ECE 420 Homework#3

1. Consider the balanced three-phase system shown in Figure 1. $V_{AN} = 132.79\angle 0^\circ$kV, $V_{BN} = 132.79\angle{-120}^\circ$kV, $V_{CN} = 132.79\angle{+120}^\circ$kV. Transmission line impedance of **each phase** is $Z_{line} = j3.0\ \Omega$. The load is Y connected and the load impedance of **each phase** is $Z_{load} = 80+j60\ \Omega$.

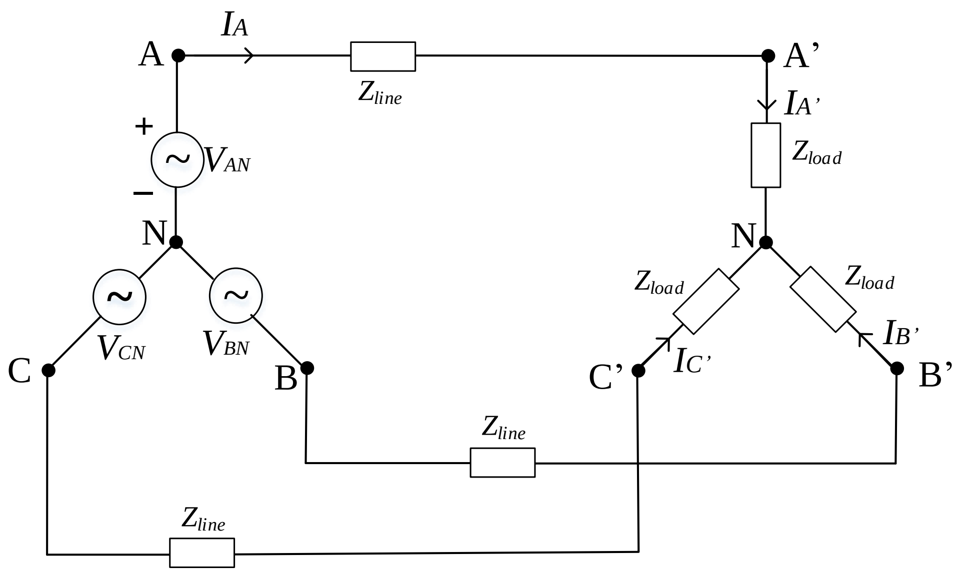

Figure 1

(a) (1 points) Determine voltage V_{AB} and currents I_A , $I_{A'}$, $I_{B'}$, $I_{C'}$.

(b) (1 points) Determine voltages $V_{A'N}$, $V_{B'N}$, $V_{C'N}$, and $V_{A'B'}$

(c) (1 points) Determine the complex power consumed by phase A load (S_{loadA}), phase B load (S_{loadB}), and phase C load (S_{loadC}). Determine the total complex power consumed by the three phases of load ($S_{3\phi}$).

2. For the system as shown in Figure 1, $V_{AN} = 132.79\angle\mathbf{50}^\circ$kV, $V_{BN} = 132.79\angle\mathbf{-70}^\circ$kV, $V_{CN} = 132.79\angle\mathbf{-190}^\circ$kV. Transmission line impedance of **each phase** is $Z_{line} = j3.0\ \Omega$. The load is Y connected and the load impedance of **each phase** is $Z_{load} = 80+j60\ \Omega$.
(a) (2 points) Determine V_{AB}, $V_{A'N}$, $V_{A'B'}$, $I_{A'}$, S_{loadA}, S_{loadB}, S_{loadC}, and $S_{3\phi}$

(b) (1 points) Compare the results of V_{AB}, $V_{A'N}$, $V_{A'B'}$, $I_{A'}$, S_{loadA}, S_{loadB}, S_{loadC}, and $S_{3\phi}$ to the values obtained in problem 1, what values have changed? What values stay the same?

