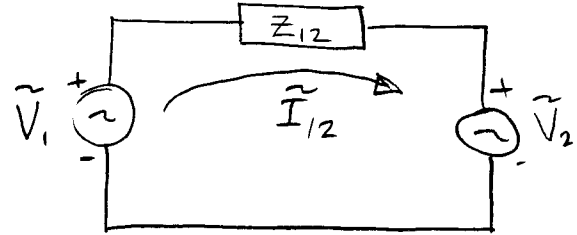


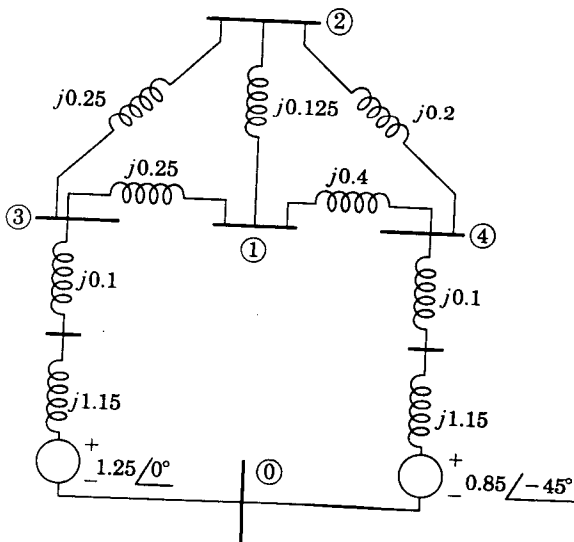
Due 9am Mon September 20th.
 This is an individual submission.
 Use Homework Cover Sheet!

EE5200 CKTS EXERCISE

- 1) [15pts] For the following circuit, $v_1(t) = 100 \cos(\omega t + 0^\circ)$, $v_2(t) = 120 \sin(\omega t - 30^\circ)$ and $Z_{12} = 0.5 - j0.5\Omega$.
- Convert $v_1(t)$ and $v_2(t)$ to their phasor equivalents V_1 and V_2 .
 - Calculate I_{12} .
 - Calculate the complex power S consumed by "source 2".
 - In terms of generator or load, what are sources 1 & 2? Was the correct guess made in labeling current direction?
 - What is the power factor of "source 1"?



- 2) [10 pts] Form $[Y_{BUS}]$ for the network given. Values given are **impedances** in ohms.



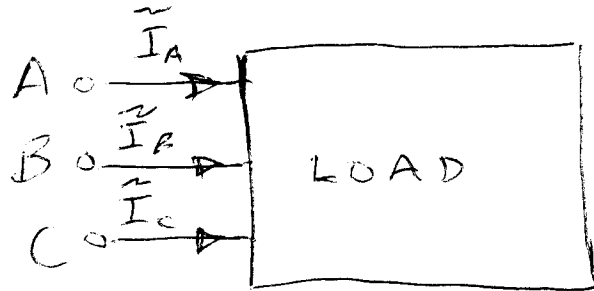
- 3) [20 pts] A balanced Δ -connected 3ϕ 480-V positive sequence source supplies a balanced Y-connected load. The load has a per phase impedance of $Z_Y = 18 + j24\Omega$. Assume that V_{AN} has an angle of 0° .
- Draw a schematic of the circuit, labeling all of the load and source voltages. Also label line currents and phase currents within the Δ -connected source.
 - Draw the closed voltage phasor diagram. Label all L-N and L-L voltages.
 - Solve for the line current I_A which flows toward the load.
 - Solve for the phase current I_{BA} flowing in the source.
 - Draw a phasor diagram, showing the line currents and the phase currents in the Δ -connected source.

- 4) [20 pts] Answer any four of the following short essay questions. Indicate which one you do **not** want graded, or else the first 4 will be graded. Give very brief to-the-point answers. Two or three sentences should do it. A quick sketch or equation is worth 1000 words.
- a) [5 pts] Why might an engineer want to place an additional impedance in the neutral path of a grounded-wye load or a grounded wye source? And what effect does it have on the zero sequence impedance?
- b) [5 pts] Consider the L-L voltages measured from an unbalanced Y-connected voltage source. Are there any zero sequence components in the L-L voltages? Explain why or why not.
- c) [5 pts] Explain what effect the existence of non-zero off-diagonal elements in the sequence impedance matrix $[Z_s]$ has on the solution for V and I in the sequence networks.
- d) [5 pts] For steady-state network calculations involving synchronous machines, the synchronous (also called "steady-state") reactances are specified for the machine impedances. Besides synchronous reactance, what other machine impedances might be used instead, and for what type of simulation (network calculation) are each of them used?
- e) [5 pts] Explain the difference between "generator convention" and "load convention."

- 5) [20 pts] A 3 ϕ motor draws 20 kVA at 0.707 power factor lagging from a 480-volt source. The owner of the motor must pay the utility a penalty charge, since the current drawn through the utility's lines at this low power factor is higher than necessary, making for higher than necessary I^2R line losses.
- Determine the kVAR rating of shunt capacitors to make the combined power factor 0.95 lagging. Draw "before" and "after" power triangles and use them as the basis of solution.
 - Determine the RMS magnitude of the line current before and after the capacitors are added. (Don't waste time calculating the kVAR size of the capacitors).
 - By what percentage have the I^2R losses on the utility's line been reduced? (Give answer as a percentage of the "before" I^2R losses. Hint: you don't need to know the value of R, just the ratio of the currents squared).

- 6) [15 pts] A 3ϕ 22-kV Δ -connected synchronous generator has a per phase synchronous reactance of $j0.9\Omega$ and produces a positive sequence voltage. A line of $0.05 + j0.125\Omega$ per phase connects the generator to a balanced Y-connected load of $3 + j4\Omega$ per phase. The load neutral is grounded through a reactance of $j0.05\Omega$ (this is called a Peterson coil). Draw the positive, negative and zero sequence networks, labelling all impedances values. Don't solve.

- 7) In each of the following cases, a balanced 3-phase source supplies a balanced 3-phase load. For all phasor calculations, assume that V_{AN} is the "reference." (The angle of V_{AN} is 0°)



For each case, first draw the power triangle for the load, labeling P, Q, S , and θ .

a) $V_{LL} = 34.5 \text{ kV RMS}$. The source is positive sequence and the load consumes 165 kW at a PF of 0.75 LEAD. Calculate the phasor values of I_A and I_B flowing into the load.

b) $V_{LL} = 69 \text{ kV RMS}$. The source is positive sequence and the load consumes 300 MVA at a PF of 0.8 LAG. Calculate the phasor value of I_A flowing into the load.

c) $V_{LL} = 480 \text{ V RMS}$. The source is negative sequence and the load generates 58 kVAR. The PF is known to be 0.6, but it was not noted whether it is LEAD or LAG. Calculate the phasor value of I_B flowing into the load. Is the PF LEAD or LAG? Explain.