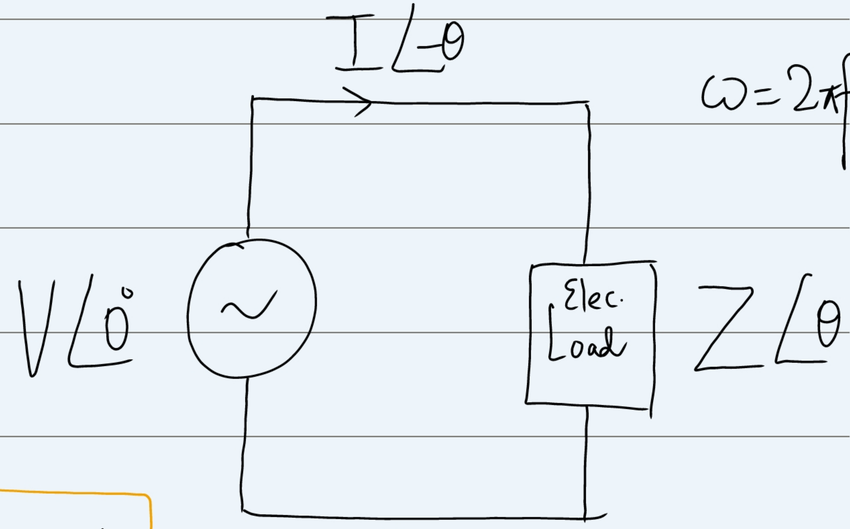
# Single-Phase AC Power Supply :

$$\underline{I} = \frac{V\angle 0^\circ}{Z\angle\theta} = \frac{Ve^{j0^\circ}}{Ze^{j\theta}} = \frac{V}{Z}e^{-j\theta}$$




$\omega = 2\pi f = 314\ rad/s$

$$\underline{I} = I\angle -\theta \; ; \quad \boxed{i(t) = \sqrt{2}\, I \cos(\omega t - \theta)}$$

$V\angle 0^\circ$: $\boxed{v(t) = \sqrt{2}\, V \cos(\omega t + 0^\circ)}$

Impedance angle, $\theta$ = +ve for Inductive load

$Z_1 = 4 + j3$ ; $Z_2 = 5 - j4$ = -ve for capacitive load

$\theta_1$ = +ve ; $\theta_2$ = -ve

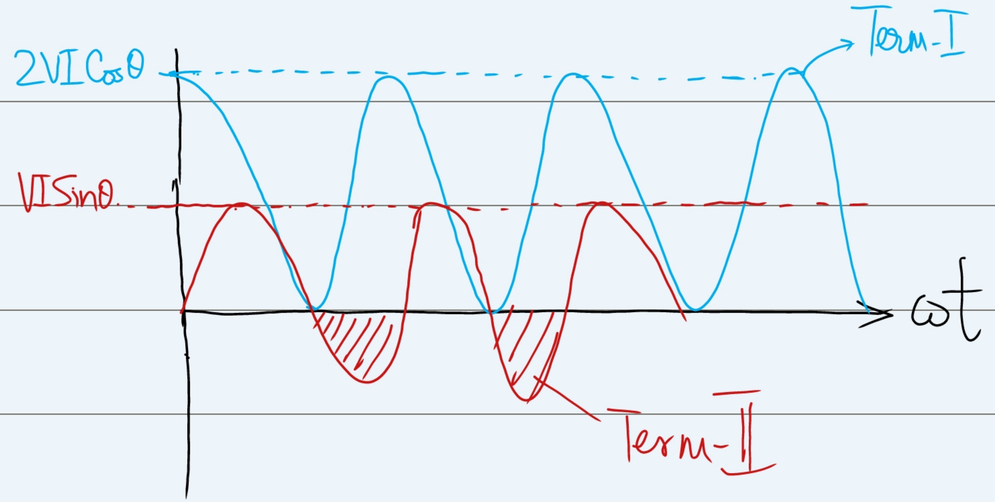
Inst. Power:

$$p(t) = v(t) \cdot i(t) = \left(\sqrt{2}\, V \cos \omega t\right)\left(\sqrt{2}\, I \cos(\omega t - \theta)\right)$$

$$p(t) = 2VI \cos \omega t \cdot \cos(\omega t - \theta)$$

$$p(t) = VI\cos\theta\left(1+\cos 2\omega t\right) + VI\sin\theta\,\sin 2\omega t$$

Term-I  Term-II




$$\langle \text{Term-I} \rangle_{\text{ave.}} = VI\cos\theta$$

$$\langle \text{Term-II} \rangle_{\text{ave}} = 0$$

$\langle \text{Term-I} \rangle_{ave} = V \cdot I \cdot \cos\theta$ = Real Power that the source $V\angle 0^\circ$ is supplying to the load $Z\angle\theta$

$$P = V \cdot I \cdot \cos\theta \quad \text{(Unit: Watt, W)}$$

$\langle \text{Term-II} \rangle_{ave} = 0$

$Q = V \cdot I \cdot \sin\theta$ = Reactive Power

= From source to load & then from load to source.

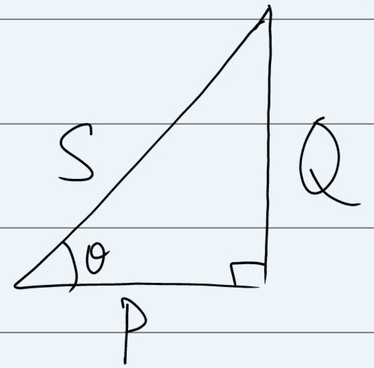
Unit

1. Real Power, $P = V \cdot I \cos\theta$ — W

2. Reactive Power, $Q = V \cdot I \sin\theta$ — VAR (Voltage-Ampere-Reactive)

3. Apparent Power, $S = V \cdot I$ — VA ... Ignoring the impedance angle $\theta$. (Voltage-Amp)

p.f = Cosθ (leading/lagging) ; p.f = 0.8 (lagging) ⇒ Cosθ = 0.8 & the load is inductive in nature.

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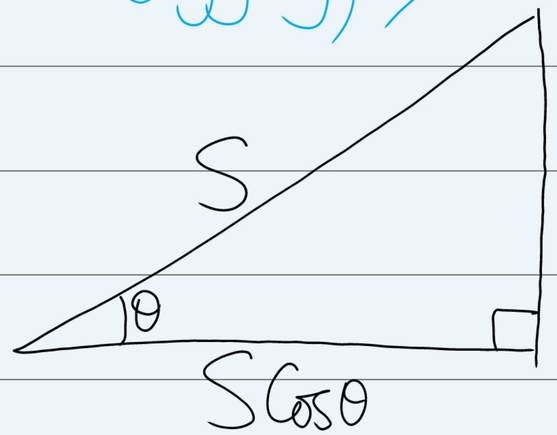


S Sinθ = VISinθ = Q

= VICosθ = P

Power Triangle

Power factor, pf = Cosθ = fraction of the apperent power consumed by the load.

# Example Problem:

1. Current $= \frac{220V \angle 45^\circ}{5\Omega \angle 30^\circ} = 44 \angle 15^\circ A$
2. Real Power $= V \cdot I \cos\theta = 220V \cdot 44A \cos 30^\circ W$
3. Reactive Power = ?
4. Apparent Power = ?
5. Power factor =