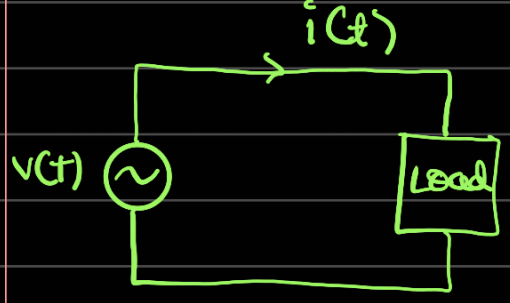
Day - 9

→



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

$$i(t) = i_m \cos(\omega t + \theta_i)$$

$$\text{So} \quad P = vi = \frac{V_m I_m}{2} \cos(\theta_v - \theta_i) + \underbrace{\frac{V_m I_m}{2} \cos(2\omega t + \theta_v + \theta_i)}_{\text{Becomes 0 over a cycle}}$$

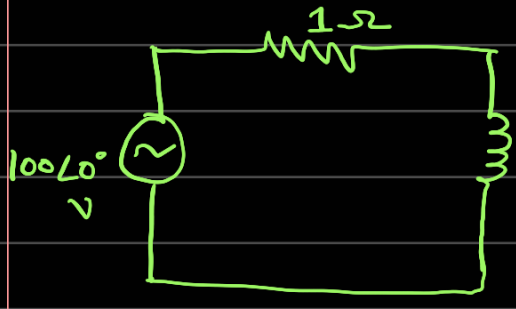
$$P_{avg} = \frac{V_m}{\sqrt{2}} \frac{I_m}{\sqrt{2}} \cos(\theta_v - \theta_i)$$

$$= \underbrace{V_{rms} I_{rms} \cos(\theta_v - \theta_i)}_{\text{Useful power}}$$

$S = VI$ (Apparent ; VA)
$P = VI\cos\theta$ (Real ; W)
$Q = VI\sin\theta$ (Reactive ; VAr)

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

1)



Find S, P, Q
(100 → RMS)

Ans) $I_{rms} = \dfrac{100}{1+j}$

$S = V_{rms} I_{rms}^* = \frac{10}{1+j}$

$= 5000(1-j)^*$

So $P = 5\ kW$
$Q = 5\ kVA_r$
$S = 5\sqrt{2}\ kVA$

* we do VI^* to preserve sign convention ($P_L > 0$, $P_C < 0$)

→ Power Factor is the cosine of angle between voltage and current vectors. It is also the ratio of active power and apparent power.

→ Power Factor is the property of the load.

2.) Replace $1j\ \Omega$ with $4j\ \Omega$; $1\ \Omega$ with $3\ \Omega$. Do the same things.

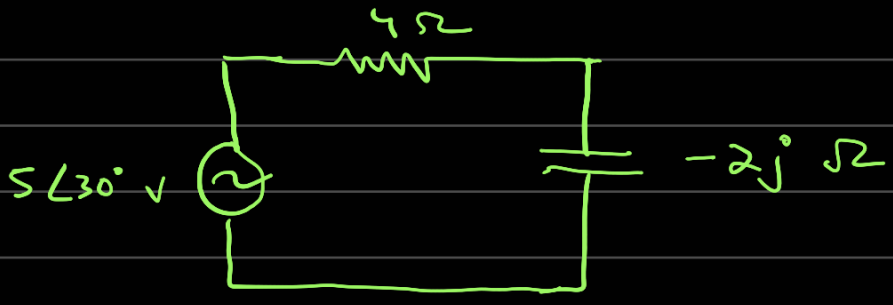
Ans.) $\vec{I} = \frac{100}{3+4j} = 4(3-4j) = 20\angle -53.13^\circ$

$\vec{V} = 100\angle 0^\circ$

$\vec{S} = \vec{V} \cdot \vec{I}^* = 100\angle 0^\circ \times 20\angle 53.13^\circ$
$= 100 \times (12 + 16j)$

$= 1200 + 1600j$ VA

3.)



Find S

Ans:) $Z = 4 - 2j = 2\sqrt{5} \angle -26.57^\circ \ \Omega$

$$I = \frac{5 \angle 30^\circ}{2\sqrt{5} \angle -26.57}$$

$$= \frac{\sqrt{5}}{2} \angle 56.57^\circ \ A$$

$$S = VI^*$$

$$= 5 \angle 30^\circ \ \frac{\sqrt{5}}{2} \angle -56.57^\circ$$

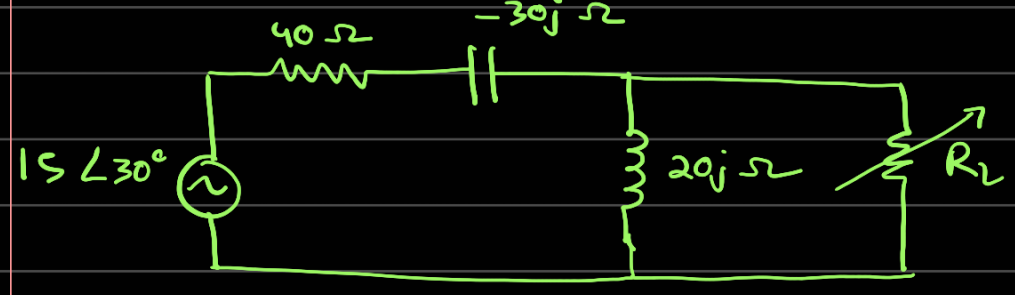
$$= \frac{5\sqrt{5}}{2} \angle -26.57^\circ \ VA$$

→ MPTT-

$$Z_L = Z_{Th}^*$$

max. Power gets transferred from source to load when load impedance = complex conjugate of source impedance.

4.)



Find R_L for MPT

Ans:) $$Z_{Th} = \frac{(40 - 30j)\,20j}{40 - 10j}$$

$$= 9.41 + 22.35j$$

So $R_L = |Z_{Th}| = 24.25\ \Omega$