American International University- Bangladesh (AIUB)
Faculty of Engineering (EEE)

Course Name:	Introduction to Electrical	**Course Code:**	COE 2102
Semester:	Fall 2023-24	**Sec:L**	All
Faculty:	Md. Shahariar Parvez		

Task:	Perform Open End Lab following given instructions.
Experiment title:	Construct an R-L-C circuit with a series parallel combination and apply KCL and KVL in AC and analyze behavior of it.

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Group Members	**ID**	**Name**
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3.	22-47975-2	Mohammad Ansar Uddin
4.	22-48056-2	Chinmoy Guha
5.	22-48067-2	Suvra Chakraborty

CO4: Implement electrical circuit (including DC, AC source, load and measuring equipment) in a group from the given schematics circuits and adapt with electrical measuring devices considering standards for professional engineering. (P.e.2.P4), K6-P1,P4,P5

	Objectives	**Unsatisfactory (0-1)**	**Good (2-3)**	**Excellent (4-5)**	**Marks**
Performance (10)	**Setup of experiment, Take proper measurements**	Cannot setup experiment without support Cannot take measurements	Can setup some of the portions of experiment without support Can take measurements but inaccurately	Can setup the whole experiment without support Can take organized and accurate measurements	
	Identify experiment goals, Summarize findings and compare actual to expected results	Cannot identify goals Cannot summarize or compare findings to expected results	Can identify some goals but unable to draw adequate hypothesis Summarize finding in an incomplete way	Can identify necessary and sufficient goals Summarize finding in a complete way	
Report (10)	**Observation 1**	Cannot answer any question related to the experimental setup	Can answer some of the questions	Can answer most or all the questions	
	Observation 2	Unexpected experimental outcome between calculated data and experimented data	Somewhat unexpected experiment outcome	Accurate data collected from the hardware	
	Comments	Assessed by (Name, Sign, and Date)	Total (out of 10):		

Marking Rubrics (to be filled by Faculty)

AMERICAN INTERNATIONAL UNIVERSITY- BANGLADESH (AIUB)

Introduction to Electrical Circuit

FALL 2023-2024

Section: L, Group: 07

LAB REPORT ON

Construct an R-L-C circuit with a series parallel combination and apply KCL and KVL in AC and analyze the behavior of the circuit through data obtained during Laboratory work

Supervised By

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Abstract:

The purpose of the experiment was to construct an RLC circuit in a series parallel combination using laboratory knowledge previously gained and verify KCL and KVL in them. The circuit designed had at least two branches that are in parallel. Each inductor and capacitor had at least one resistor in series with it and there were 4 resistors in total.

Circuit diagram:

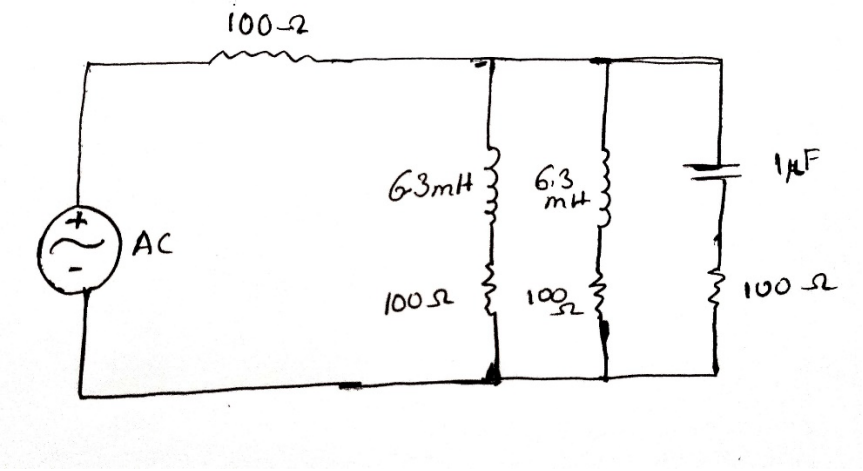

Figure 1: Series-Parallel combination circuit.

Apparatus:

a) Oscilloscope, b) Function generator c) Resistor: 100 ohm - 4 pcs d) 2 Inductors: 6.3 mH e) Capacitor: 1 microF f) Connecting wire, g) Bread board f) PC

Experimental Procedure:

KCL:

The circuit shown in Figure 1 was successfully constructed, with channel 1 of the oscilloscope connected across the function generator and channel 2 across RL. We set the amplitude of the input signal to 5V peak, adjusted the frequency to 1 kHz, and selected a sinusoidal wave shape. The values of VRL and IL were measured, and the phase relationship (θL) between E and VRL was determined. Same was done for the 2^{nd} inductor. Then, channel 2 of the oscilloscope was then connected across RC, and measurements for VRC and IC were taken. The phase relationship (θC) between E and VRC was determined. Phasors IL and IC were added, and subsequently, channel 2 of the oscilloscope was connected across R to measure VR and IR. The phase relationship (θ) between E and VR was determined. The theoretical sum of IL and IC was compared with the practically obtained value of IR.

