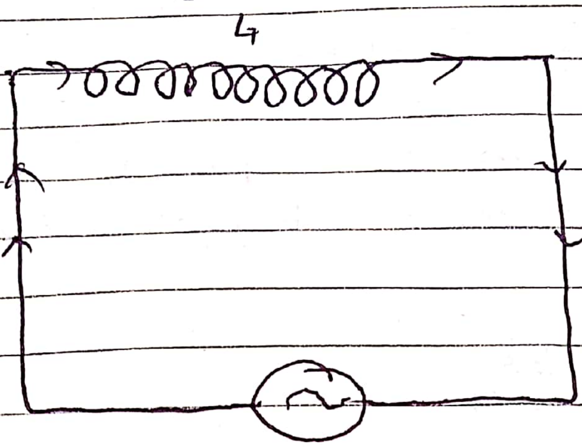
PAGE NO.:
DATE:

A.C Containing Inductor only:-



Let the instantaneous voltage be

$$V = V_0 \sin \omega t$$

If I be the linked current to coil at any instant

$$E = -L \frac{dI}{dt}$$

$$E = -V$$

$$V = -E$$

$$V = +L \frac{dI}{dt}$$

$$\frac{V}{L} dt = dI$$

$$dI = \frac{V_0}{L} \sin \omega t \, dt$$

$$\int dI = \frac{V_0}{L} \int \sin \omega t \, dt$$

$$I = \frac{V_0}{L} \left[-\frac{\cos \omega t}{\omega} \right]$$

Scanned with CamScanner

$\sin(90 - \theta) = \cos\theta$

$\sin(\theta - 90°) = -\cos\theta$

$$I = \frac{V_0}{\omega L}\left[-\cos\omega t\right]$$

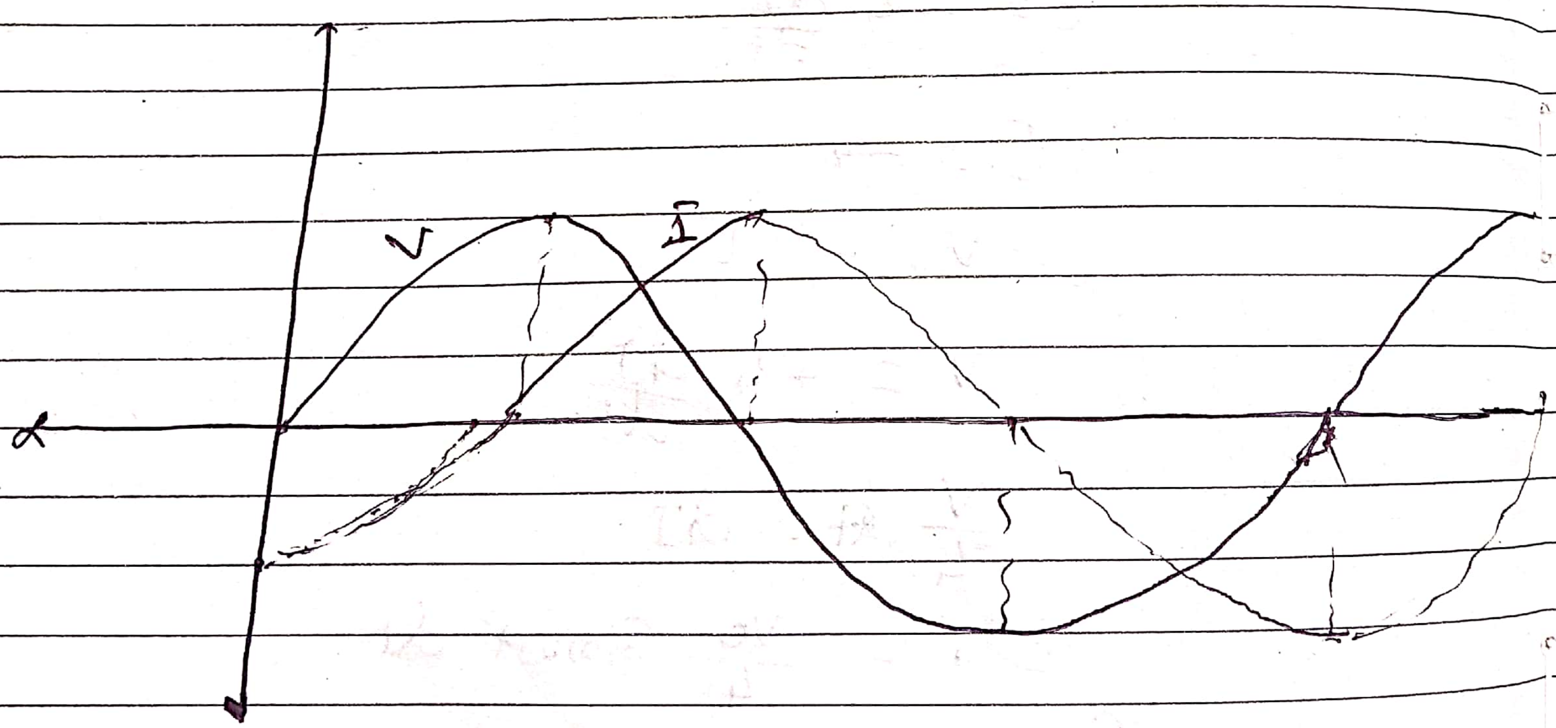
$$I = \frac{V_0}{\omega L}\sin\left(\omega t - \frac{\pi}{2}\right)$$

