Experiment: 17

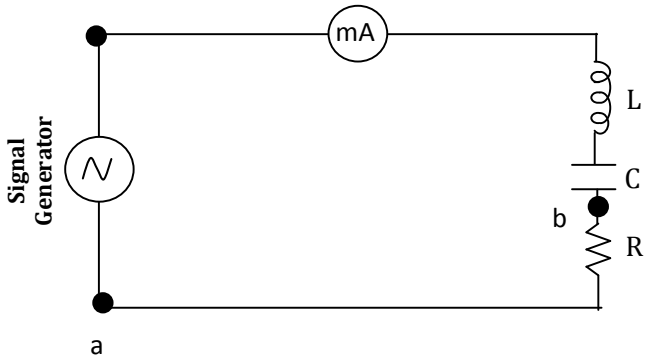
PHASE SHIFT IN LCR CIRCUITS

AIM: To study the phase shift between voltage and current in a given series LCR circuit using a CRO and to draw a phasor diagram.

APPARATUS:

Capacitors (0.01 μ*F*), Resistors (330Ω, 1KΩ), Signal Generator, Bread board, CRO with probe

CIRCUIT DIAGRAM:



FORMULA:

The phase shift $\Phi = \frac{\Delta T}{T} \times 360^{o}$ in degree

Where ΔT is the time phase shift between the current (actually the voltage across the resistor) and the voltage across the function generator and T is the period of the sine wave generated ($1/f$).

WAVEFORM:

TABULAR COLUMN:

Frequency (Hz) **f**	**ΔT (s)** Δt x Time Constant	$\Phi = \Delta \mathbf{T} \times \mathbf{f} \times 360^{o}$ (degree)
3000		
8000		

PHASOR DIAGRAM for series LCR circuit:

f=……..Hz C= 0.01μF R=330Ω L=0.1H

V_L (V)	V_C (V)	V_R (V)	$X_L=2\pi fL$ (Ω)	$X_C=1/(2\pi fC)$ (Ω)	$\theta = \tan^{-1}\left(\frac{X_L - X_C}{R}\right)$ (deg)

Procedure:

1. Measure the voltages across inductor (V_L), capacitor (V_C) and resistor (V_R) using AC voltmeter.
2. Since the current flowing through the circuit is common to all three circuit elements, mark this as the reference vector.
3. Draw the three voltage vectors relative to this at their corresponding phase angles.
4. The resulting vector V_S is obtained by adding together two of the vectors, V_L and V_C and adding this sum to the remaining vector V_R.

5. The angle made by the resultant vector V_S with V_R gives the phase difference between voltage and current in series LCR circuit. As shown in the Fig 2, the resultant voltage leads the current by an angle θ.

6. If $X_L > X_C$, tanθ is positive, and applied voltage leads the current by phase angle θ.

If $X_L < X_C$, tanθ is negative and applied voltage lags behind the current by phase angle θ.

The phase angle θ can also be calculated from R, L and C values, using X_L and X_C as:

$$\tan\theta = \frac{X_L - X_C}{R}$$

$$\theta = \tan^{-1}\left(\frac{X_L - X_C}{R}\right)$$

where, Inductive reactance $X_L = 2\pi fL$ and Capacitive reactance $X_C = X_C = \frac{1}{2\pi fC}$.

Result: For a given series LCR circuit phase angle is measured using DSO,

i. For ……. Hz is …….. deg

ii. For…….. Hz is ……... deg

And from phasor diagram for For…….. Hz is ……... deg.