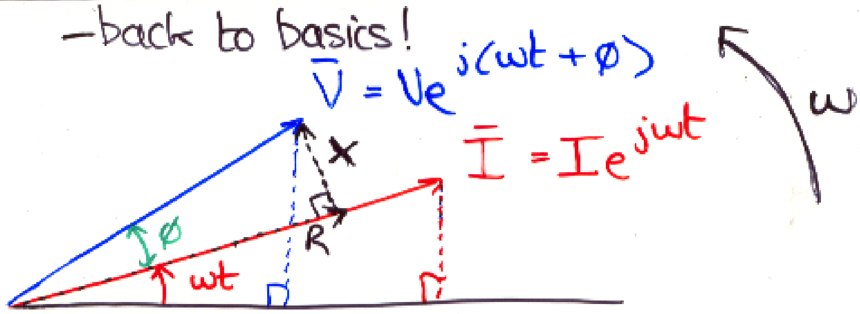
VECTOR & MATRIX POWER

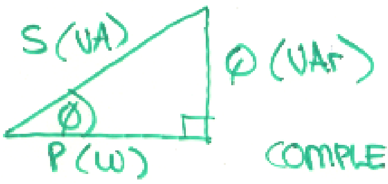
— back to basics!



$$\bar{V} = V(\cos(\omega t + \phi) + j\sin(\omega t + \phi)) = Ve^{j(\omega t + \phi)}$$

$$\bar{I} = I(\cos \omega t + j\sin \omega t) = Ie^{j\omega t}$$

Power triangle ..... recall...



Real Power $= S\cos\phi$

Reactive P $= S\sin\phi$

COMPLEX POWER, $S = P + jQ = S\cos\phi + Sj\sin\phi$

$$\bar{V}\bar{I} = VIe^{j(2\omega t + \phi)}$$ → DOES NOT GIVE POWER!

However, $\bar{V} \times \bar{I}^* = Ve^{j(\omega t + \phi)} \cdot Ie^{-j\omega t}$

$$= VIe^{j\phi} = VI(\cos\phi + j\sin\phi) \text{ (VA)}$$

$\Rightarrow$ REAL POWER $= Re\{\bar{V}\bar{I}^*\}$ (W)

alternatively, REAL POWER $= Re\{\bar{V}^*\bar{I}\}$

· Consider a simple dc system, where power (total) made from no. of sub-systems....

$$P = V_1 I_1 + V_2 I_2 + V_3 I_3 + \ldots V_n I_n$$

.... to represent in matrix form, this becomes....

$$P = \begin{bmatrix} V_1 & V_2 & V_3 & \ldots & V_n \end{bmatrix} \begin{bmatrix} I_1 \\ I_2 \\ I_3 \\ \vdots \\ I_n \end{bmatrix}$$ i.e. $P = V_t I$

or, $P = I_t . V$, so for ac systems:-

..... matrix power $= R_e \{ [V_t][I]^* \} = R_e \{ [I_t]^* [V] \}$

· Combining the definition of matrix power with both definitions of complex power also gives us...

matrix power $= R_e \{ [V_t]^* [I] \} = R_e \{ [I_t] [V]^* \}$

i.e. four equivalent forms of power depending upon which vector is conjugated, & which is transposed !!