PHYSICS PRACTICAL SHEETS

Date: 2078/06/11 ... Prime CAMPUS
Class: BSc.CSIT
Roll No.:
Shift: Morning
Object of the Experiment (Block Letter)

Experiment No.: 3
Group:
Sub.:
Set:

VARIETY PRODUCT

TO DESIGN AND STUDY THE SERIES LCR FINDING THE QUALITY FACTOR OF THE ELEMENTS.

APPARATUS REQUIRED:

i) An inductor
ii) Resistor connecting wire
iii) Voltmeter
iv) Ammeter
v) Capacitor
vi) An audio frequency oscillator (10Hz - 10KHz)
vii) One way key

THEORY:

When the resistor (R), inductor (L) & capacitor (C) are connected in series with a source of emf 'E', the circuit is called series resonance circuit as shown in fig (i).

Under certain conditions, the voltage and current are (connected) in phase even though the circuit consist of L, C & R, and the circuit behave as a pure resistor. This phenomenon is called resonance. This occurs at single frequency known as resonant frequency (f_r). At this frequency, the capacitive reactance ($X_C = \frac{1}{\omega C}$) and inductive reactance ($X_L = \omega L$) are equal and opposite, i.e. $\frac{1}{\omega C} = \omega L \Rightarrow \omega^2 = \frac{1}{LC}$

or, $\omega = \frac{1}{\sqrt{LC}} \Rightarrow 2\pi f_r = \frac{1}{\sqrt{LC}} \Rightarrow \boxed{f_r = \frac{1}{2\pi\sqrt{LC}}}$ — (i)

