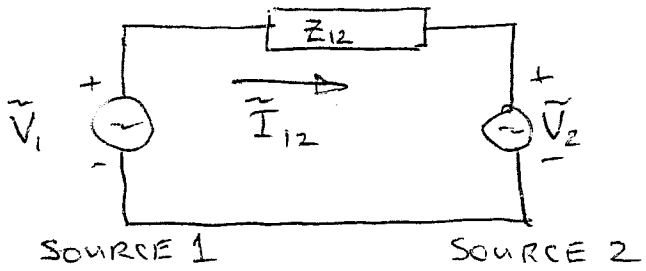
EE 5223 - Homework #3A - Due latest Tues Feb 7, 2023, 9am
(Form team of 3, a least one BSEE and one MSEE student per team!)

H1.1) For the following circuit, $v_1(t) = 120\cos(\omega t + 0°)$, $v_2(t) = 120\sin(\omega t + 60°)$ and $\mathbf{Z}_{12} = 0.5 + j0.5\Omega$.

a) Convert $v_1(t)$ and $v_2(t)$ to their phasor equivalents $\mathbf{V}_1$ and $\mathbf{V}_2$. According to the "sign convention" used to label the current and sources, classify the two sources as "active" or "passive."
b) Calculate $\mathbf{I}_{12}$.
c) Calculate the complex power **S** consumed by source 2.
d) Calculate the complex power **S** produced by source 1.
e) In terms of generator or load, what are sources 1 & 2? Was the correct guess made in labeling current direction?
f) What is the power factor of source 2?



H1.2) A 3-phase 480-Volt circuit has a positive-sequence Y-connected source and supplies a delta-connected load. The impedance of the lines between the source and load is negligible. The angle of $\mathbf{V}_{AB}$ is 0° and the phase impedance of the load is 20 - j8 Ohms.

a) Draw the circuit. Label the value of the phase voltages at the source. Label nodes A, B, and C.
Label the line currents $\mathbf{I}_A$, $\mathbf{I}_B$, and $\mathbf{I}_C$. Label the L-L voltages at the load: $\mathbf{V}_{AB}$, $\mathbf{V}_{BC}$, and $\mathbf{V}_{CA}$.
Label the phase currents at the load: $\mathbf{I}_{AB}$, $\mathbf{I}_{BC}$, and $\mathbf{I}_{CA}$.

b) Determine the phasor values of the L-L voltages at the load. Draw the closed voltage phasor diagram for the system, showing all L-L and L-N voltages.

c) Determine the phasor value of the line currents.

d) Determine the phasor value of the phase currents in the source and the load.

e) Calculate the complex power S that is consumed by the load and draw the power triangle.

f) What is the power factor of the load?

H1.3) A 3-phase 480-Volt circuit has a positive-sequence Y-connected source and supplies a delta-connected load. The impedance of the lines between the source and load is $1\underline{/85}^{\circ}$ Ohms. The angle of $\mathbf{V}_{AB}$ is 0° and the phase impedance of the load is $30\underline{/40}^{\circ}$ Ohms.

a) Draw the circuit. Label the value of the phase voltages at the source. Label nodes A, B, and C at source and A', B', and C' at load.
Label the line currents $\mathbf{I}_A$, $\mathbf{I}_B$, and $\mathbf{I}_C$. Label L-L voltages at the load: $\mathbf{V'}_{AB}$, $\mathbf{V'}_{BC}$, and $\mathbf{V'}_{CA}$.
Label the phase currents at the load: $\mathbf{I}_{AB}$, $\mathbf{I}_{BC}$, and $\mathbf{I}_{CA}$.

b) Convert the load to an equivalent Y-connected impedance and combine with the line impedances.

c) Determine the phasor values of the L-L voltages at the source. Draw the closed voltage phasor diagram for the system, showing all L-L and L-N voltages.

d) Using an A-N per phase equivalent, determine the phasor values of the line currents.

e) Determine the L-N and L-L voltages at the terminals of the delta load.

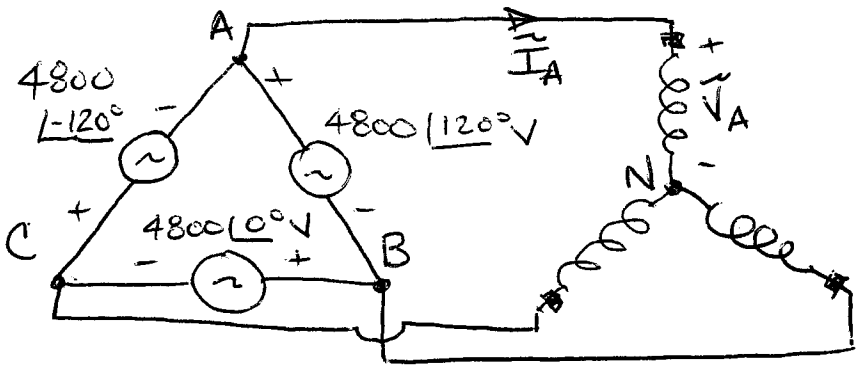
f) Determine the phasor value of the phase currents in the source and the load.

