Additional experiments No :(5)

Aim: Investigate how the reactance of an inductor varies with frequency and determine inductance of the inductor.

1- Investigate how the reactance of an inductor varies with frequency, Replace the mains transformer by a signal generator and select a low frequency f, say $500Hz$. Adjust the output voltage of the signal generator until conveniently high readings I and V are shown on the ammeter and voltmeter scales.

2- Increase the frequency and again adjust the output voltage until the fullest use has been made of the scales on the various instruments.

Tabulate the results:

f/Hz	I/A	V/V	X_L/Ω from $X_L = \frac{V}{I}$

Plot a graph with values of X_L/Ω as ordinates (Yaxis) against the corresponding values f/Hz as abscissae (X axis)

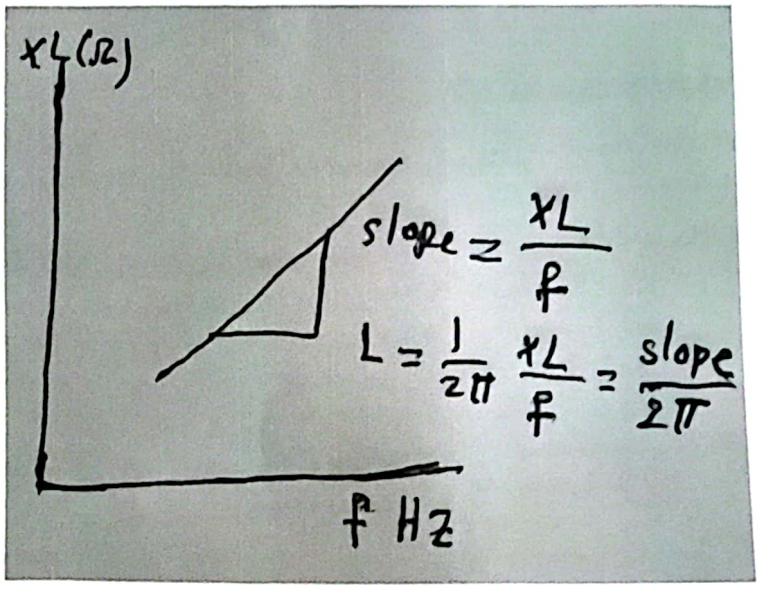
By using the equation $X_L = 2\pi fL$ (1) hence

inductance of the coil, usually called the inductance, the value of L can be found from $L = \frac{X_L}{2\pi f}$ (2)

from the Plot a graph with values of X_L/Ω a (Y axis) against the values f/Hz (X axis),m we can determine the value of reactance of inductor. As following

$slope = \frac{\Delta X_L}{\Delta F}$ **, bysustitude the value of slope from equation (2) we get** $L = \frac{X_L}{2\pi f} = \frac{1}{2\pi}\frac{\Delta X_L}{\Delta F} = \frac{1}{2\pi} \times slope$

$$L = \frac{1}{2\pi} \times slope = \frac{slope}{2\pi} \qquad L = \frac{slope}{2\pi}$$



Experiments (6) SERIES AND RESONANCEFERQUENCY

AIM :

To determine resonant frequency, band width and Q-factor for series and parallel RLC

circuits

APPARATUS :

NAME	RANGE	QUANTITY
1. Resistor	$1K\Omega$	1 No.
2. Inductor	45mH	1 No
3. Capacitor	$0.01\mu FF$	1 No
4. Milli Ammeter	0-20mA (AC)	1 No
5. Function generator		

THEORY :

An AC circuit is said to be in Resonance when the applied voltage and current are in phase.

Resonance circuits are formed by the combination of reactive elements connected in either series or parallel.

Resonance frequency in series circuit is given by

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

The impedance of the RLC circuit is

$$Z = R : j\left(\omega L - \frac{1}{\omega C}\right) = R + jX$$

The circuit is in resonance when X = 0 ie., when $\omega L = \frac{1}{\omega C}$

In series RLC circuit the current lags behind or leads the applied voltage depending upon the value of X_L and X_c. When X_L is greater than Xc the circuit is inductive and when Xc is greater than X_L, the circuit is capacitive. Quality factor (Q-factor) or (Selectivity) :

