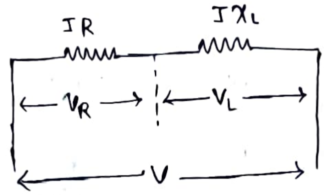
~~Pavg~~

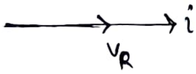
Resistance - Inductance (R-L) series circuit :

* In series, same amount of i flows through all elements so, current should be taken as reference.

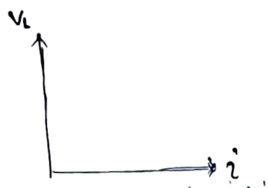


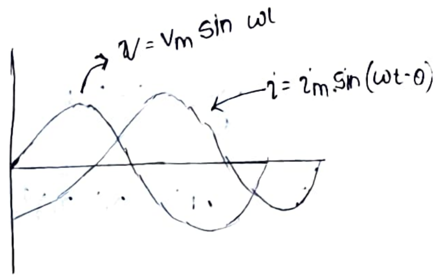
* $V_R = iR$, $V_L = iX_L$

* In resistor :



In Inductor :





* $V^2 = V_R^2 + V_L^2$

$\Rightarrow V = \sqrt{V_R^2 + V_L^2} = \sqrt{(iR)^2 + (iX_L)^2} = \underline{I\sqrt{R^2 + X_L^2}}$

$\Rightarrow i = \underline{\dfrac{V}{\sqrt{R^2 + X_L^2}}} = \underline{\dfrac{V}{Z}}$

* $\tan\theta = \dfrac{V_L}{V_R} = \dfrac{X_L}{R}$

* $X_L = \omega L = 2\pi f L$

* Power factor $\Rightarrow \cos\theta = \underline{R/Z}$

* Instantaneous Power : $P = V \times i$

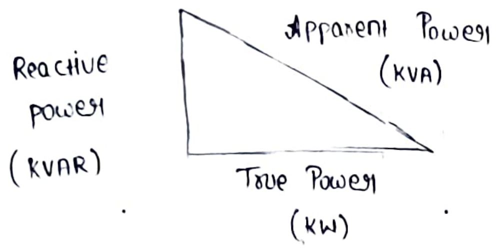
$\Rightarrow P = V_m \sin \omega t \cdot i_m \sin(\omega t - \theta)$

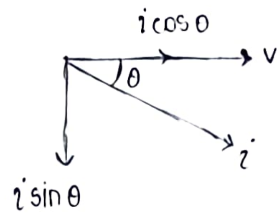
$\Rightarrow P = \underline{\dfrac{V_m}{\sqrt{2}} \cdot \dfrac{i_m}{\sqrt{2}} \cos\theta} - \cancel{\dfrac{1}{2} V_m I_m \cos(2\omega t - \theta)}$ 0

(fluctuating power is zero for one cycle)

* Avg Power $\Rightarrow P_{avg} = \underline{V_{rms}\, i_{rms} \cos\theta}$.

→ Apparent Power, True Power, Reactive Power & Power factor:





* Apparent Power : $S = Vi = \frac{Vi}{1000}$ KVA (KVA ↓ volt, kilo ampere)

* True Power (or) Real Power (or) Active Power ⇒ $P = Vi\cos\theta = \frac{Vi\cos\theta}{1000}$ (KW) (W → watts)

* Reactive Power ⇒ $Q = Vi\sin\theta$ $Q = \frac{Vi\sin\theta}{1000}$ KVAR (R ↳ reactive)

* $KVA = \sqrt{(KW)^2 + (KVAR)^2}$

* Real Power : (P) → The actual power consumed in an A.C circuit

* Reactive Power : The power absorbed by pure reactance

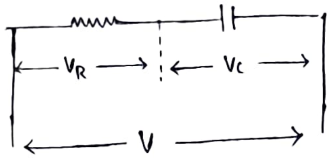
* Apparent Power (or) Total Power (S) : It is given by product of Vi

* Power factor : $\cos\theta = \frac{R}{Z} = \frac{Vi\cos\theta}{Vi}$ (Vi cos θ → real power; Vi → app. power)

• The max value of P.F. is 1
  min value of P.F. is 0

R-C Series circuit :

A circuit containing a resistance in series with a capacitance.