The maximum or peak value of the current is I_0, $\sin\left(\omega t - \frac{\pi}{2}\right) = 1$

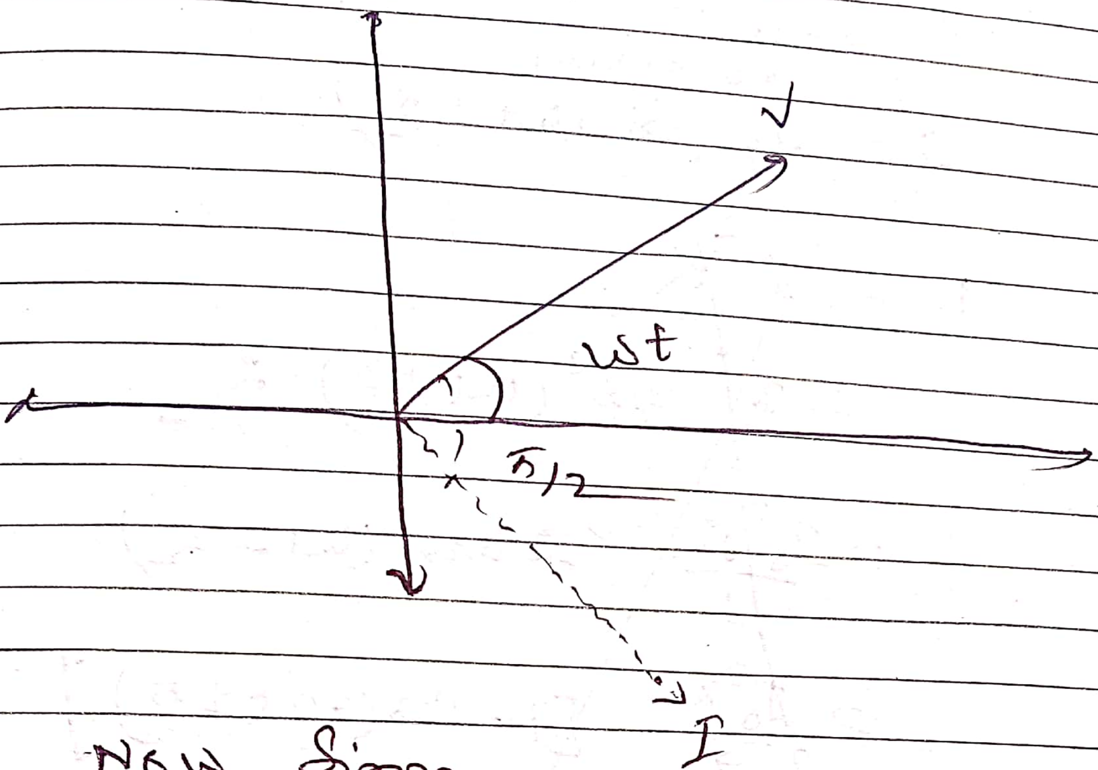
$$I_0 = \frac{V_0}{\omega L}$$

$$I = I_0 \sin\left(\omega t - \frac{\pi}{2}\right)$$

The current is lagging by a phase of $\frac{\pi}{2}$ to ~~100~~ voltage



Phasor diagram:-



Now since

$$I_0 = \frac{V_0}{\omega L}$$

$$\Rightarrow \frac{V_0}{I_0} = \omega L$$

$\frac{V_0}{I_0}$ it appears as resistance to the circuit and it is called Inductive reactance

$$\boxed{X_L = \omega L}$$

Avg power in inductor or capacitor is zero

$V = V_0 \sin\omega t$

$I = I_0 \sin(\omega t \pm \frac{\pi}{2})$

$P = I^2 R$

$= I_0^2 \sin^2(\omega t \pm \frac{\pi}{2}) R$

$= \frac{I_0^2 R}{2} 2\sin^2(\omega t \pm \frac{\pi}{2})$