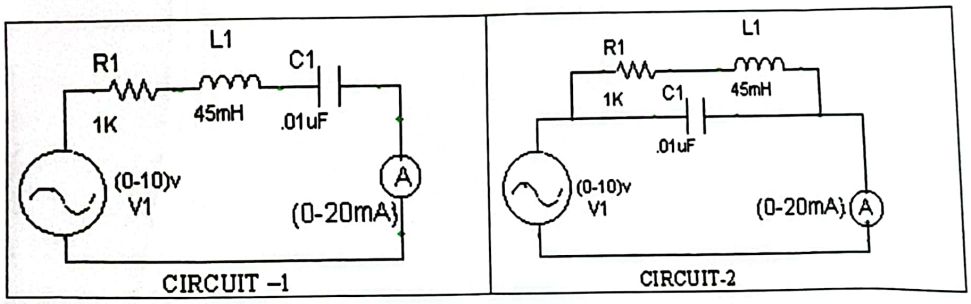
Quality factor can be defined as , = 2π (maximum energy stored (energy dissipated per cycle). $Q = \frac{f_2 - f_1}{f_r} =$

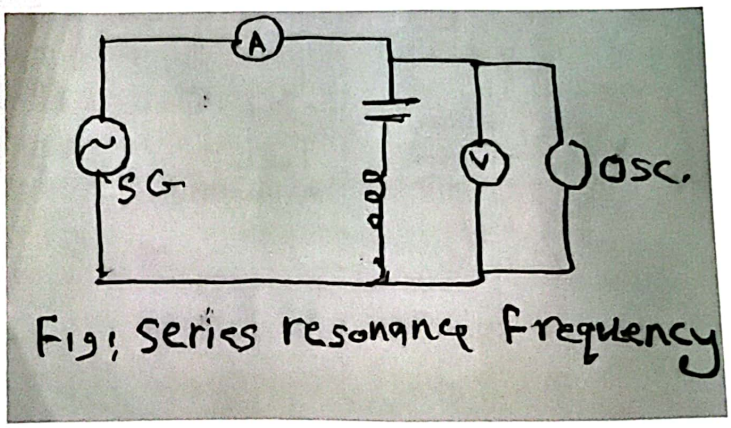
Band width: Band width of a resonance circuit is defined as the band of frequencies on

either sides of resonance frequency. This frequency range can be obtained by dropping a vertical in the graph at its half power value, i.e., $\frac{1}{2}$ times of maximum value.

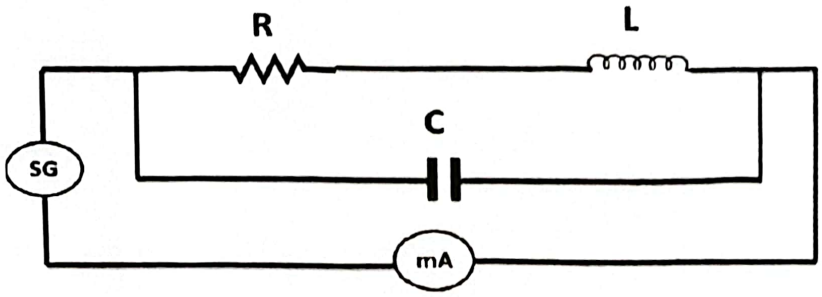
$$Band\ width = f_2 - f_1$$

CIRCUIT DIAGRAM





Fig; Series resonance Frequency



PROCEDURE :

1. Connect the circuit as shown in diagram(1).
2. Apply 20V (peak to peak) from the Function Generator.
3. Vary the input frequency in suitable steps (starting from 1K Hz to 10K Hz in step of 500 Hz).
4. Note down the readings of the millimeter for different values of frequency.
5. Calculate the Impedance Z.
6. Plot the graphs for current Vs frequency and Z Vs frequency.
7. Identify the values of f_0 , f_1 and f_2 from the graph, Calculate the Q-factor and Band width.
8. Compare with theoretical values.
9. Connect the circuit as per diagram(2).
10. Repeat steps (2) & (3).
11. Note down the readings of the voltmeter and milli ammeter for different frequencies.
12. Calculate the Impedance Z.
13. Plot the graphs for current Vs frequency and Z Vs frequency
14. Also plot the graph of Voltage Vs Frequency.
15. Identify the values of f_0 , f_1 and f_2 from the graph, Calculate the Q-factor and Band width.

Quality factor $Q = \frac{f_2 - f_1}{f_r}$

$$Band\ width = f_2 - f_1$$

Table of experiment

f/Hz														
v/volt														
f/Hz														
mA														

Series	Parallel
$f_0 = \frac{1}{(2\pi\sqrt{LC})}$	$f_0 = \frac{1}{2\pi}\sqrt{\frac{1}{LC} - \frac{R^2}{L^2}}$
$f_1 = f_0 - (R/4\pi L)$	$f_1 = f_0 - (R/4\pi L)$
$f_2 = f_0 + (R/4\pi L)$	$f_2 = f_0 + (R/4\pi L)$
Band width $= f_2 - f_1$	Band width $= f_2 - f_1$
Q-factor =	Q-factor =