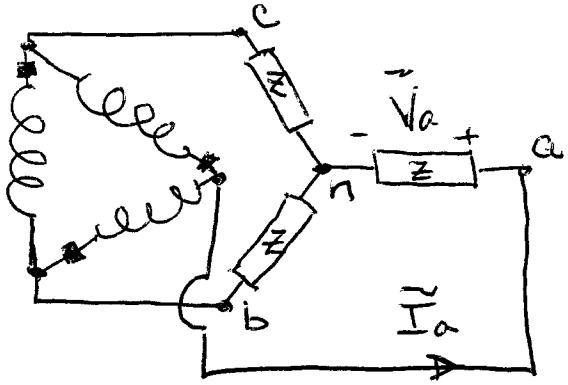
g) Calculate the complex power S that is consumed by the load and draw the power triangle.

h) What is the power factor of the load?

H1.4

A balanced 3ϕ Δ-connected 4800V source supplies a balanced 208V Y-connected load through a Y-Δ transformer. Z = 4 - j2Ω in each phase of the load.





a) Determine the following voltage and current magnitudes:

$V_{LL,PRI}$ = _____ $V_{LN,PRI}$ = _____ $V_{LL,SEC}$ = _____ $V_{LN,SEC}$ = _____

$I_{PH,SRC}$ = _____ $I_{PH,PRI}$ = _____ $I_{PH,SEC}$ = _____ $I_{PH,LOAD}$ = _____

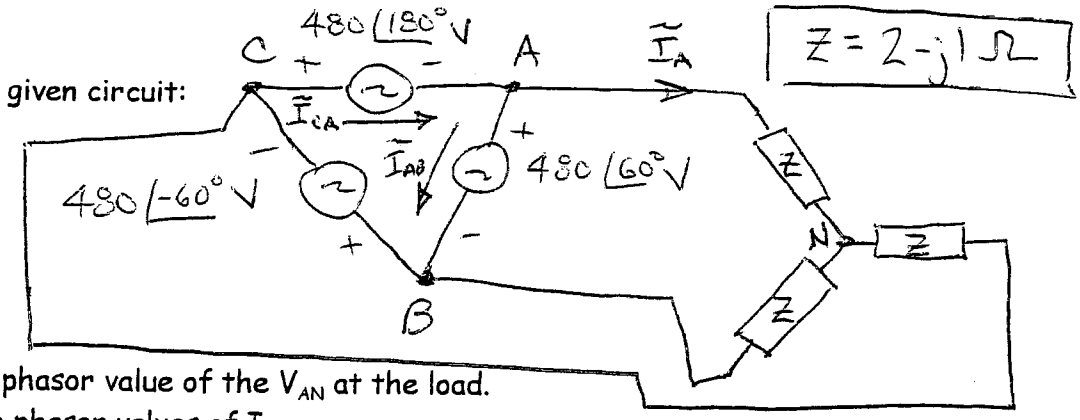
b) Draw **closed** phasor diagrams of the primary and secondary voltages, orienting all phasors to the nearest 30° angle. Label all phasors (i.e. V_A, V_{AB}, V_a, V_{bc}, etc.)

PRIMARY VOLTAGES SECONDARY VOLTAGES

c) Find the phasor values of the following: V_a, I_a, V_A, and I_A.

H1.5

For the given circuit:



a) Calculate the phasor value of the V_{AN} at the load.

b) Calculate the phasor values of I_A.

c) Calculate the phasor values of I_{AB} and I_{CA}.

H2.1) A single-phase autotransformer has an input voltage of 1380 Volts and supplies a 277-Volt 15-kW load of PF = 0.8 lag. Assuming that the voltage at the load has a reference angle of zero degrees,

a) Draw the complete circuit, including source, transformer, and load. Label all voltages and currents. Show polarity markings on the transformer windings.
b) Determine the phasor value of the current flowing into the load.
c) Determine the phasor value of the currents in the 2 windings of the autotransformer, and specify the required voltage and current ratings for each of the windings.
d) What is that phase angle of the source voltage?
e) Calculate the volt-amp advantage of this particular transformer.
f) Explain what the volt-amp advantage is, by contrasting the performance and cost of this autotransformer with an equivalent 2-winding transformer.