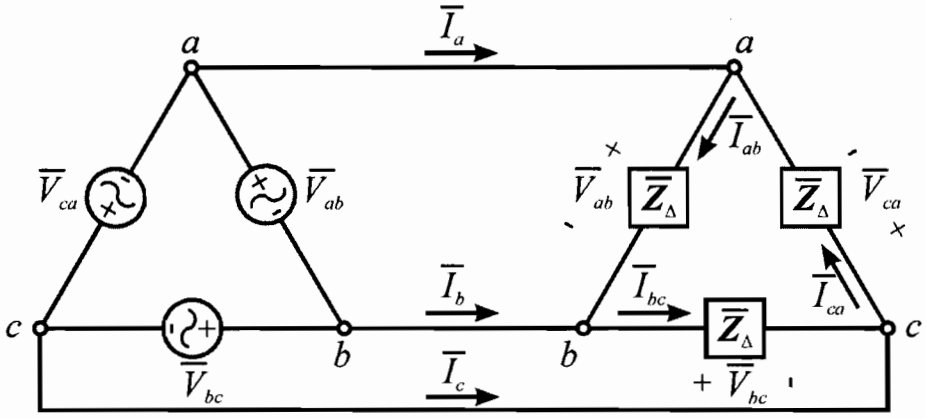
EE 330/330L Energy Systems (Spring 2012) Quiz #1

Name Key A

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 240 V_{rms} and the load impedance is $16 + j4\ \Omega$. 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 → $V_{LL} = V_\phi = 240\ V_{rms}$ $\bar{Z}_\phi = \bar{Z}_\Delta = 16 + j4\ \Omega$

(A-14) → $I_\phi = \frac{V_\phi}{Z_\phi} = \frac{240}{16.4924}$ $= 16.4924 \angle 14.036^\circ\ \Omega$

+

(A-15) → $= 14.55214\ A_{rms}$

$I_L = \sqrt{3}\, I_\phi = \sqrt{3}(14.552) = 25.205\ A_{rms}$

$pf = \cos\theta_z = \cos 14.036^\circ = 0.9701$ lagging (R-L load)

(A-23) $P = 3 V_\phi I_\phi \cos\theta = 3(240)(14.55214)\,0.9701 = 10,164.3\ W$

(A-24) $Q = 3 V_\phi I_\phi \sin\theta = 3(240)(14.55214)\sin 14.03624^\circ = 2541.2\ VAR$

(A-25) $S = 3 V_\phi I_\phi = 3(240)\,14.55214 = 10,477.5\ VA$

$I_\phi =$ 14.552 A_{rms} $I_L =$ 25.205 A_{rms} $V_{LL} =$ 240 V_{rms} $pf =$ 0.9701 lagging

$P =$ 10.164 KW $Q =$ 2.541 KVAR $S =$ 10.478 KVA