

Chapter 11, Solution 50.

$$\begin{aligned} \text{(a)} \quad \mathbf{S} &= \mathbf{P} - j\mathbf{Q} = 1000 - j \frac{1000}{0.8} \sin(\cos^{-1}(0.8)) \\ \mathbf{S} &= 1000 - j750 \end{aligned}$$

$$\text{But, } \mathbf{S} = \frac{|\mathbf{V}_{\text{rms}}|^2}{\mathbf{Z}^*}$$

$$\mathbf{Z}^* = \frac{|\mathbf{V}_{\text{rms}}|^2}{\mathbf{S}} = \frac{(220)^2}{1000 - j750} = 30.98 + j23.23$$

$$\mathbf{Z} = [30.98 - j23.23] \, \Omega$$

$$\begin{aligned} \text{(b)} \quad \mathbf{S} &= |\mathbf{I}_{\text{rms}}|^2 \mathbf{Z} \\ \mathbf{Z} &= \frac{\mathbf{S}}{|\mathbf{I}_{\text{rms}}|^2} = \frac{1500 + j2000}{(12)^2} = [10.42 + j13.89] \, \Omega \end{aligned}$$

$$\begin{aligned} \text{(c)} \quad \mathbf{Z}^* &= \frac{|\mathbf{V}_{\text{rms}}|^2}{\mathbf{S}} = \frac{|\mathbf{V}|^2}{2\mathbf{S}} = \frac{(120)^2}{(2)(4500 \angle 60^\circ)} = 1.6 \angle -60^\circ \\ \mathbf{Z} &= 1.6 \angle 60^\circ = [0.8 + j1.386] \, \Omega \end{aligned}$$