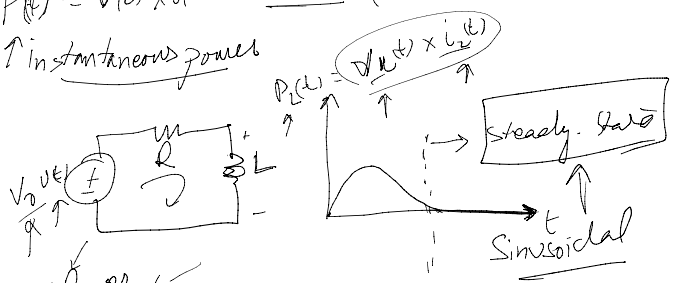
SSS Power

Wednesday, March 24, 2021 2:08 PM

Ac - Power Analysis

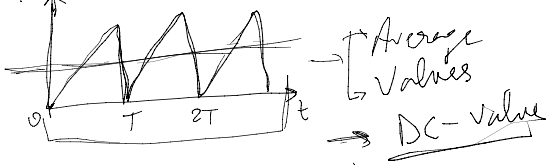
$p(t) = v(t) \times i(t)$ Watts (W)

↑ instantaneous power



Average Power ←

Real power ←

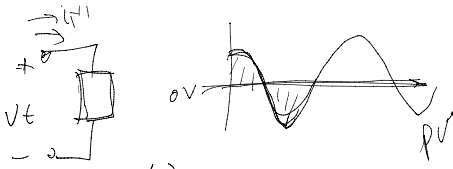


$$\frac{1}{T}\int_0^T p(t)\,dt = P \quad \text{watts (W)}$$

Average Power in SSS:

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

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



$p(t) = v(t)\,i(t) = V_m \cos(\omega t + \phi_v) \times I_m \cos(\omega t + \phi_i)$

$$p(t) = \frac{1}{2} V_m I_m \cos(\phi_v - \phi_i) + \frac{1}{2} V_m I_m \cos(2\omega t + \phi_v + \phi_i)$$

gone

$$P = \frac{1}{2} V_m I_m \cos(\phi_v - \phi_i) \text{ watts (W)}$$

Resistor:

$$P = \frac{1}{2} V_m I_m = \frac{1}{2}\frac{V_m^2}{R} = \frac{1}{2} I_m^2 \times R$$

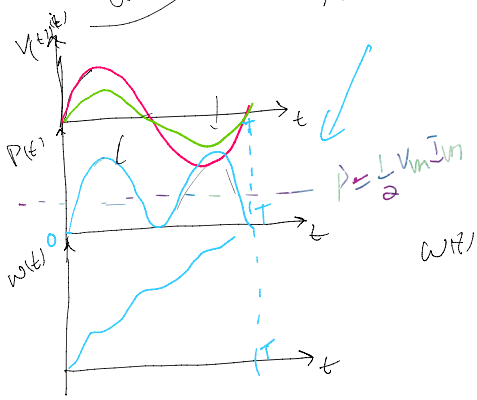
$2 \cos x \cos y = \cos(x+y) + \cos(x-y)$

Inductor / Capacitor: $P_{ave} = 0$ watts

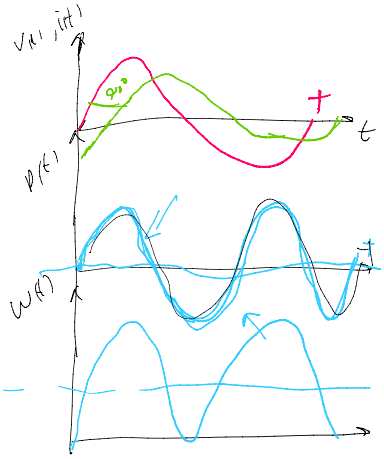
$$P = \frac{1}{2} V_m I_m \cos(\phi_v - \phi_i)$$

$\phi_v - \phi_i = 90^\circ$

Resistor:



$w(t) = \int p(t)\,dt$



Pure → R

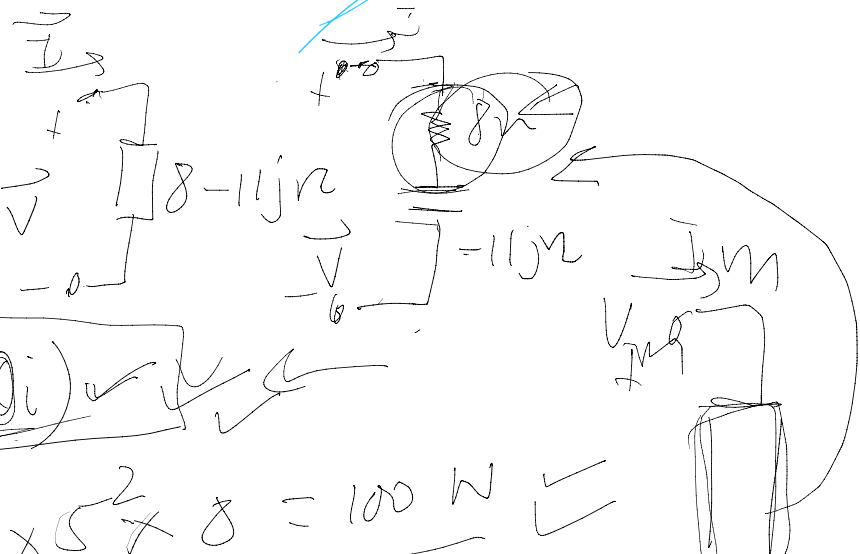
Energy → charge - C, magnet - L

$w(t) = \int p(t) \times dt$

Example:

$Z_L = 8 - 11j\,\Omega$

$\vec{V} = 5\angle 20^\circ\ A$



(1) $P = \frac{1}{2} V_m I_m \cos(\theta_v - \theta_i)$

(2) $P = \frac{1}{2} I_m^2 R = \frac{1}{2} \times 5^2 \times 8 = 100\ W$

$V = 68.01\angle -33.97^\circ\ V$

$P = \frac{1}{2} 68.0 \times 5 \cos(-33.97^\circ - 20^\circ)$

$= 100\ watts$

$P = \frac{1}{2} \frac{V_m^2}{R}$