Exp 9:- Impedance and Sinusoidal steady State.

* **For a Sinusoidal Source:-**

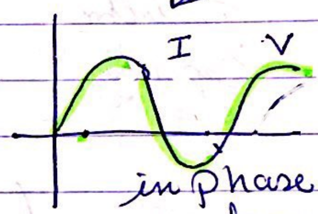
$V = V_m \cos(\omega t + \phi)$ • V_m, I_m is Max Amp

$I = I_m \cos(\omega t + \theta)$

$V = V_m e^{i\theta} = P\{V_m \cos(\omega t + \theta)\}$

Phasor form

• Ohm's law for a Resistor: $V = R I_m e^{i\theta}$ But $\theta = 0$ for a Resistor



• V–I Relation for an Inductor

$I \Rightarrow L \frac{di}{dt}$

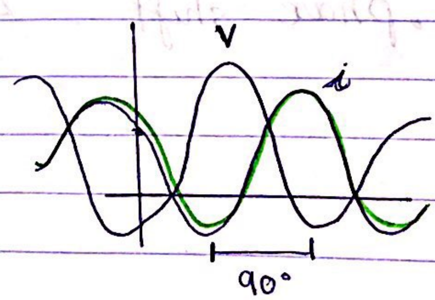
So $V_L = L\frac{di}{dt} = L\frac{d(I_m \cos(\omega t + \theta_i))}{dt}$

$= -\omega L I_m \sin(\omega t + \theta_i) = -\omega L I j$.

• Voltage and Current are Out of Phase by 90

So $V = \omega L I_m \angle(90 + \theta_i)$

Current lags voltage



* V-I Relation for a Capacitor:-

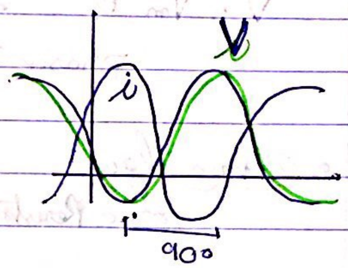
$V = V_m \cos(\omega t + \theta_v)$ and $i = C \frac{dv}{dt}$

So $V = \frac{1}{j\omega C} I$ — current l. Voltage by 90°

$V = I_m / \omega C \angle (\theta_i - 90)$

- Impedance and Reactance:-

$V = Z I$



Element	Impedance	Reactance
Resistor	R	-
Inductor	$j\omega L$	ωL
Capacitor	$j(-1/\omega C)$	$-1/\omega C$

- Impedance is Not a phasor but It's a complex Number
- It is the Quantity analogous to resistance, capacitance and inductance in the time domain

- Imaginary part of Z = Reactance

- phase shift : $\Delta\theta = 360° \times f \times \Delta t$