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2K20/A6/56

Experiment 5

Aim:

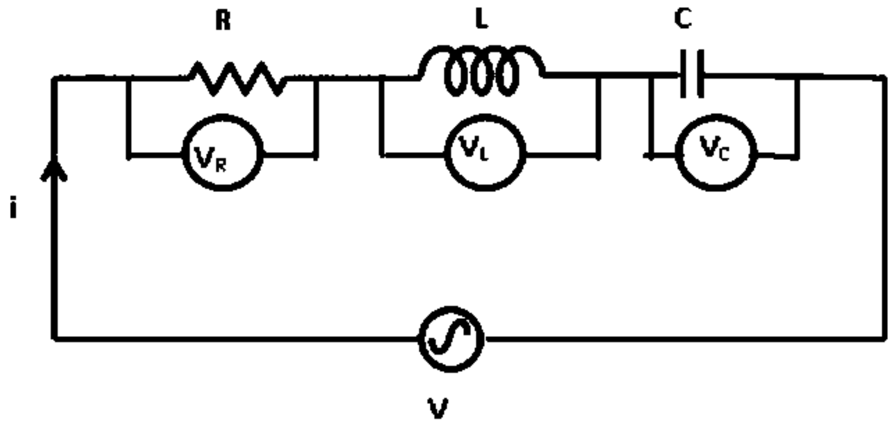
To study the behaviour of a series R-L-C circuit.

Theory:

$$Z = R + j\left(\omega L - \frac{1}{\omega C}\right) = \sqrt{(R)^2 + \left(\omega L - \frac{1}{\omega C}\right)^2} \underline{/} tan^{-1}\frac{\left(\omega L - \frac{1}{\omega C}\right)}{R}$$

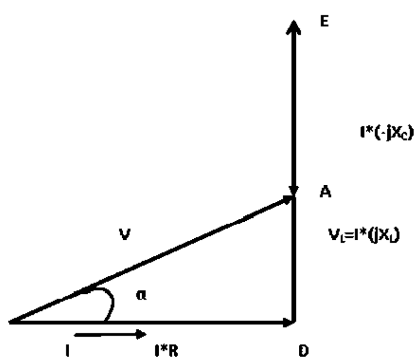
This is the complex impedance (Z) which indicates that the circuit will become inductive if ωL > 1/ωC and then the sign of the angle of Z is positive.
On the other hand, for ωL < 1/ωC, the circuit will become capacitive and the sign of the angle of Z is negative.

