ECEN 460 SPRING 2023 (Birchfield) Quiz 3 26 Jan 2023

Name: _____ UIN: _____ Score: _____

An agricultural customer is supplied with a single-phase (60 Hz) 7.2 kV utility connection. It is consuming 5.5 MW of active (real) power and the measured power factor is 0.71 lagging.

1. How much reactive power is the customer currently consuming?

$$\tan\phi = \frac{Q}{P} \rightarrow Q = P\ \tan(\text{acos}(0.71)) = 5.46\ \text{Mvar}$$

2. What would be the capacitance of the capacitor necessary to improve the power factor to 0.9 lagging?

$$Q = P\tan(\text{acos}(.9)) = 2.66\ \text{Mvar}$$
$$Q_c = 2.66 - 5.46 = -2.80\ \text{Mvar}$$
$$Z_c = \frac{|V|^2}{S^*} = \frac{(7.2\ \text{kV})^2}{j2.8\ \text{Mvar}} = -j18.5\ \Omega$$
$$Z_c = \frac{1}{j\omega C} \rightarrow C = \frac{1}{j\omega Z_c} = \frac{1}{j2\pi 60\ \text{Hz} \cdot -j18.5\ \Omega} = 143.4\ \mu F$$