

Solutions problem 16-8+11+16+29

Problem 16-8

$$|S| = \frac{P}{\text{pf}} = \frac{8000}{0.8} = 10000 \text{ VA}$$

$$Q = -\sqrt{|S|^2 - P^2} = -\sqrt{(10000)^2 - (8000)^2} = -6000 \text{ VAR}$$

$$S = 8000 - j6000 \text{ VA}$$

$$|I| = \frac{|S|}{|V|} = \frac{10000}{880} = 11.36 \text{ A(rms)}$$

$$Z = \frac{S}{|I|^2} = \frac{8000 - j6000}{(11.36)^2} = 61.95 - j46.46 \Omega$$

Problem 16-11

$$\omega = 2\pi f = 376.99 \text{ rad/s}$$

$$Z_L = R + j\omega L = 100 + j56.55 \Omega$$

$$|I| = \frac{|V|}{|Z_L|} = \frac{240}{|100 + j56.55|} = 2.0891 \text{ A(rms)}$$

$$S_L = Z_L |I|^2 = (100 + j56.55)(2.0891)^2 = 436.438 + j246.8 \text{ VA}$$

$$\text{pf} = \frac{P_L}{|S_L|} = \frac{436.438}{|436.438 + j246.8|} = 0.87046 \quad \text{eller: } \frac{V_{rms}^2}{Z^*}$$

The reactive power is positive, so the power factor is lagging.

Problem 16-16

Determine the input impedance seen by the source.

$$Z_{IN} = j100 + [-j25 \parallel (100 + j100)] = 4 + j72 \Omega$$

Find the magnitude of the source current.

$$|I_S| = \frac{|V_S|}{|Z_{IN}|} = \frac{240}{|4 + j72|} = 3.3282 \text{ A(rms)}$$

Find the complex power produced by the source.

$$\text{eller: } \frac{V_{rms}^2}{Z^*}$$

$$S_S = Z_{IN} |I_S|^2 = (4 + j72)(3.3282)^2 = 44.3077 + j797.5385 \text{ VA}$$

Problem 16-29

$$\text{pf} = 0.7 \text{ lagging} \rightarrow \theta = 45.57^\circ; \quad S = |S|(\cos\theta + j\sin(\theta)) = 17500 + j17854 \text{ VA}$$

$$\text{Required: } S_c = -j17854 = (V_{rms})^2 / Z^* = -j (V_{rms})^2 \omega C \rightarrow C = 17854 / (2400^2 \cdot 2\pi \cdot 60) = 8.227 \mu\text{F}$$