Chapter 11, Solution 72.

(a) $P = S \cos \theta_1 \quad \longrightarrow \quad S = \dfrac{P}{\cos \theta_1} = \dfrac{2.4}{0.8} = 3.0 \text{ kVA}$

$pf = 0.8 = \cos \theta_1 \quad \longrightarrow \quad \theta_1 = 36.87^o$

$Q = S \sin \theta_1 = 3.0 \sin 36.87^o = 1.8 \text{ kVAR}$

Hence, $\quad S = 2.4 + j1.8 \text{ kVA}$

$S_1 = \dfrac{P_1}{\cos \theta} = \dfrac{1.5}{0.707} = 2.122 \text{ kVA}$

$pf = 0.707 = \cos \theta \quad \longrightarrow \quad \theta = 45^o$

$Q_1 = P_1 = 1.5 \text{ kVAR} \quad \longrightarrow \quad S_1 = 1.5 + j1.5 \text{ kVA}$

Since, $S = S_1 + S_2 \quad \longrightarrow \quad S_2 = S - S_1 = (2.4 + j1.8) - (1.5 + j1.5) = 0.9 + j0.3 \text{ kVA}$

$S_2 = 0.9497 < 18.43^o$

pf $= \cos 18.43^o = \underline{0.9487}$

(b) $pf = 0.9 = \cos \theta_2 \quad \longrightarrow \quad \theta_2 = 25.84^o$

$C = \dfrac{P(\tan \theta_1 - \tan \theta_2)}{\omega V_{rms}^2} = \dfrac{2400(\tan 36.87 - \tan 25.84)}{2\pi x 60 x (120)^2} = \underline{117.5 \ \mu F}$