Tuesday, December 7, 2021
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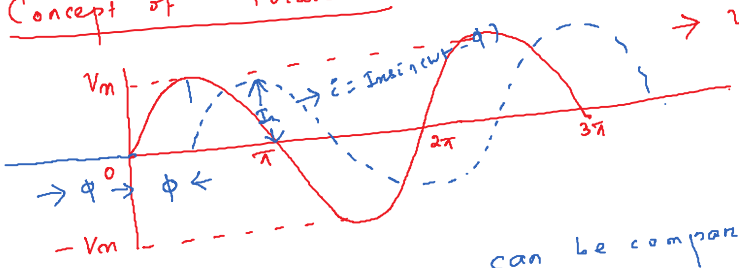
Concept of Phasore



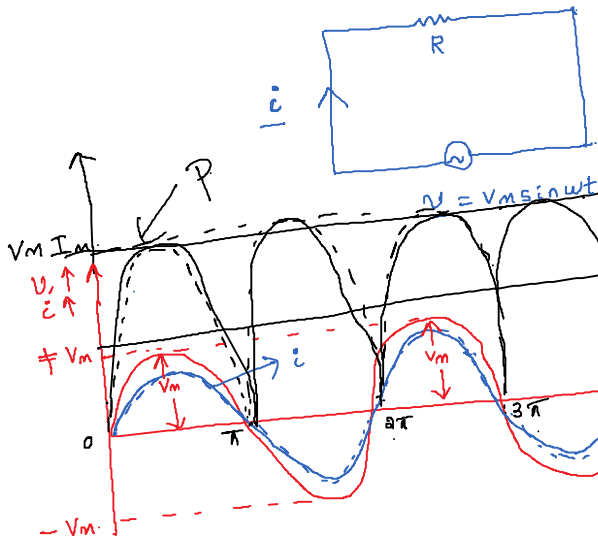
$v = V_m \sin\omega t$
$i = I_m \sin(\omega t - \phi)$

The phase of 2 sinewave can be compared if

- Both have same freq
- Both are having either +ve amplitude or -ve amplitude
- Both are either sin function or cos function

Behavior of (R), (L), (C) in AC Circuit

(1) Purely Resistive Circuit



$v = V_m \sin\omega t$ — (1)

$i = \frac{v}{R} = \frac{V_m \sin\omega t}{R}$

$= \frac{V_m}{R} \sin\omega t$

$= I_m \sin\omega t$ — (2)

Instantaneous Power $p = v\,i = V_m \sin\omega t \; I_m \sin\omega t$

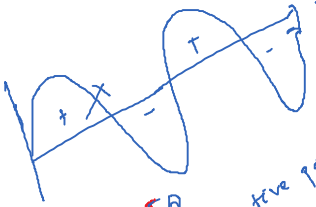
$= \frac{V_m I_m}{2} [2\sin^2\omega t]$

$= \frac{V_m I_m}{2} [1 - \cos 2\omega t]$

Avg power $P_{(av)} = \frac{V_m I_m}{2} = \left(\frac{V_m I_m}{2}\right) - \frac{V_m I_m \cos 2\omega t}{2}$ (0)

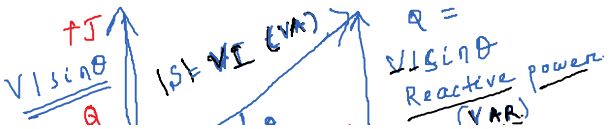
$= \frac{V_m}{\sqrt{2}} \times \frac{I_m}{\sqrt{2}} = V_{rms} I_{rms}$

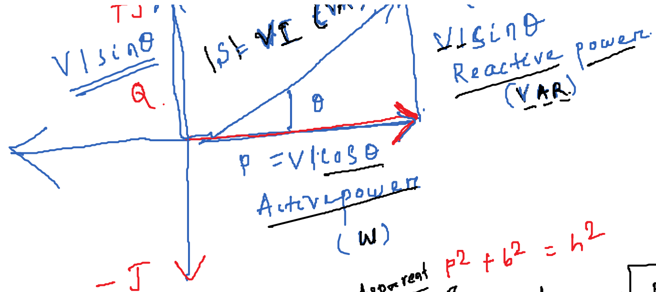
= Apparent power.



$S = P + jQ$

= Active +j reactive power





= Apparent

pf $\cos\theta = \cos 0^\circ = 1$

Real power / Active power

$P_{active} = P_r = VI\cos\theta$

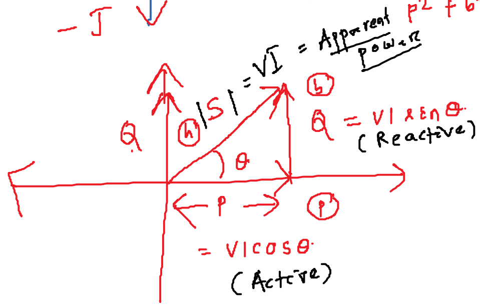
$= VI = V_{rms} I_{rms}$

$= I_{rms}^2 R$ = Apparent power

Reactive power

$P_{reactive} = VI\sin\theta$

$= 0^\circ$



$h = \sqrt{p^2 + b^2}$

$S = \sqrt{P^2 + Q^2}$

$= \sqrt{(VI\cos\theta)^2 + (VI\sin\theta)^2}$

$= VI\sqrt{\cos^2\theta + \sin^2\theta}$

$= VI$

Q. 1. In an ac circuit $v = 55\sin\omega t$, $i = 6.1\sin(\omega t - \frac{\pi}{5})$

Calculate (i) Avg power (ii) Apparent power (iii) P_{inst} when $\omega t = 0.3$ sec (iv) pf in %.

$P_{inst} = vi = 55\sin\omega t \times 6.1\sin(\omega t - \frac{\pi}{5})$ — (1)

$= \frac{55 \times 6.1}{2} \, 2\sin\underbrace{\omega t}_{A} \sin\underbrace{(\omega t - \frac{\pi}{5})}_{B}$

$= \frac{55 \times 6.1}{2}\left[\cos\frac{\pi}{5} - \cos\left(2\omega t - \frac{\pi}{5}\right)\right]$ — (2)

(i) $P_{avg} = \left[\frac{55 \times 6.1}{2}\cos\frac{\pi}{5}\right] = 135.6\,W$

(ii) $P_{apparent} = V_{rms} I_{rms} = \frac{V_m}{\sqrt{2}} \times \frac{I_m}{\sqrt{2}}$

$= \frac{55}{\sqrt{2}} \times \frac{6.1}{\sqrt{2}} = 167.75$ VA

(iii) $P_{inst}]_{\omega t = 0.3\ sec}$

$= 135.6 - \frac{55 \times 6.1}{2}\cos\left(0.6 - \frac{\pi}{5}\right)$

$= -31.98\,W$

— 0.809 × 100

(iv) pf in % = $\cos\frac{\pi}{5}$ = 0.809 × 100

= 80.9 %