Chapter 9:

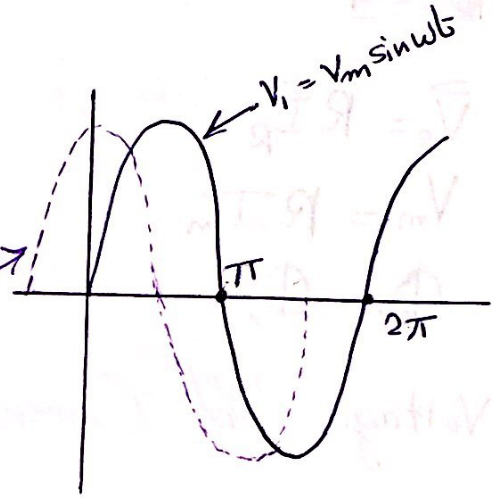
The Sinusoidal Source :-

$V_s(t) = V_m \sin \omega t$ ← Angular frequency

↑ Amplitude of the Sinusoid

$\omega = 2\pi f$

$f = \frac{1}{T}$



- V_2 leads V_1 by Φ
- V_1, V_2 have the same frequency

The Sinusoidal Response

$i(t) = i_n(t) + i_f(t)$

$I_o e^{-t/\tau}$ — Transient Component

$I_1 \cos \omega t + I_2 \sin \omega t = y_p$ — steady-state Component

عوض في المعادلة لإيجاد الحل

* To use Calculator :-

$Z_1 = 4 + j3 \longrightarrow$ Calculator Pol(4,3) Then $\boxed{RCl}$ tan $\longrightarrow 5\angle 36.9°$

$5\angle 36.9 \longrightarrow$ Calculator Rec (5, 36.9) Then $\boxed{RCl}$ tan

(Rec (5, 36.9) → to give Re; $\boxed{RCl}$ tan → to give Im)

- Phasors

$$i(t) = I_m \cos(\omega t + \Phi_i)$$

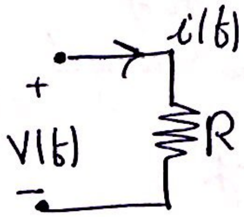
$$v(t) = V_m \cos(\omega t + \Phi_v)$$

$$\vec{I} = I_m \angle \Phi_i$$

$$\vec{V} = V_m \angle \Phi_v$$

- Phasor Relationship for Circuit Elements

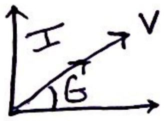
→ Resistor



$$\vec{V}_R = R \vec{I}_R$$

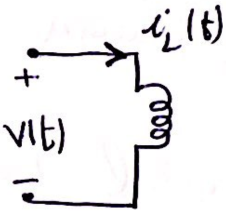
$$V_m = R I_m$$

$$\Phi_v = \Phi_i$$



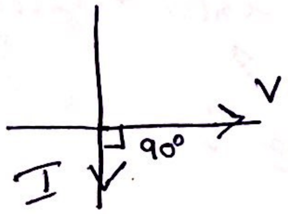
* Voltage And Current of a Resistor are inphase

→ Inductor



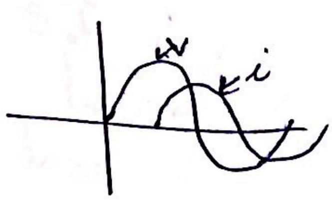
$$\frac{\vec{V}_L}{\vec{I}_L} = j\omega L$$

↗ Impedence



$$V_m = \omega L I_m$$

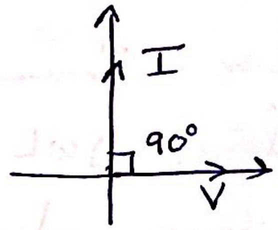
$$\Theta_v = \Theta_i + 90$$



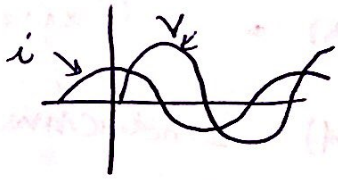
- Voltage leads the Current by 90°

→ Capacitor

$\vec{V}_c = \frac{1}{jwc} \vec{I}_c$



$I_m = W c \, V_m$



$\Phi_i = \Phi_v + 90°$

Current leads the Voltage by 90°

Impedance and Admitance

[1] $Z(j\omega) = \frac{\vec{V}}{\vec{I}} \sim \Omega$ Imp

[2] $Y(j\omega) = \frac{\vec{I}}{\vec{V}} \sim \mho$ Adm

$Z(j\omega) = \frac{1}{Y(j\omega)}$

• $\vec{Z}(Imp) = R + jX$

Reactive Part

Resistive Part

$X = |Z| \sin\theta_z$ $\theta_z = \theta_v - \theta_i$

$R = |Z| \cos\theta_z$

→ You Can Use Current and Voltage Divider Rules To find Z_1, Z_2 ---

- load 5 Types :- (look at Z_{eq} To Know)

1) pure Resestive R
2) pure Inductance $j\omega L$
3) " Capacitance $\frac{1}{j\omega C}$
4) Inductive load $R+xj$
5) Capacitive load $R-xj$

Rmk: if $Z_L = Z_C$ Then $\omega = \frac{1}{\sqrt{LC}}$

→ Where $Z_{eq} = R$ Resestive

Resonant frequency

$$\sin(A \pm B) = \sin A \cos B \pm \cos A \sin B$$

$$\cos(A \pm B) = \cos A \cos B \mp \sin A \sin B$$

$$\sin(\omega t \pm 180^\circ) = -\sin \omega t$$

$$\cos(\omega t \pm 180^\circ) = -\cos \omega t$$

$$\sin(\omega t \pm 90^\circ) = \pm \cos \omega t$$

$$\cos(\omega t \pm 90^\circ) = \mp \sin \omega t$$

$$A \cos \omega t + B \sin \omega t = C \cos(\omega t - \theta)$$

where

$$C = \sqrt{A^2 + B^2} \quad \text{and} \quad \theta = \tan^{-1} \frac{B}{A}$$

Complex Numbers :-

forms :-

1) Rec. form

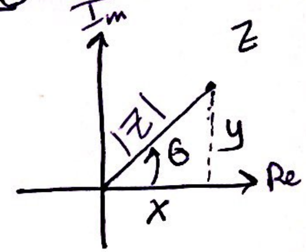
$Z = x + jy$

2) Exp. form

$Z = |Z| e^{j\theta}$

3) Pol. form

$Z = |Z| \angle \theta$



Multiplication :-

- $Z_1 Z_2 = |Z_1| |Z_2| \angle \theta_1 + \theta_2$
- $\dfrac{Z_1}{Z_2} = \dfrac{|Z_1|}{|Z_2|} \angle \theta_1 - \theta_2$