KVL:

Channel 1 of the oscilloscope was connected across the AC voltage source, and channel 2 was linked across R.

The amplitude of the input signal was set to 5V peak.

The frequency of the signal generator was adjusted to 1 kHz, and a sinusoidal wave shape was selected.

The phase relationship (θ) between the waves was determined.

The value of current (I) was measured.

Measurements were taken for the values of VR, VRL1, VRL2 and VRC.

Kirchhoff's Voltage Law (KVL) was verified using the experimental data

Result analysis :

Data Table:

f	V_{RL1}	V_{RL2}	$I_{L1\&2}$	V_{RC}	Ic	$I_{L1}+I_{L2}+Ic$	V_R	I_S	V_{RMS}
1K Hz	$1.18 \angle 4.43^0$	$1.18 \angle 4.43^0$	$0.011\angle -17.17^0$	$1.14\angle 4.43^0$	$0.0006044\angle 62.33^0$	$0.024\angle -2.98^0$	3.432V	$0.023\angle -2.2^0$	3.535V

Simulation:

TABLE:

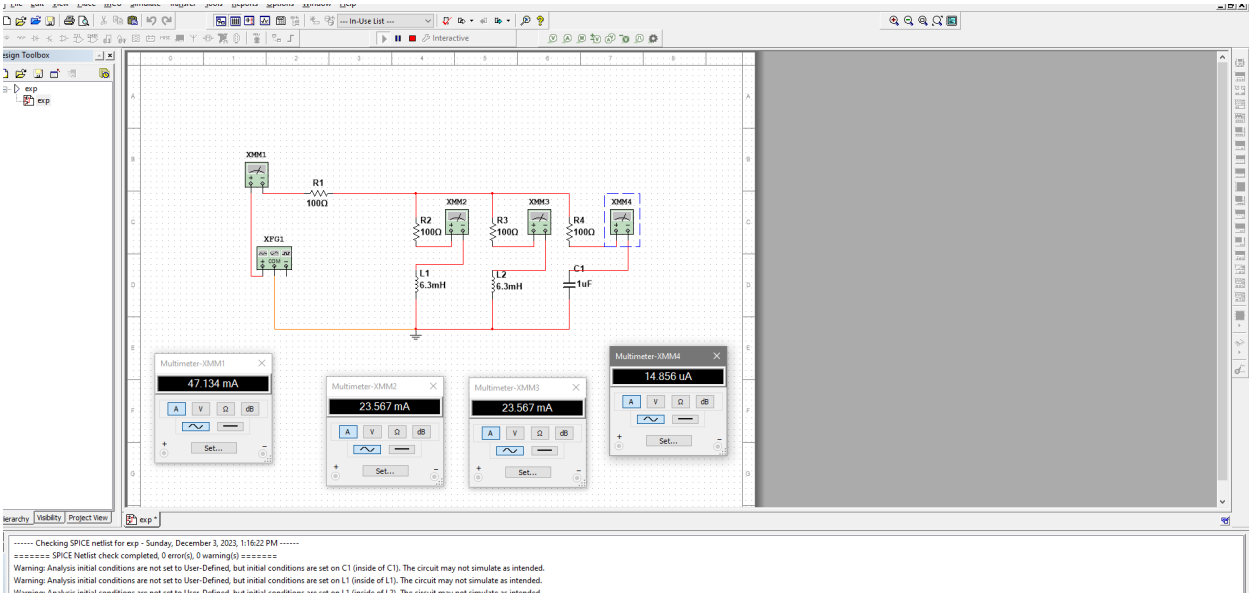

Figure: KCL

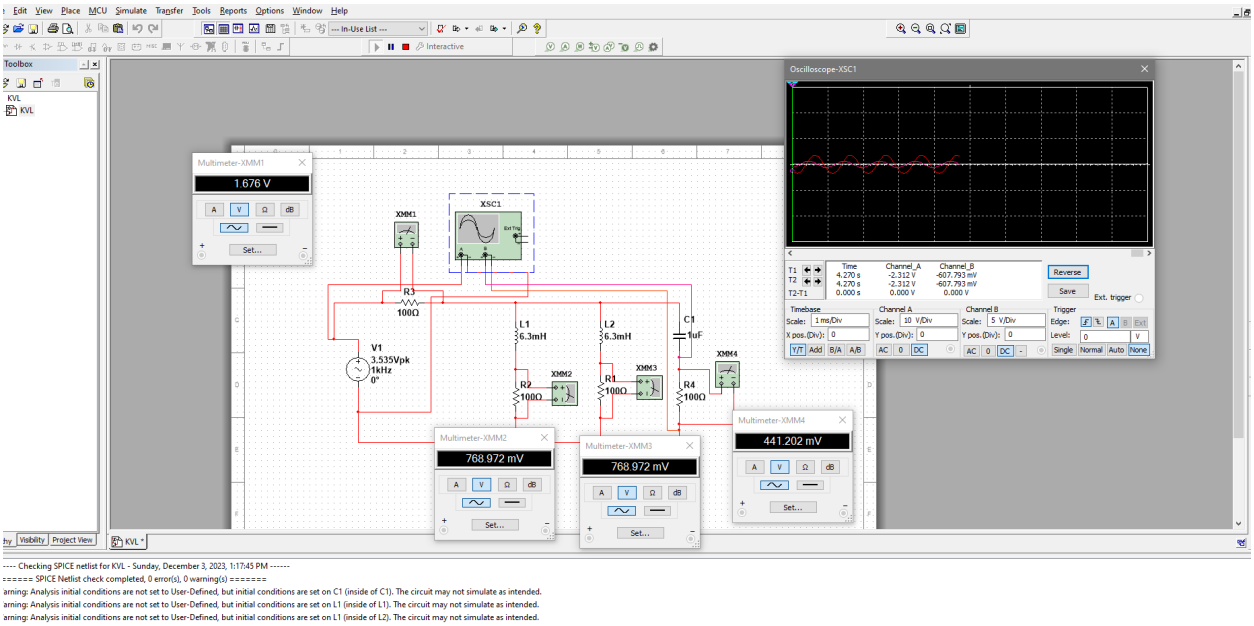

Figure: KVL

Calculation:

Frequency = 1kHz

$X_{L_1} = 2\pi f L_1 = 39.6\,\Omega$

$X_{L_2} = 2\pi f L_2 = 39.6\,\Omega$

$Z_{RL_1} = R_{L_1} + jX_{L_1} = 100 + 39.6j\,\Omega = 107.6 \angle 21.6°$

$Z_{RL_2} = R_{L_2} + jX_{L_2} = 100 + 39.6j\,\Omega = 107.6 \angle 21.6°$

$X_C = \frac{1}{2\pi f C} = 159.2\,\Omega$

$Z_R = R = 100\,\Omega$

$Z_{RC} = R_C - jX_C = 100 - 159.2j\,\Omega = 188 \angle -57.9°$

$Z_{RL_1} \parallel Z_{RL_2} \parallel Z_{RC} = \left(\frac{1}{107.6\angle 21.6°} + \frac{1}{107.6\angle 21.6°} + \frac{1}{188\angle -57.9°}\right)^{-1}$

$= 49.1 + 5.70j\,\Omega$

$Z_T = 100\Omega + 49.1 + 5.70j\,\Omega = 149.1 + 5.70j\,\Omega$

