Valor medio en un periodo T de la potencia instantánea

$$T = \frac{2\pi}{\omega} \quad \text{(relación entre } T \text{ y } \omega\text{)}$$

$$P(t) = V_e I_e \left[\cos(2\omega t - \varphi) + \cos\varphi\right]$$

$$\langle P(t) \rangle = \frac{1}{T}\int_0^T P(t)\,dt =$$

$$= \frac{1}{T}\int_0^T V_e I_e \cos(2\omega t - \varphi)\,dt + \frac{V_e I_e}{T}\int_0^T \cos\varphi\,dt =$$

$$= \frac{V_e I_e}{T}\int_0^T \cos(2\omega t - \varphi)\,dt + \underbrace{\frac{V_e I_e}{\cancel{T}}\cos\varphi\,\cancel{T}}_{V_e I_e \cos\varphi}$$

Tenemos en cuenta:

$$\cos(2\omega t - \varphi) = \cos(2\omega t)\cos\varphi + \operatorname{sen}(2\omega t)\operatorname{sen}\varphi$$

Calculamos:

$$\int_0^T \cos(2\omega t - \varphi)\,dt = \int_0^T \cos(2\omega t)\cos\varphi\,dt +$$

$$+ \int_0^T \operatorname{sen}(2\omega t)\operatorname{sen}\varphi\,dt =$$

$$= \cos\varphi\int_0^T \cos(2\omega t)\,dt + \operatorname{sen}\varphi\int_0^T \operatorname{sen}(2\omega t)\,dt =$$

$$= \cos\varphi \frac{1}{2\omega} \operatorname{sen}(2\omega t)\Big|_0^T + \operatorname{sen}\varphi \frac{1}{2\omega}\Big[-\cos(2\omega t)\Big]_0^T =$$

$$= \frac{\cos\varphi}{2\omega}\Big(\operatorname{sen}(2\omega T) - \operatorname{sen}(0)\Big) -$$

$$- \frac{\operatorname{sen}\varphi}{2\omega}\Big(\cos(2\omega T) - \cos(0)\Big) =$$

$$\omega = \frac{2\pi}{T}$$

$$= \frac{\cos\varphi}{2\omega}\Big[\underbrace{\cancel{\operatorname{sen}(4\pi)}}_{=0} - \underbrace{\cancel{\operatorname{sen}(0)}}_{=0}\Big] -$$

$$- \frac{\operatorname{sen}\varphi}{2\omega}\Big[\underbrace{\cancel{\cos(4\pi)}}_{=1} - \underbrace{\cancel{\cos(0)}}_{=1}\Big] = 0 - 0 = 0$$

luego:

$$\boxed{\langle \underline{P}(t)\rangle = V_e I_e \cos\varphi}$$