LCR-Circuits

Object: To determine the impedance of LCR circuit.

Apparatus Used: resistance, inductor coil, capacitor, connecting wires, a.c. voltmeter, mili-ammeter, low voltage a.c. source.

Formula Used: The following formula is used for the determination of impedance of LCR circuit.

$$Z = \sqrt{R^2 + (X_L \sim X_C)^2}$$

Where, Z : impedance of LCR circuit, R : resistance

X_L : Inductive reactance, X_C : Capacitive reactance

$$R = \frac{dV_R}{dI_R}, \qquad X_L = \frac{dV_R}{dI_L} \qquad \textbf{and} \qquad X_C = \frac{dV_C}{dI_C}$$

V_R, V_L and V_C are the voltage across R, L and C respectively.

I_R, I_L and I_C are the currents through R, L and C respectively.

Circuit Diagram:

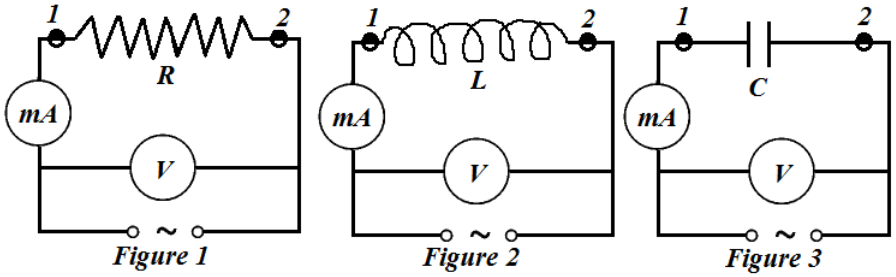

Figure 1

Figure 2

Figure 3

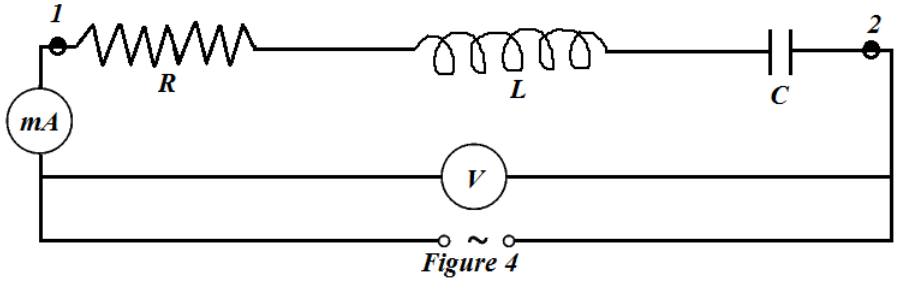

Figure 4

Procedure:

1. Note: In the given apparatus the ac. source, voltmeter and mili-ammeter are internally connected. The two points 1 and 2 are given for rest connections. So connect resistor or inductor or capacitor or series of all with points 1 and 2 to complete the circuit.
2. Initially make the circuit as shown in Figure 1. Now vary the voltage across R with help of given knob in apparatus, and note the corresponding current. This will provide you the values of V_R and I_R. Plot the graph in V_R and I_R. the slope of this graph will give the value of R.
3. Now make the circuit as shown in Figure 2. Now vary the voltage across L with help of given knob in apparatus, and note the corresponding current. This will provide you the values of V_L and I_L. Plot the graph in V_L and I_L. The slope of this graph will give the value of X_L.

4. Similarly, make the circuit as shown in Figure 3. Now vary the voltage across C with help of given knob in apparatus, and note the corresponding current. This will provide you the values of V_C and I_C. Plot the graph in V_C and I_C. The slope of this graph will give the value of X_C.
5. After it, make the circuit as shown in Figure 4. Now vary the voltage across combination of R, L and C with help of given knob in apparatus, and note the corresponding current. This will provide you the values of V and I. Plot the graph in V and I. The slope of this graph will give the value of *Z*.
6. Further more calculate the value of z with the help of R, X_L and X_C. This value should be equal or approximately equal to the value of z obtained with graph.

Observation:

1. Least count of voltmeter= …….. volts
2. Least count of mili-ammeter= …….. mA
3. Table for value of voltage and current

Sr.No.	**R-Circuit**		**L-Circuit**		**C-Circuit**		**LCR-Circuit**	
	V_R (volt)	I_R (mA)	V_L (volt)	I_L (mA)	V_C (volt)	I_C (mA)	V (volt)	I (mA)
1.								
2.								
3.								
4.								
5.								
6.								

Calculation:

(1) Show the evaluation of R, X_L, X_C and Z with graph.

(2) Show the calculation of Z with the evaluated values of R, X_L, and X_C.

Result:

1. R= …… Ω
2. X_L= …… Ω
3. X_C= …… Ω
4. Z_{graph}= …… Ω
5. $Z_{calculated}$=…… Ω

Precaution:

1. Connections should be tight.
2. Variation in voltage should be in slow manner.
3. Reading of voltage and current should be started with zero.