EE2001: CIRCUIT ANALYSIS

Tutorial 7 Solutions

(Power Factor)

{ Note : This tutorial will be preceded by Quiz Test }

7.1

(a) Find the original power factor seen by the source in problem 6.4.

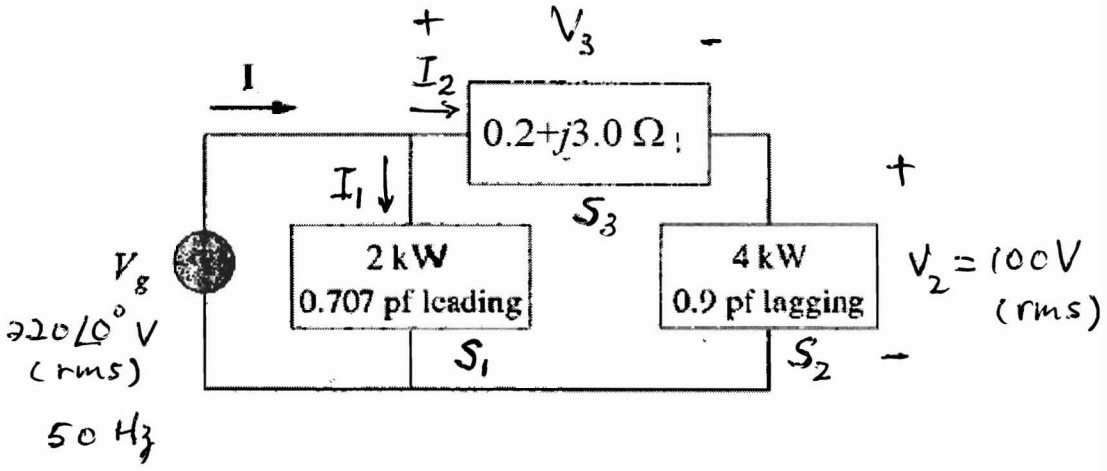
$$S_T = 6.395 + j\,0.233 \quad kVA$$

(Inductive load)

$$pf = \cos\left(\tan^{-1}\frac{0.233}{6.395}\right) = 0.9993$$

$$\approx 1$$

(b) Determine the power factor of the network on addition of the new load.



From Problem 6.4,

$$I_2 = 40 - j19.37 \text{ A}$$

$$S_3 = V_3 I_2^*$$

$$= (0.2 + j3) I_2 \cdot I_2^*$$

$$= (0.2 + j3)(40 - j19.37)(40 + j19.37)$$

$$= (0.2 + j3)(40^2 + 19.37^2)$$

$$= 395.04 + j5925.6 \text{ VA}$$

$$S_T = S_1 + S_2 + S_3$$

$$= (2 - j2) \cdot 10^3 + (4 + j1.937) \cdot 10^3 + 395.04 + j5925.6$$

$$= 6.395 + j5.862 \text{ kVA} \quad \text{(Inductive load)}$$

$$pf = \cos\left(\tan^{-1}\frac{5.862}{6.395}\right) = 0.7372 \text{ lagging}.$$

Power factor angle is

$$\theta = \tan^{-1}\frac{5.862}{6.395} = 42.5^\circ.$$

(c)

To raise the power factor from 0.7375 lagging to unity.

$$\theta = 42.5^\circ \longrightarrow \theta_c = 0^\circ$$

Connect a capacitor parallel to the loads, hence

$$Q_c = P(\tan\theta - \tan\theta_c)$$

$$= 6395(\tan 42.5^\circ - \tan 0^\circ)$$

$$= 5859.9 \text{ VAR}$$

$$C = \frac{Q_c}{\omega V_{rms}^2}$$

$$= \frac{5859.9}{2\pi \cdot 50 \cdot 220^2}$$

$$= 0.4 \text{ mF}$$