$= \frac{I_0^2 R}{2} [1 - \cos(2\omega t \pm \pi)]$

$P_{av} = \langle P \rangle$

$= \frac{I_0^2 R}{2} [1 - \langle \cos(2\omega t \pm \pi) \rangle]$

$\langle \cos(2\omega t \pm \pi) \rangle = 0$

Scanned with CamScanner

PAGE NO.:
DATE:

$$P = VI$$

$$P = I_0 V_0 \sin\omega t \sin(\omega t \pm \frac{\pi}{2})$$

$$= \frac{V_0 I_0}{2} [2 \sin(\omega t \pm \frac{\pi}{2}) \sin\omega t]$$

$$\{2 \sin A \sin B = \cos(A-B) - \cos(A+B)\}$$

$$P = \frac{V_0 I_0}{2} [\cos(\pm\frac{\pi}{2}) - \cos(2\omega t \pm \pi)]$$

$$= -\frac{V_0 I_0}{2} \cos(2\omega t \pm \pi)$$

$$P_{av} = -\frac{V_0 I_0}{2} \langle \cos(2\omega t \pm \pi) \rangle$$

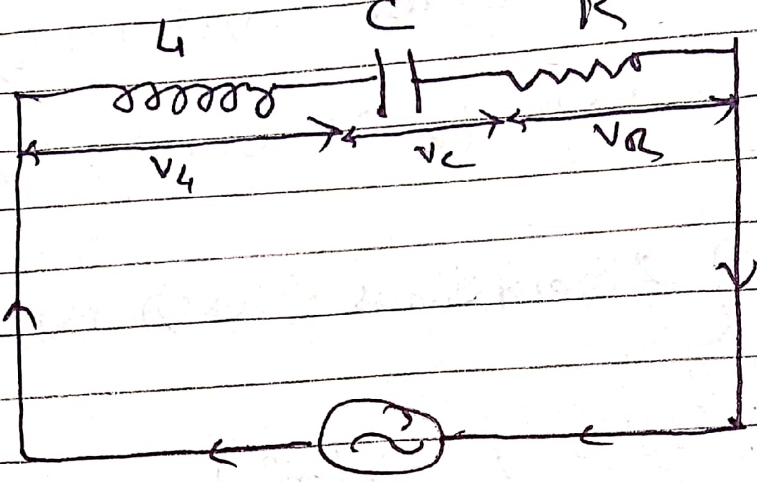
$$\langle \cos(2\omega t \pm \pi) \rangle = 0$$

$$P_{av} = -\frac{V_0 I_0}{2} \times 0$$

$$\boxed{P_{av} = 0}$$

DATE:

A.C Containing L-C-R



Let the Instantaneous Voltage be

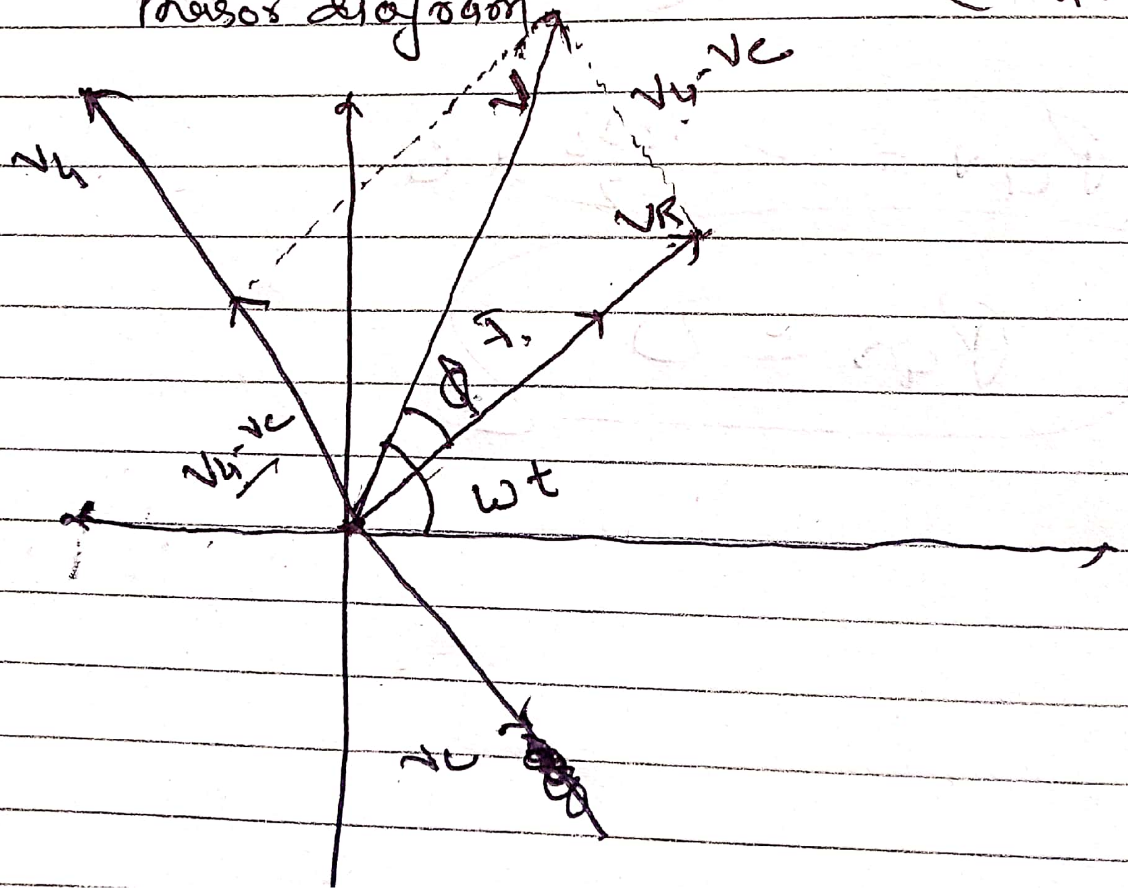
$$V = V_0 \sin \omega t$$

then voltage will be distributed in series

$$\vec{V} = \vec{V_L} + \vec{V_C} + \vec{V_R}$$

$(V_L > V_C)$

Phasor diagram



Scanned with CamScanner

Let I be the Instantaneous value of current

$$V_L = I X_L \qquad V_C = I X_C \qquad V_R = IR$$

$$V = \sqrt{(V_L - V_C)^2 + V_R^2}$$

$$V = \sqrt{(I X_L - I X_C)^2 + I^2 R^2}$$

$$V = I \sqrt{(X_L - X_C)^2 + R^2}$$

$$\frac{V}{I} = \sqrt{(X_L - X_C)^2 + R^2}$$

$\frac{V}{I}$ is like Resistance of the Combination. It is Called Impedance represented by 'Z'

$$\frac{V}{I} = Z$$

$$\boxed{Z = \sqrt{(X_L - X_C)^2 + R^2}}$$

Now,

$$I = I_0 \sin(\omega t - \phi)$$

$$\tan\phi = \frac{V_L - V_C}{V_R} = \frac{I X_L - I X_C}{IR}$$

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

Scanned with CamScanner