



# ALTERNATING CURRENT

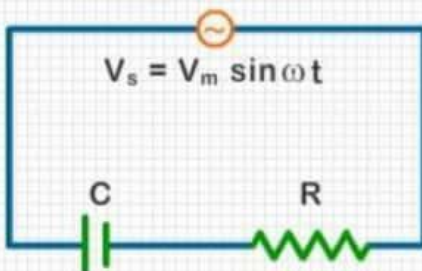
It is the movement of electrical charge through a medium that changes direction periodically

## 1 SUMMARY

AC SOURCE CONNECTED WITH	PHASE $\phi$	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 $90^\circ$	$X_L$	
Pure Capacitor	$-\frac{\pi}{2}$	$V_C$ lags $i_C$ by $90^\circ$	$X_C$	

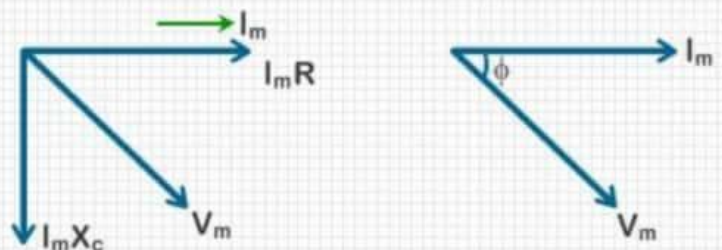
## 2 RC SERIES CIRCUIT WITH AN AC SOURCE

Circuit Diagram



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

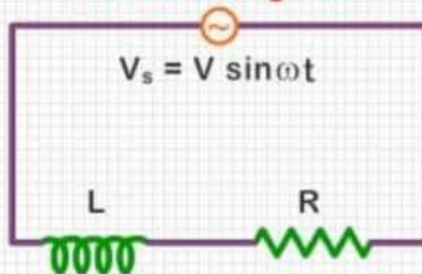
Phasor Diagram



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

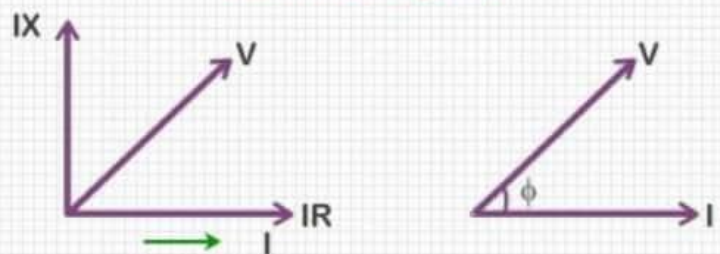
## 3 LR SERIES CIRCUIT WITH AN AC SOURCE

Circuit Diagram



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

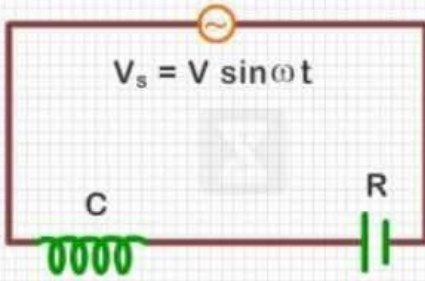
Phasor Diagram



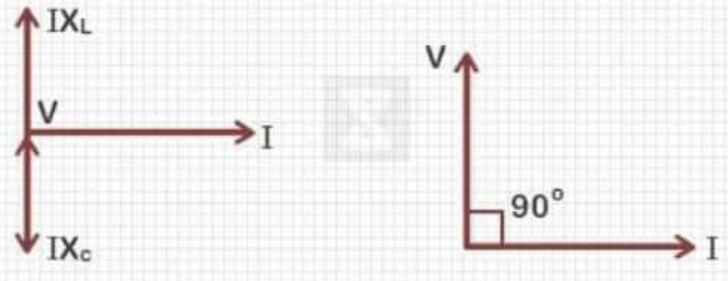
$$\tan \phi = \frac{IX_L}{IR} = \frac{X_L}{R}$$

### 4 LC SERIES CIRCUIT WITH AN AC SOURCE

Circuit Diagram



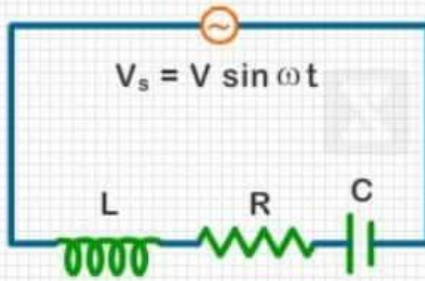
Phasor Diagram



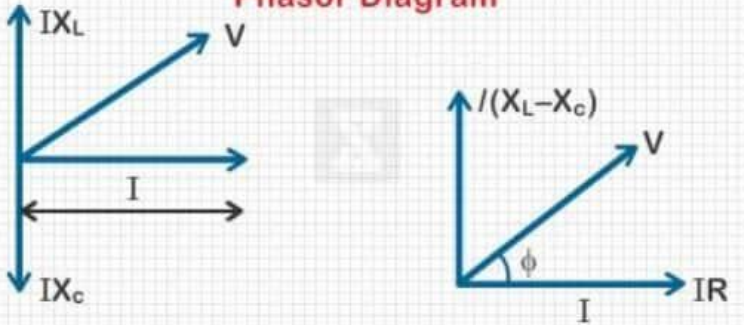
From the phasor diagram  $V = I|(X_L - X_C)| = IZ$ ,  $\phi = 90^\circ$

### 5 RLC SERIES CIRCUIT WITH AN AC SOURCE

Circuit Diagram

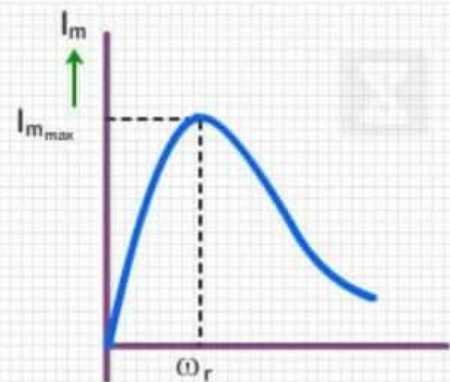
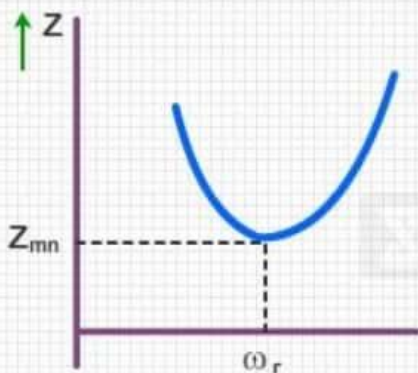


Phasor Diagram



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:  $X_L - X_C = 0 \Rightarrow \omega = \frac{1}{\sqrt{LC}}$