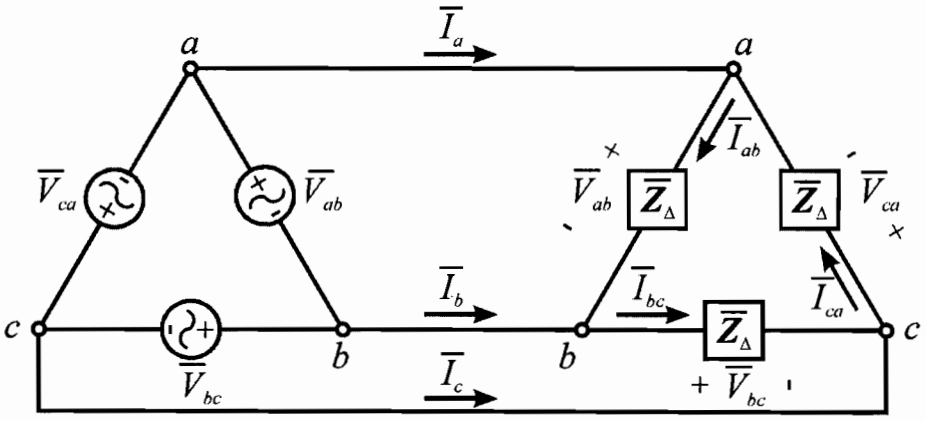
EE 330/330L Energy Systems (Spring 2012) Quiz #1

Name Key B

Instructions: Open notes & homework. Place answers in indicated spaces & show all work for credit.

For the balanced three-phase circuit shown, the phase voltage is measured to be 220 V_{rms} and the load impedance is $12 + j3\ \Omega$. Determine the phase I_ϕ & line I_L currents and line-to-line voltage V_{LL}. Then, find the real power P, reactive power Q, and apparent power S supplied by the source as well as the power factor *pf*.



For Δ-source (A-14) $V_{LL} = V_\phi = 220 V_{rms}$

$\overline{Z}_\phi = \overline{Z}_\Delta = 12 + j3\ \Omega = 12.36932 \angle 14.03624^\circ\ \Omega$

$I_\phi = V_\phi / Z_\phi = \frac{220}{12.36932} = 17.785946\ A_{rms}$

(A-15) $I_L = \sqrt{3}\, I_\phi = 30.80618\ A_{rms}$

$pf = \cos\theta_z = \cos 14.03624^\circ = 0.97014$ lagging (R-L Load)

(A-23) $P = 3V_\phi I_\phi \cos\theta = 3(220)(17.786)0.97014 = 11,388.2\ W$

(A-24) $Q = 3V_\phi I_\phi \sin\theta = 3(220)(17.786)\sin 14.036^\circ = 2847.06\ VAR$

(A-25) $S = 3V_\phi I_\phi = 3(220)(17.786) = 11,738.7\ VA$

$I_\phi =$ 17.786 A_{rms} $I_L =$ 30.806 A_{rms} $V_{LL} =$ 220 V_{rms} $pf =$ 0.9701 lagging

$P =$ 11.388 kW $Q =$ 2.847 kVAR $S =$ 11.739 kVA