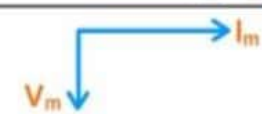
Part I

ALTERNATING CURRENT

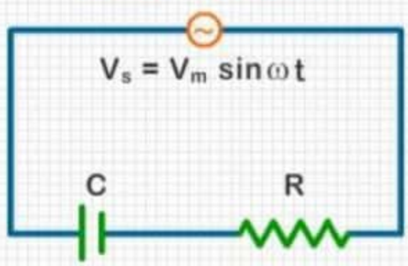
It is the movement of electrical charge through a medium that changes direction periodically

1 SUMMARY

AC SOURCE CONNECTED WITH	PHASE ϕ	PHASE DIFFERENCE	IMPEDANCE Z	PHASOR DIAGRAM
Pure Resistor	0	V_R is in same phase with i_R	R	
Pure Inductor	$\frac{\pi}{2}$	V_L leads i_L by 90^0	X_L	
Pure Capacitor	$-\frac{\pi}{2}$	V_C lags i_C by 90^0	X_C	

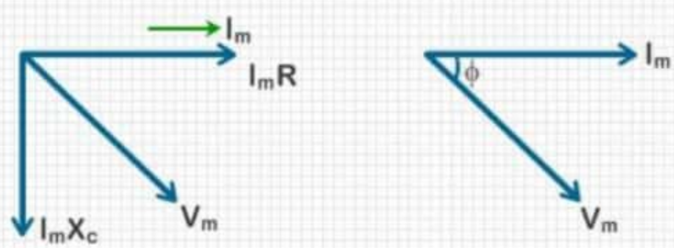
2 RC SERIES CIRCUIT WITH AN AC SOURCE

Circuit Diagram



$$I_m = -\frac{V_m}{\sqrt{R^2 + X_c^2}} \Rightarrow Z = \sqrt{R^2 + X_c^2}$$

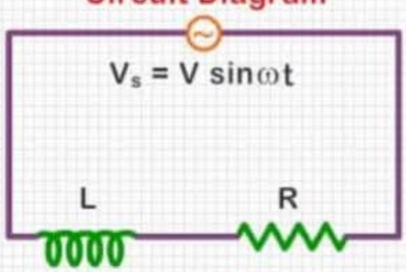
Phasor Diagram



$$\tan\phi = \frac{I_m X_c}{I_m R} = \frac{X_c}{R}$$

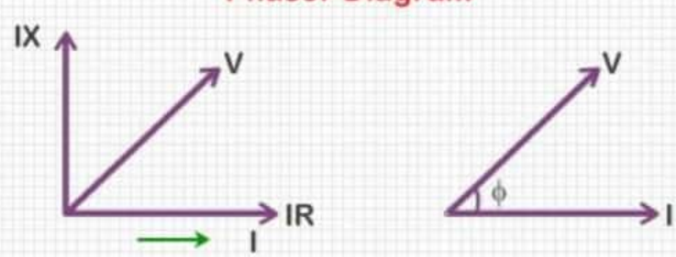
3 LR SERIES CIRCUIT WITH AN AC SOURCE

Circuit Diagram



$$V = I\sqrt{R^2 + X_L^2}$$

Phasor Diagram

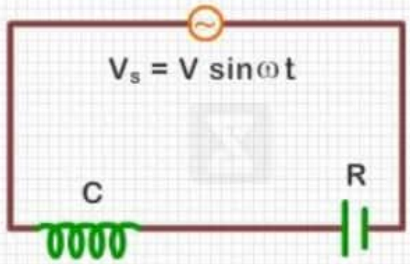


$$\tan\phi = \frac{IX_L}{IR} = \frac{X_L}{R}$$

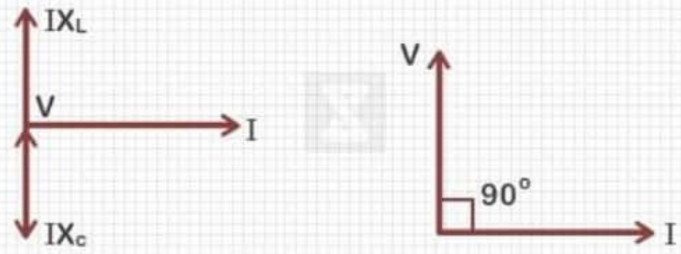
Part II

4 LC SERIES CIRCUIT WITH AN AC SOURCE

Circuit Diagram



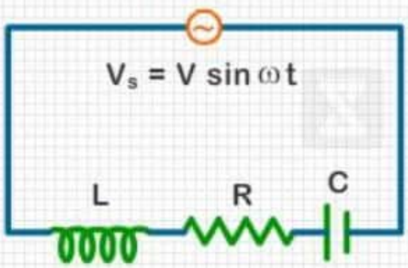
Phasor Diagram



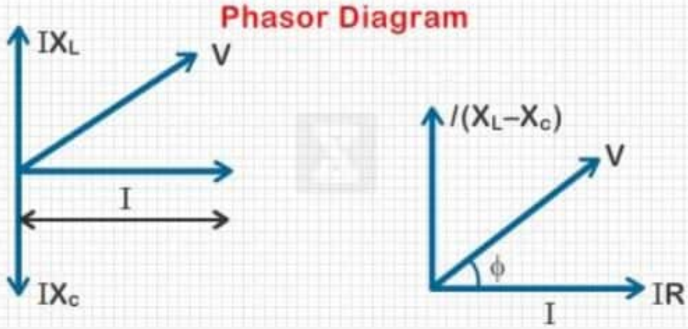
From the phasor diagram $V = I\left|(X_L - X_C)\right| = IZ$, $\varphi = 90°$

5 RLC SERIES CIRCUIT WITH AN AC SOURCE

Circuit Diagram



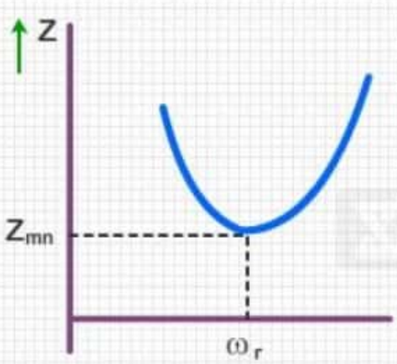
Phasor Diagram

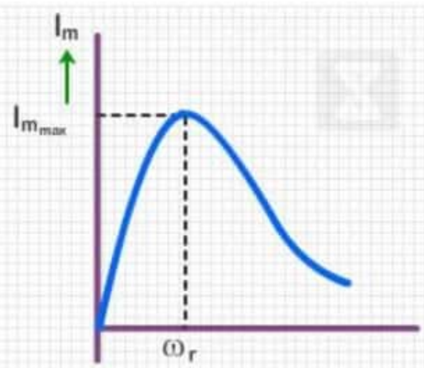


From the phasor diagram $V = \sqrt{(IR)^2 + (IX_L - IX_C)^2}$, $Z = \sqrt{R^2 + (X_L - X_C)^2}$

$$\tan\phi = \frac{I(X_L - X_C)}{IR} = \frac{(X_L - X_C)}{R}$$

6 RESONANCE





Amplitude of current (and therefore I_{rms} also) in an RLC series circuit is maximum for a given value of V_m and R, if the impedance of the circuit is minimum, which will be when $X_L - X_C = 0$. This condition is called resonance.

So at resonance: $X_L - X_C = 0 \Rightarrow \omega = \dfrac{1}{\sqrt{LC}}$