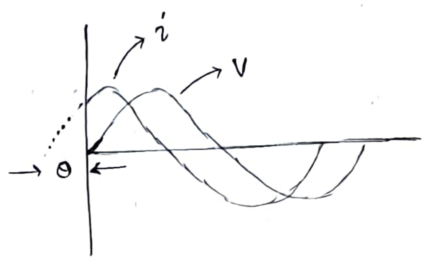
* $V = \sqrt{V_R^2 + V_C^2} = i\sqrt{R^2 + X_C^2}$

* $\tan\theta = \dfrac{V_C}{V_R} = \dfrac{X_C}{R}$

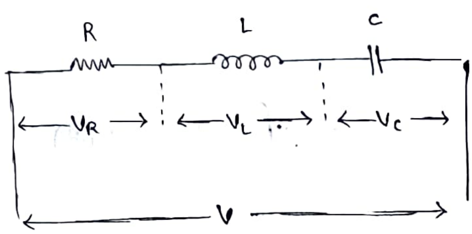
* Instantaneous voltage ⇒ $V = V_{max} \sin \omega t$

  " current ⇒ $i = i_m \sin(\omega t + \theta)$

  $\therefore P = Vi \cos\theta$



R-L-C Series circuit :



~~Case~~ :

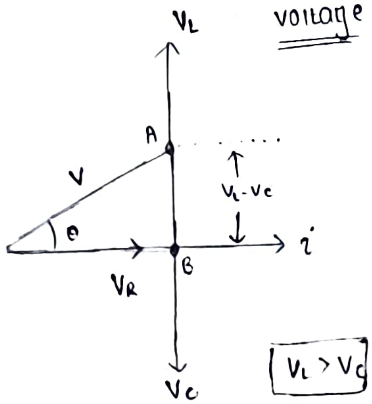
→ Conditions :

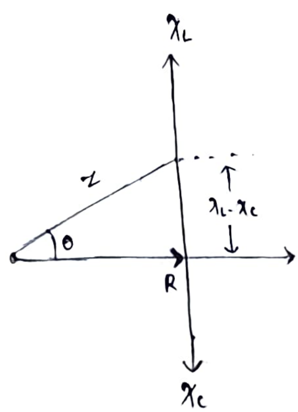
i) $X_L > X_C$ → inductive

ii) $X_C > X_L$ → capacitive

iii) $X_L = X_C$ → Resistive.

→ Case - 1 :

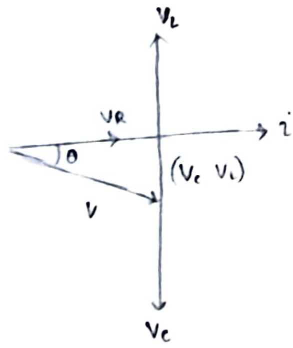


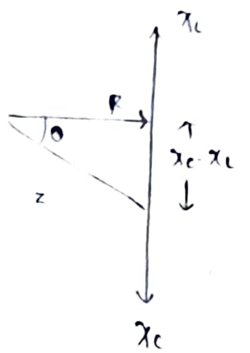


$\boxed{X_L > X_C}$

→ Case - 2 :

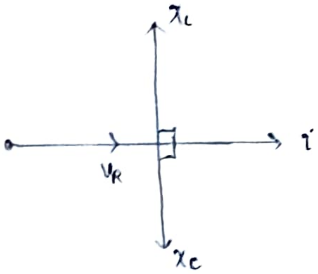
$V_C > V_L$ $\qquad\qquad$ $X_C > X_L$





→ Case - 3 :

$X_L = X_C$



$(X_L - X_C) = 0$

* $X_L > X_C$ → Nature of circuit is inductive, so i lags the voltage

$\theta > 0$ ($\theta \rightarrow$ phase angle).

* $X_C > X_L$ → Nature of circuit is capacitive, so i leads the voltage

$\theta < 0$

* $X_C = X_L$ → Nature of circuit is resistive, i & v are in same phase

$\theta = 0$