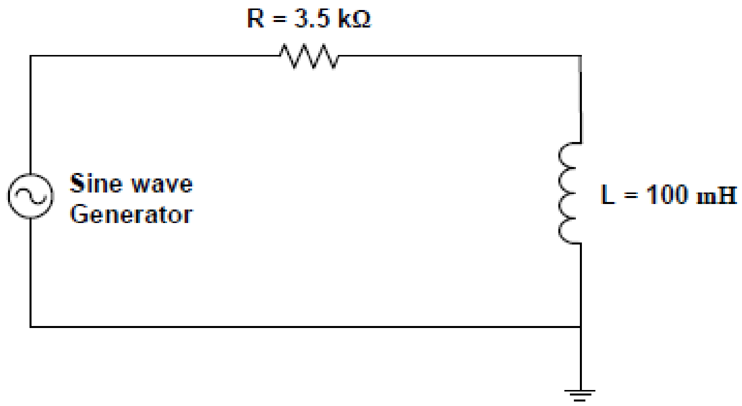

Figure1.2 : Series RL Circuit

Table shows the experimental values of the RL circuit

Table 1.2 Experimental values of Series RL Circuit

Parameter	**1kHz**		**5kHz**	
	Theoretical Value	**Experimental Value**	**Theoretical Value**	**Experimental Value**
V_S rms (V)		1.41		1.4
V_L rms (V)		0.243		0.923
V_R rms (V)		1.30		1.01
I_S rms (mA)		0.397		0.31
Ø (Degrees)		10.1		40.1
Xc		627.35		3150
Z_{Total}		3554.95		4903.15