$= 149.2 \angle 2.2°$

So $I_S = \frac{E}{Z_T} = \frac{3.575}{149.1 + 5.70j} = 0.023 \angle -2.2°$

$I_{L_1} = \frac{Z_T}{Z_{L_1}} \times I_S = \frac{149.2\angle 2.2}{107.6\angle 21.6} \times 0.023\angle -2.2°$

$= 0.011 \angle -17.17°$

$I_{L_2} = 0.011 \angle -17.17°$

$I_C = \frac{49.4\angle 6.63°}{188\angle -57.9°} \times 0.023\angle -2.2°$

$= 6.044 \times 10^{-3} \angle 62.33°$

$I_{L_1} + I_{L_2} + I_C = 0.024 \angle -2.98°$

$\therefore$ KCL verified

$V_{RL_1} = I_{L_1} \times Z_{RL_1} = 0.011\angle -17.17° \times 107.6\angle 21.6$

$= 1.18 \angle 4.43°\ V$

$V_{RL_2} = I_{L_2} \times Z_{RL_2} = 1.18\angle 4.43°\ V$

$V_{RC} = I_C \times Z_{RC} = (6.044 \times 10^{-3}\angle 62.33°) \times (188\angle -57.9°)$

$= 1.14 \angle 4.43°\ V$

$V_R = I_S \times Z_R$

$= (0.023\angle -2.2°)(149.2\angle 2.20°)$

$= 3.432\ V$

Discussion

If we apply KCL,

$I = IL1 + IL2 + IC$

This condition must be true. But there might be some mismatch of the measured value with the theoretical value because we are taking the value as fraction. If we take all the values from the fractional part, results must be equal. When we are taking the values from the waveforms, approximate data are taken so there might be some error too.

In this experiment, we got a value which was very close to our expected value.

For KVL, the source voltage must be equal to the voltage drops across all the nodes which is also approximately similar in our experiment. Therefore

Conclusion:

By completing this experiment we successfully measured RLC series-parallel circuits and we verified KCL and KVL in it.