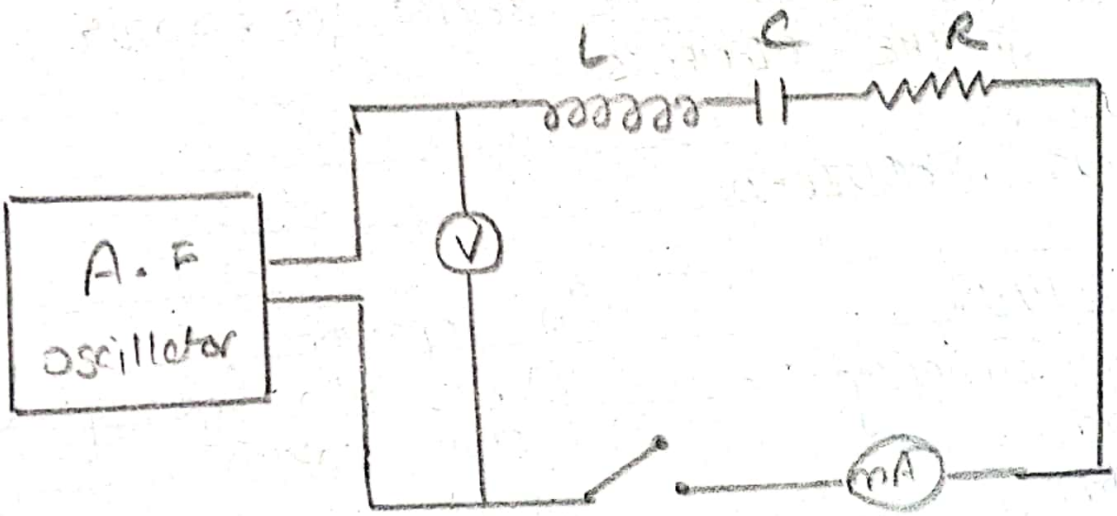

fig (i) Series LCR circuit

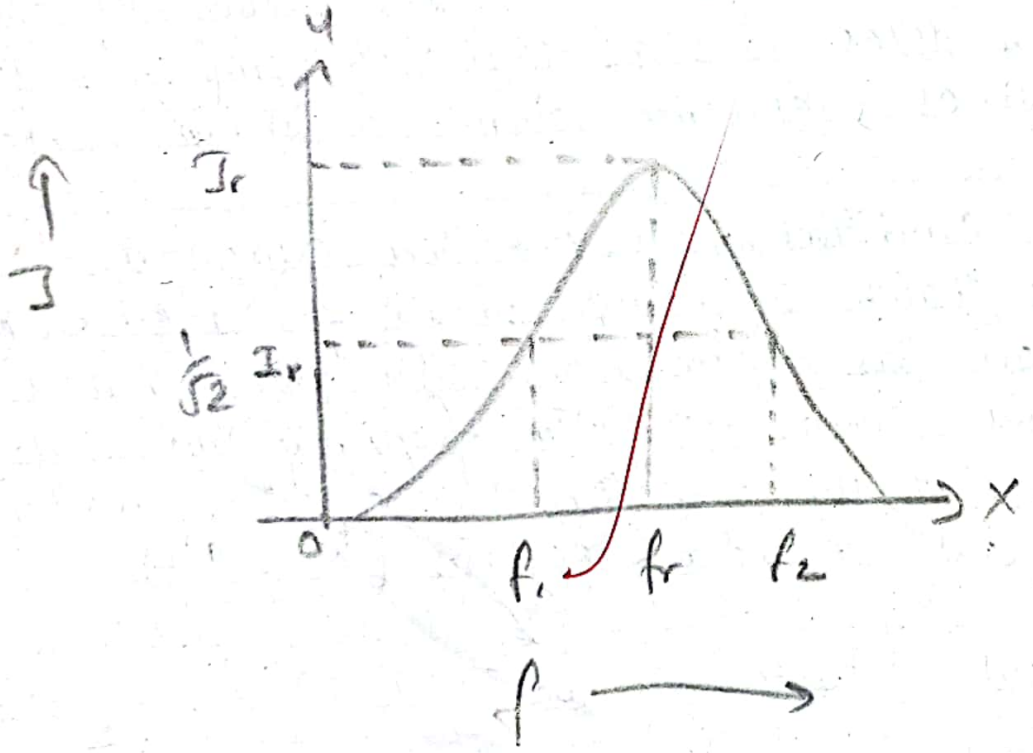

fig (ii) graph of 'I' vs 'f'

The Quality factor of series LCR circuit is given by:

$$Q = \frac{2\pi f_r}{f_2 - f_1} \quad \text{— (ii)}$$

where f_2 & f_1 are the values of frequency above & below the resonant frequency for which the current in the circuit is $\frac{I_r}{\sqrt{2}} = 0.707 I_r$, where '$I_r$' is current at resonance which is obtained by plotting a graph of current (I) vs frequency (f) as shown in fig. (ii).

OBSERVATION:

Inductance (L) = 1.1 mH

Resistance (R) = 100 Ω, 220 Ω & 470 Ω

Capacitance (C) = 0.22 μF

LC of voltmeter = 0.2 V L.C of ammeter = 0.2 A

Observation Table for measurement of current

SN	frequency (f) in KHz	Current in mA		
		$R_1 = 100\ \Omega$	$R_2 = 220\ \Omega$	$R_3 = 470\ \Omega$
1	1	1.8	1.8	1.2
2	2	3.8	2.8	1.4
3	3	5.2	3.2	1.4
4	4	4.4	2.6	1.6
5	5	3.6	2.4	1.4
6	6	3.2	2.2	1.4

7	7	2.8	2	1.2
8	8	2.4	1.8	1.2
9	9	2.2	1.6	1.2
10	10	2	1.6	1

CALCULATION:

From the graph, we can see that,
Resonant frequency (f_r) = 3kHz
f_1 = 1.9 kHz
f_2 = 5kHz

Now,

Quality factor (Q) = $\frac{2\pi f_r}{f_2 - f_1}$

$= \frac{2 \times 3.14 \times 3}{5 - 1.9}$

$= 6.077$

RESULT:

The quality factor of the element of LCR circuit is found to be 6.077.

CONCLUSION:

By the help of graph, the quality factor of the elements of LCR circuit can be found which is 6.077.

PRECAUTIONS:

i) The wires should be connected in correct places.
ii) The apparatus should be handled properly
iii) The measurements must be taken properly.