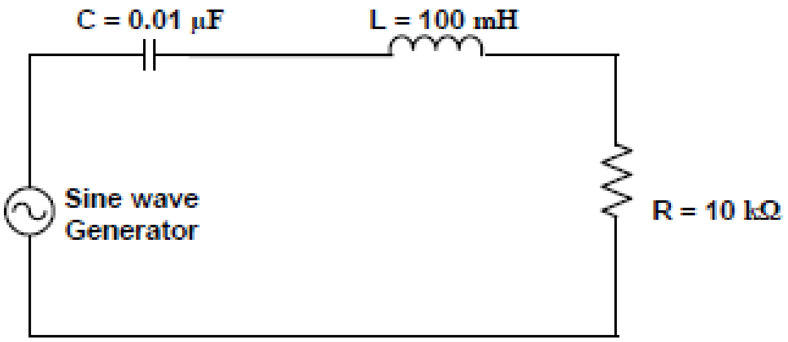

Figure1.3: Series Resonance Circuit

Table 1.3 Experiment value of Series Resonance frequency

	Theoretical Value	**Experimental Value**
Resonance Frequency f_o (Hz)		4500

2 Calculation

2.1 Specimen Calculation

Considering RC circuit,

When f = 200 Hz, Vpp= 4V , C=0.1µF ,R=3.5kΩ To RC circuit,

$$V_{S\ rms} = \frac{4}{2\times\sqrt{2}}$$

$$= 1.414V$$

$$X_C = \frac{1}{2\pi\times200\times0.1\times10^{-6}}$$

$$= 7957.75\Omega$$

$$Z_{\ total} = \sqrt{(R^2 + Xc^{2})}$$

$$= \sqrt{(3500^2 + 7957.75^{2})}$$

$$= 8555.03\Omega$$

$$Vc_{\ rms} = Vs_{\ rms} \times \frac{Xc}{Z}$$

$$= 1.414 \times \frac{7957.75}{8555.03}$$

$$=1.320V$$

$$V_{R\ rms} = Vs_{\ rms} \times \frac{R}{Z}$$

$$= 1.414 \times \frac{3500}{8555.03}$$

$$= 0.578V$$

$$Is_{\ rms} = \frac{VR\ rms}{R}$$

$$= \frac{0.578}{3500}$$

$$= 0.165\text{mA}$$

$$\emptyset_{(degree)} = \tan^{-1}(-1.32/0.578)$$

$$= -66.355^0$$

Considering RL Circuit,

When f=1kHz, Vpp=4V, C=0.1μF, R=3.5kΩ

$$V_{S\ rms} = \frac{4}{2\times\sqrt{2}}$$

$$= 1.414V$$

$$X_L = 2\pi fL$$

$$= 2\pi\times1000\times100\times10^{-3}$$

$$= 628.319\Omega$$

$$Z_{total} = \sqrt{(R^2 + X_L^2)}$$

$$= \sqrt{(3500^2 + 628.319^2)}$$

$$= 3555.950\Omega$$

$$V_{L\ rms} = Vs_{rms} \times \frac{XL}{Z}$$

$$= 1.414 \times \frac{628.319}{3555.950}$$

$$=0.249V$$

$$V_{R\ rms} = Vs_{rms} \times \frac{R}{Z}$$

$$= 1.414 \times \frac{3500}{3555.950}$$

$= 1.361V$

$$Is_{\ rms} = \frac{VR\ rms}{R}$$

$$= 0.397mA$$

$$\emptyset_{(degree)} = \tan^{-1}(0.249/1.391)$$

$$= 10.148^{0}$$

For series resonance,

Vpp = 2V

Supply Frequency = 1kHz

$$f_0 = \frac{1}{2\Pi\sqrt{L\times C}}$$

$$= \frac{1}{2\Pi\sqrt{100\times10^{-3}\times0.1\times10^{-6}}}$$

$$= 5032.921Hz$$

3 Tabulation

Table 3.1 : Series RC circuit

Parameter	200Hz		1kHz	
	Theoretical Value	**Experimental Value**	**Theoretical Value**	**Experimental Value**
V_S rms (V)	1.414	1.47	1.414	1.4
V_C rms (V)	1.320	1.27	0.585	0.576
V_R rms (V)	0.578	0.569	1.287	1.25
I_S rms (mA)	0.165	-0.11	0.368	0.27
∅ (Degrees)	-66.355	-63	-24.443	-24.1
Xc	7957.75	7963.2	1591.55	1591.97
Z_{Total}	8555.03	8692.4	3844.87	3845.1

Table 3.2 : Series RL circuit

Parameter	1kHz		5kHz	
	Theoretical Value	**Experimental Value**	**Theoretical Value**	**Experimental Value**
V_S rms (V)	1.414	1.41	1.414	1.4
V_L rms (V)	0.249	0.243	0.945	0.923
V_R rms (V)	1.391	1.30	1.052	1.01
I_S rms (mA)	0.397	0.397	0.301	0.31
∅ (Degrees)	10.148	10.1	41.933	40.1
X_L	628.319	627.35	3141.593	3150
Z_{Total}	3555.95	3554.95	4703.149	4903.15

Table 3.3 : Series Resonance

	Theoretical Value	**Experimental Value**
Resonance Frequency f_o (Hz)	5032.921	4500

4 Discussion

Q1.

The oscilloscope is a measurement device that can be used to determine a wave's characteristics. Two channels of the oscilloscope are used to measure the values of two waves.

The output of the sine wave generator was first connected to oscilloscope channel 1 in order to measure the voltage sine wave.

The T-connector at the circuit's input is where we attached the oscilloscope's second channel.

The oscilloscope and any additional equipment that was connected to it were then turned on.

Following that, we modified the input waves' frequency and peak-to-peak values. Setting the sweep trigger of the oscilloscope to channel one will stabilize the sine wave if the wave is changing rapidly.

The sine wave of channel 1's peak value was then determined. From there, descend to the oscilloscope's display center, where there are horizontal time division markers.

The channel 2 sine wave's time division mark was then discovered using the same technique. The time division marks between channel 1 and channel 2 were then counted. The phase difference between those two numbers represents two sine waves.

Q2.

Considering the Figure 1.1 : Series RC Circuit

If we increase the value of frequency of the supply voltage, then the value of X_C will decrease. Because,

$$X_C = \frac{1}{2 \times \Pi \times f \times C}$$

Also, according to the equation $Z_{Total} = \sqrt{(R^2 + Xc^2)}$ equation,

Total impedance also decreasing,

According to the Ohm's Law,

$$V = I \times Z$$

$$I \ \alpha \ \frac{1}{Z}$$

As the total impedence decreases, the current increases

Q3.

Considering the Figure1.2 : Series RL Circuit

If we decrease the of frequency of the supply voltage, then the X_L will decrease. Because,

$$X_L = 2\pi f L$$

Also, according to the equation $Z_{Total} = \sqrt{(R^2 + X_L^2)}$ equation,

Total impedance also decreasing,

According to the Ohm's Law,

$$V = I \times Z$$

$$I \ \alpha \ \frac{1}{Z}$$

As the total impedence decreases, the current increases

Q4.

Considering Figure1.3: Series Resonance Circuit

If the values of X_L and X_C are equal to each other can be show the resonance frequency,

According to Figure1.3: Series Resonance Circuit the total impedance is:

$$Z_{total} = \sqrt{(R^2 + (X_L - X_C)^2)}$$

When the supply frequency is lower than the resonance frequency:

$$X_C = \frac{1}{2\pi \times f \times C}$$

$$X_C \ \alpha \ \frac{1}{f}$$

If the frequency is low ($f<f_0$) the equation states that the circuit is very capacitive.

According to this,circuit becomes a capacitive circuit when the frequency is lower than resonance frequency.

When the supply frequency is higher than the resonance frequency,

$$X_L = 2\Pi \times f \times L$$

$$X_L \ \alpha \ f$$

When the frequency is high ($f>f_0$), the equation states that the circuit is very inductive.

According to this, circuit becomes an inductive circuit when the frequency is higher than the resonance frequency.

5 References

[1] https://learn.sparkfun.com/tutorials/how-to-use-an-oscilloscope/all

6 Appendix