3. Consider the balanced three-phase system shown in Figure 1. $V_{AN,pu} = 1.0\angle 0^\circ$ pu, $V_{BN,pu} = 1.0\angle{-120^\circ}$ pu, $V_{CN,pu} = 1.0\angle{+120^\circ}$ pu. Transmission line impedance of **each phase** is $Z_{line,pu} = (j3.0\ \Omega)/Z_{base}$. The load is Y connected and the load impedance of **each phase** is $Z_{load,pu} = (80+j60\ \Omega)/Z_{base}$

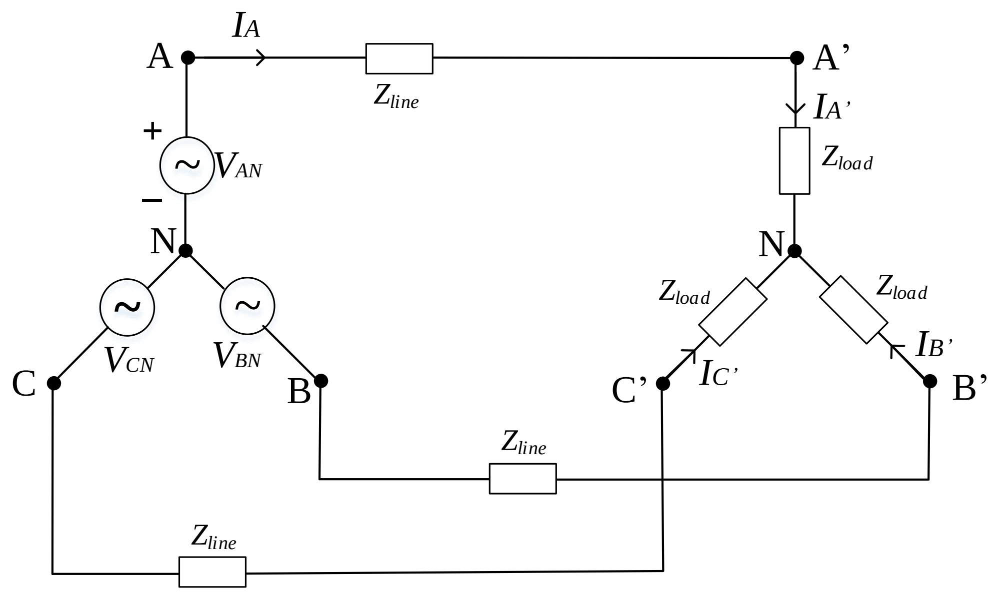

Figure 2

(a) (1 points) Use $V_{ll,b}$ = 230 kV, $V_{LN,b} = 230/\sqrt{3}$ kV = 132.79 kV, $S_{3\phi,b}$ = 100 MVA, $S_{\phi,b}$ = 33.33 MVA, $I_{base} = \dfrac{S_{\phi,b}}{V_{LN,b}} = \dfrac{S_{3\phi,b}}{\sqrt{3}V_{ll,b}}$, $Z_{base} = \dfrac{(V_{LN,b})}{(\frac{S_{\phi,b}}{V_{LN,b}})} = \dfrac{(V_{ll,b}/\sqrt{3})}{(\frac{S_{3\phi,b}}{\sqrt{3}V_{ll,b}})} = \dfrac{V_{ll,b}^2}{S_{3\phi,b}}$ to determine I_{base} , Z_{base}, $Z_{line,pu}$, and $Z_{load,pu}$. (Note that I_{base} should have unit A, Z_{base} should have unit Ω. Z_{line} and Z_{load} should have no unit because the Ω on the numerator and denominator are canceled out.)

(b) (2 points) Determine $V_{A'N,pu}$, $I_{A',pu}$, and $S_{loadA,pu}$

(c) (1 points) Multiply line-to-neutral voltage $V_{A'N,pu}$ by $V_{LN,b}$, multiply $I_{A',pu}$ by I_{base}, and multiply $S_{loadA,pu}$ by $S_{\phi,b}$, to obtain their actual values. Compare the results with problem 1.