Circuit diagram for given impedence,

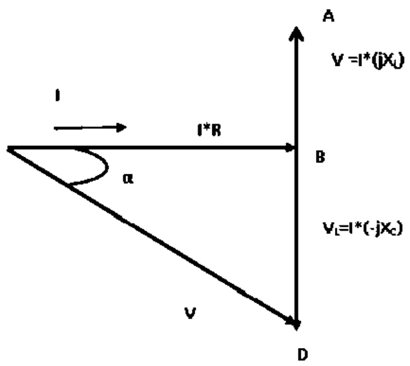


Phasor Diagram

The phasor diagram for Inductive and capacitive series R-L-C circuit



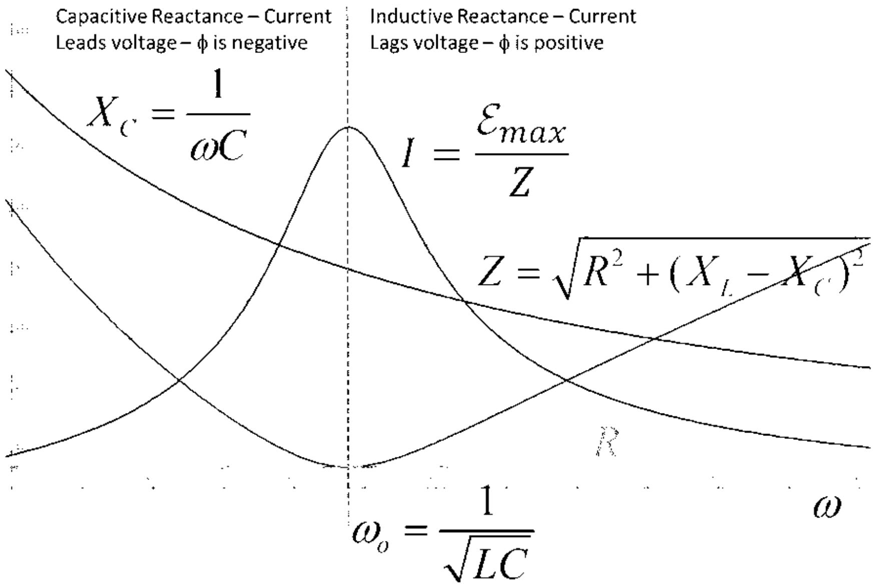
Phasor diagram for inductive circuit



Phasor diagram for capacitive circuit

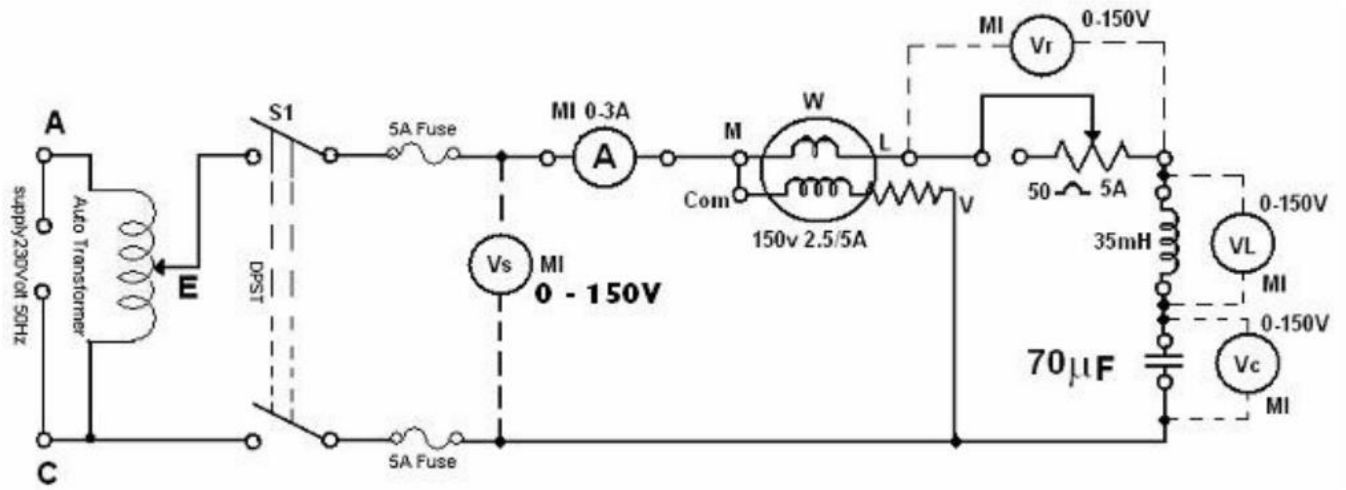
Resonance

When $V_L = V_C$, the circuit is said to be in resonance.



At resonance $X_L = X_C$, $Z = R$, $\phi = 0$, I and P peak.

Procedure:



1. Connect the circuit as shown in the diagram.

2. Adjust the rheostat for maximum resistance and the auto transformer to the position of zero-output voltage and switch on the supply.

3. Adjust the voltage across the circuit and note I, V_S, V_L, V_C, V_R *and* W.

4. Adjust the rheostat for several settings.

5. Adjust the rheostat to the maximum setting and change the capacitance.

6. Compare the values of phase angle as obtained from the meter readings and from the phasor diagrams. (From the phasor diagrams compute θ).

Observations:

Serial no. of Observation	Power Supply Vs (in Volt)	Current I (in Amp)	Power (in Watt)	VR (in Volt)	VL (in Volt)	VC (in Volt)	Theta (in degree)	Power factor (in degree)
1	110	0.89809948	40.3291343	44.9049743	3.38511658	102.117101	-63.813940	63.8139407
2	110	1.69407090	143.493811	84.7035451	15.9632301	77.0487516	-33.719387	33.7193877
3	110	2.03703690	207.475967	101.851845	42.1906072	42.1507427	0.02075586	0.02075586
4	110	2.03236248	206.524864	101.618124	45.9622841	38.5144723	3.88075525	3.88075525
5	110	1.97954669	195.930255	98.9773346	55.9598054	30.0108654	13.6391587	13.6391587

Below resonating frequency (Capacitive circuit):

Current, Power and Voltage across resistance tends to increase

Voltage across Capacitor > Voltage across Inductor

Theta (phase angle) is negative

Power factor (in degrees) tends to decrease

At resonating frequency (Resistive circuit):

Current, Power and Voltage across resistance are at peak

Voltage across Capacitor = Voltage across Inductor

Theta (phase angle) is zero

Power factor (in degrees) is zero

Above resonating frequency (Inductive circuit):

Current, Power and Voltage across resistance tends to decrease

Voltage across Capacitor < Voltage across Inductor

Theta (phase angle) is positive

Power factor tends to increase

Results:

We have successfully studied the behaviour of RLC circuit below resonating frequency, at resonating frequency and above resonating frequency.