

1) A Series Circuit of Resistance 60Ω and inductance 75mH is connected to a 110V , 60Hz supply. Calculate the amount of power dissipated.

Soln. $R = 60\Omega$, $L = 75\text{mH}$

$$V = 110\text{V}, f = 60\text{Hz}$$

$$P = ?$$

$$P = \frac{V^2}{R} = I^2 R = VI \cos \phi$$

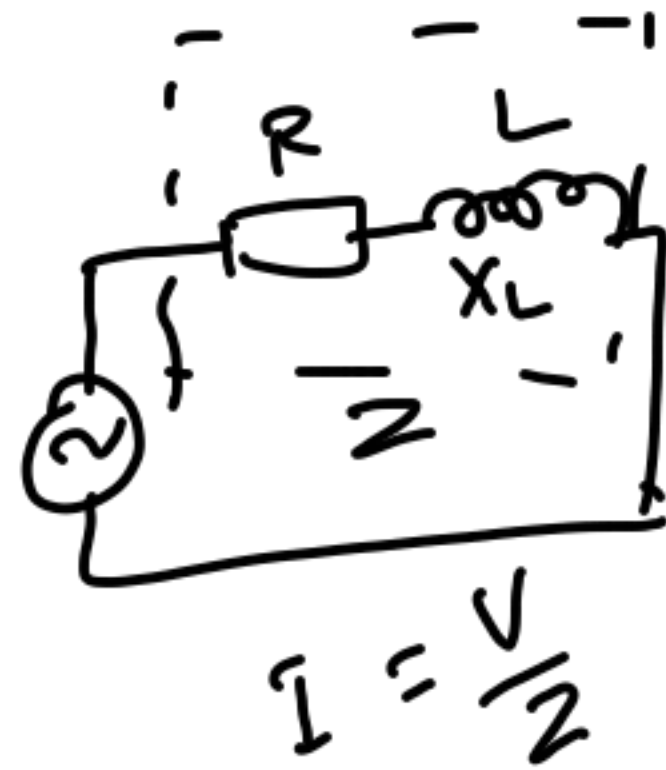
$$X_L = 2\pi fL$$

$$= 2\pi \times 60 \times 75 \times 10^{-3} = 28.27\Omega$$

$$Z = \sqrt{R^2 + X_L^2}$$

$$Z = \sqrt{60^2 + (28.27)^2}$$

$$Z = 66.33\Omega$$



To find Current

$$I = \frac{V}{Z} = \frac{110}{66.33} = 1.66\text{A}$$

$$P = I^2 R$$

$$= (1.66)^2 \times 60$$

$$P = 165.33 \text{ W}$$

$$P = VI \cos \phi$$

$$\cos \phi = P.F$$

$$P.F = \frac{R}{Z} = \frac{60}{66.33} = 0.905$$

$$P = 110 \times 1.66 \times 0.905$$

$$P = \underline{165.25 \text{ W}}$$

2) The power taken by an inductive circuit when connected to a 120V, 50Hz supply is 400W and the current is 8A. Calculate

- The Resistance
- the impedance
- the Reactance
- the power factor
- phase angle between V & I

$$V = 120V, f = 50Hz$$

$$P = 400W, I = 8A$$

$$a) P = I^2 R$$

$$R = \frac{P}{I^2} = \frac{400}{8^2} = 6.25 \Omega.$$

$$b) Z = \frac{V}{I} = \frac{120}{8} = 15 \Omega.$$

c) The Reactance, X_L

$$Z = \sqrt{R^2 + X_L^2}$$

Squaring both the sides

$$Z^2 = R^2 + X_L^2$$

$$X_L^2 = Z^2 - R^2$$

$$X_L = \sqrt{Z^2 - R^2}$$

$$X_L = \sqrt{15^2 - (6.25)^2}$$

$$X_L = 13.64 \Omega.$$

$$d) \text{Power factor} = \frac{R}{Z}$$

$$= \frac{6.25}{15} = 0.42$$

Phase Angle.

$$\text{Power factor} = \cos \phi$$

$$\cos \phi = 0.42.$$

$$\phi = \cos^{-1}(0.42)$$

$$\phi = 65^\circ 17'$$

3) A transformer has a rated output power of 200 kVA at a power factor of 0.8. Determine the Real power and the reactive power.

Soln. $S = 200 \text{ kVA} = V I$
Power factor = $0.8 = \cos \phi$

$$P = V I \cos \phi$$
$$= 200 \times 1000 \times 0.8$$

$$P = 160 \text{ kW}$$

Reactive power.

$$Q = V I \sin \phi$$

we know that

$$\cos \phi = 0.8$$

$$\phi = \cos^{-1}(0.8)$$

$$\phi = 36.87^\circ$$

Reactive power

$$Q = V I \sin \phi$$
$$= 200 \times 1000 \times \sin(36.87)$$

$$Q = 120 \text{ kVAR}$$

4) A pure inductance is connected to a 150 V, 50 Hz supply and the apparent power of the circuit is 300 VA. Find the value of inductance.

$$V = 150 \text{ V}, f = 50 \text{ Hz}, S = 300 \text{ VA}$$

$$L = ?$$

$$S = VI = 300 \text{ VA}$$

$$VI = 300$$

$$150 \times I = 300$$

$$I = \frac{300}{150} = 2 \text{ A}$$

$$X_L = 2\pi fL$$

$$X_L = Z = \frac{V}{I} = \frac{150}{2} = 75 \Omega$$

$$X_L = 2\pi fL$$

$$75 = 2\pi \times 50 \times L$$

$$L = \frac{75}{2\pi \times 50}$$

$$= 0.239 \text{ H}$$

$$X_L = 2$$

5) Obtain the polar and the rectangular form from the voltage equation. $V = 100 \sin(100\pi t + \frac{\pi}{6})$

Ans,

$$V = 100 \sin(100\pi t + \frac{\pi}{6})$$

$$V = V_m \sin(\omega t + \phi)$$

$$V_m = 100V$$

$$\omega = 100\pi$$

$$\phi = \frac{\pi}{6}$$

Polar form

$$r \angle \phi \Rightarrow V_{rms} \angle \phi$$

$$V_{RMS} = \frac{V_m}{\sqrt{2}} = \frac{100}{\sqrt{2}} = 70.7V$$

$$\phi = \frac{\pi}{6} = \frac{180}{6} = 30^\circ$$

$$\text{Polar form} \Rightarrow r \angle \phi = 70.7 \angle 30^\circ$$

Rectangular form.

$$X + jy$$

$$X = r \cos \phi = 70.7 \times \cos 30^\circ = 61.23$$

$$Y = r \sin \phi = 70.7 \times \sin 30^\circ = 35.36$$

$$X + jy = 61.23 + j35.36$$

6) Calculate the RMS value and the phase value of the current for the given value, $(25 + j40)A$

given $\underline{I} = (25 + j40)A$

$$r = \underline{I}_{rms} = \sqrt{25^2 + 40^2}$$

$$\underline{I}_{rms} = 47.2A$$

$$\phi = \tan^{-1}\left(\frac{Y}{X}\right)$$

$$= \tan^{-1}\left(\frac{40}{25}\right)$$

$$\phi = 50^\circ$$

