Chapter 11, Solution 39.

An ac motor with impedance $Z_L = 4.2 + j3.6\ \Omega$ is supplied by a 220-V, 60-Hz source. (a) Find pf, P, and Q. (b) Determine the capacitor required to be connected in parallel with the motor so that the power factor is corrected to unity.

Solution

(a) $Z_L = 4.2 + j3.6 = 5.5317 \angle 40.6^o$

pf = cos 40.6 = **0.7592**

$$S = \frac{V_{rms}^2}{Z^*} = \frac{220^2}{5.5317\angle -40.6^o} = 6.643 + j5.694 \text{ kVA}$$

P = **6.643 kW**

Q = **5.695 kVAR**

(b) $$C = \frac{P(\tan\theta_1 - \tan\theta_2)}{\omega V_{rms}^2} = \frac{6.643x10^3(\tan 40.6^o - \tan 0^o)}{2\pi x60x220^2} = \underline{312\ \mu\text{F}}$$, **312 μF**

{It is important to note that this capacitor will see a peak voltage of $220\sqrt{2} = 311.08$***V, this means that the specifications on the capacitor must be at least this or greater!}***