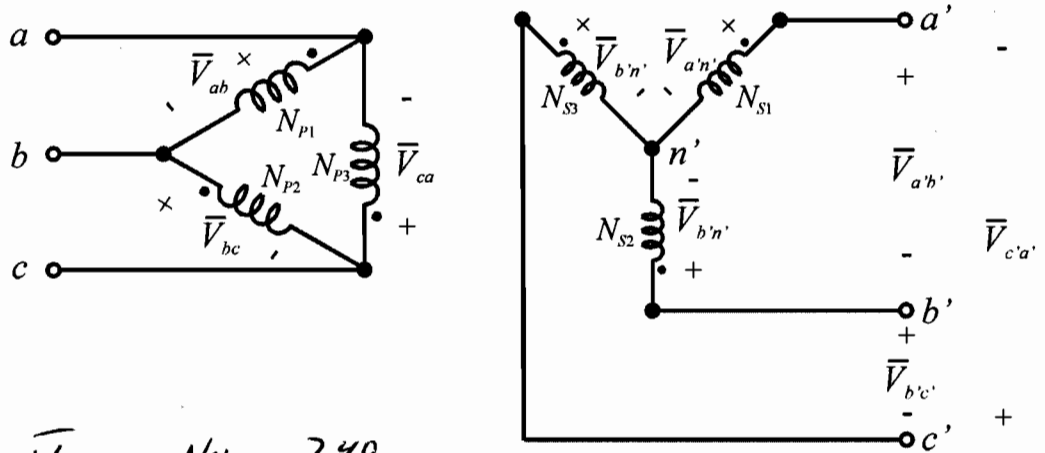
EE 330/330L Energy Systems (Spring 2012) Quiz #4

Name Key B

Instructions: **Closed** book. Place answers in indicated spaces & show all work for credit.

Helpful equations- $\frac{\bar{V}_P}{\bar{V}_S}=\frac{N_P}{N_S}=a$, $\frac{\bar{I}_P}{\bar{I}_S}=\frac{N_S}{N_P}=\frac{1}{a}$, $P=\sqrt{3}V_{LL}I_L\cos\theta$, $Q=\sqrt{3}V_{LL}I_L\sin\theta$

For the Δ-Y transformer shown, the primary phase voltages are $\bar{V}_{ab}=480\angle 60°\ V_{rms}$, $\bar{V}_{bc}=480\angle 180°\ V_{rms}$, and $\bar{V}_{ca}=480\angle -60°\ V_{rms}$. Find the secondary line-to-line voltages $\bar{V}_{a'b'}$, $\bar{V}_{b'c'}$, & $\bar{V}_{c'a'}$ and secondary phase voltages $\bar{V}_{a'n'}$, $\bar{V}_{b'n'}$, & $\bar{V}_{c'n'}$. Assume ideal transformers and $N_{P1}=N_{P2}=N_{P3}=240$ and $N_{S1}=N_{S2}=N_{S3}=150$.



coil #1 $\frac{\bar{V}_{ab}}{\bar{V}_{a'n'}}=\frac{N_{P1}}{N_{S1}}=\frac{240}{150}$ $\Rightarrow$ $\bar{V}_{a'n'}=\frac{150}{240}\bar{V}_{ab}=\frac{15}{24}(480\angle 60°)=300\angle 60°$

coil #2 $\bar{V}_{b'n'}=\frac{15}{24}(480\angle 180°)=300\angle 180°\ V_{rms}$

coil #3 $\bar{V}_{c'n'}=\frac{15}{24}(480\angle -60°)=300\angle -60°\ V_{rms}$

By KVL $\bar{V}_{a'b'}=\bar{V}_{a'n'}-\bar{V}_{b'n'}=300\angle 60°-300\angle 180°=519.615\angle 30°\ V$

$\bar{V}_{b'c'}=\bar{V}_{b'n'}-\bar{V}_{c'n'}=300\angle 180°-300\angle -60°=519.615\angle 150°\ V$

$\bar{V}_{c'a'}=300\angle -60°-300\angle 60°=519.615\angle -90°\ V$

$\bar{V}_{a'b'}=$ $519.6\angle 30°\ V_{rms}$ $\bar{V}_{b'c'}=$ $519.6\angle 150°\ V_{rms}$ $\bar{V}_{c'a'}=$ $519.6\angle -90°\ V_{rms}$

$\bar{V}_{a'n'}=$ $300\angle 60°\ V_{rms}$ $\bar{V}_{b'n'}=$ $300\angle 180°\ V_{rms}$ $\bar{V}_{c'n'}=$ $300\angle -60°\ V_{rms}$