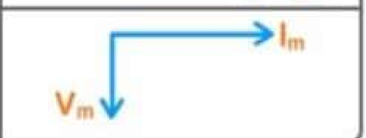
Part I

# ALTERNATING CURRENT

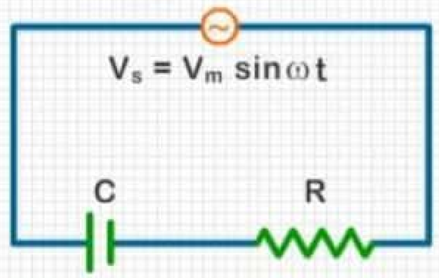
It is the movement of electrical charge through a medium that changes direction periodically

## 1 SUMMARY

| AC SOURCE CONNECTED WITH | PHASE $\phi$ | 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 $90^0$ | $X_L$ |  |
| Pure Capacitor | $-\frac{\pi}{2}$ | $V_C$ lags $i_C$ by $90^0$ | $X_C$ |  |

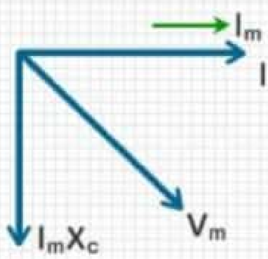
## 2 RC SERIES CIRCUIT WITH AN AC SOURCE

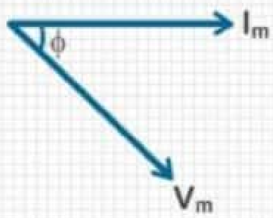
### Circuit Diagram




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

### Phasor Diagram

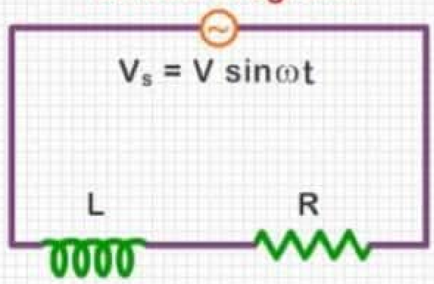



$$\tan\phi = \frac{I_mX_c}{I_mR} = \frac{X_c}{R}$$

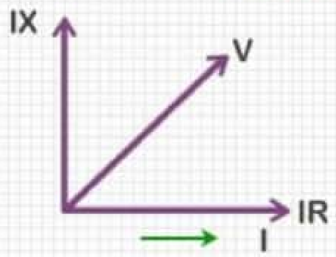
## 3 LR SERIES CIRCUIT WITH AN AC SOURCE

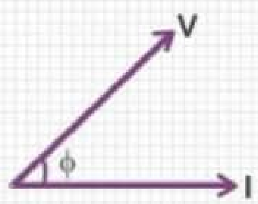
### Circuit Diagram




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

### Phasor Diagram



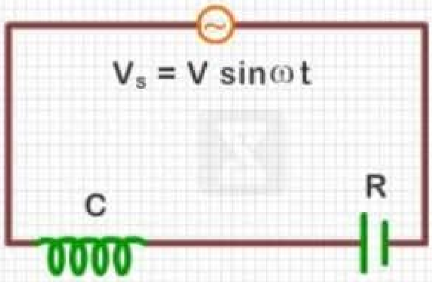




$$\tan\phi = \frac{IX_L}{IR} = \frac{X_L}{R}$$

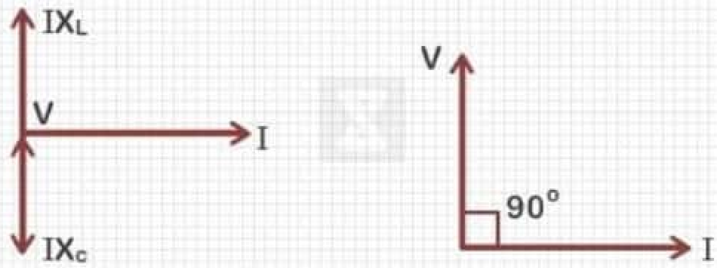
Part II

## 4 LC SERIES CIRCUIT WITH AN AC SOURCE

**Circuit Diagram**



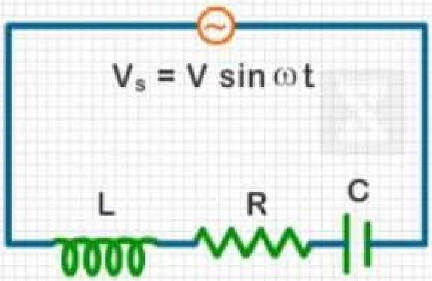

**Phasor Diagram**



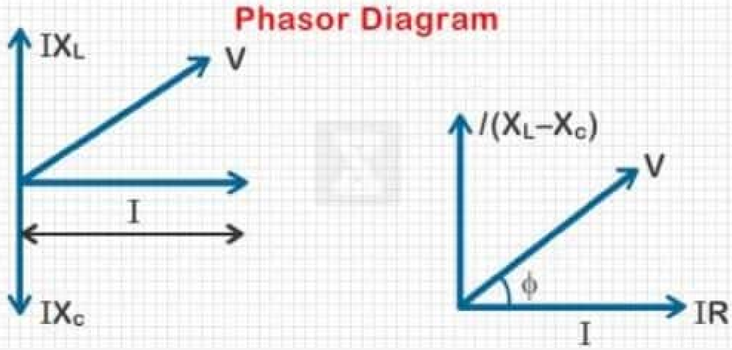

From the phasor diagram $V = I\left|(X_L - X_c)\right| = IZ$ , $\varphi = 90°$

## 5 RLC SERIES CIRCUIT WITH AN AC SOURCE

**Circuit Diagram**



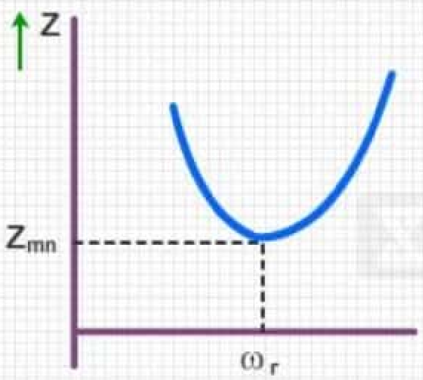

**Phasor Diagram**

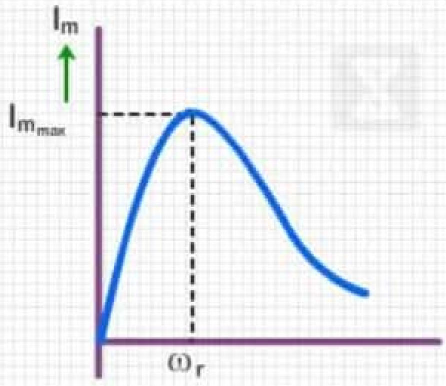



From the phasor diagram $V = \sqrt{(IR)^2 + (IX_L - IX_c)^2}$ , $Z = \sqrt{R^2 + (X_L - X_c)^2}$

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

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