EE 313 – Problem Set 5

1. A balanced, three-phase, Y-connected source has a line voltage magnitude of 400 Vrms. It is connected to two balanced, 3-phase, Y-connected loads. The first load absorbs a total 3-phase average power15 kW at a PF = 0.25 lagging. The second load absorbs a total 3-phase complex power of $60\angle 50^{o}$ kVA.

a. Draw a per phase circuit of this system. What are the line to line voltages?
b. What is the phase voltage, $V_P$?
c. What are the line currents?
d. What is the phase current, $I_P$?
e. What is the per phase impedance for each load?
f. What is the total average power delivered by the source?
g. Design a 3-phase, Y-connected, balanced corrective load that will change the total power factor of all three loads to 0.95 lagging. Remember that the average power delivered and the line voltage magnitude may not change.

2. A balanced three-phase, Y-connected source has a line to neutral voltage magnitude of 100 V rms. It is connected to two 3-phase, balanced, Δ-connected loads. The first load absorbs a total 3-phase complex power of $3.3\angle 75^{o}$ kVA. The second load absorbs a total 3-phase complex power of $6\angle 10^{o}$ kVA.

a. Draw a per phase circuit of this system. What are the line to line voltages?
b. What is the phase voltage, $V_P$?
c. What are the line currents?
d. What is the phase current, $I_P$?
e. What is the per phase impedance for each load?
f. What is the total average power delivered by the source?
g. Design a 3-phase, Δ-connected, balanced corrective load that will change the total power factor of all three loads to 0.8 lagging. Remember that the average power delivered and the line voltage magnitude may not change.

3. A balanced three-phase, Y-connected source has a line-to-neutral source voltage magnitude of 120 V rms. It is connected to two 3-phase balanced loads. The first load is Δ-connected and absorbs a total 3-phase average power of 24 kW at a PF of 0.468 lagging. The second load is Y-connected and absorbs a total 3-phase complex power of $12\angle 30^{o}$ kVA.

a. Draw a per phase circuit assuming a Y-Y system.
b. What are the line-to-line voltages?
c. What is the phase voltage, $V_P$?
d. What are the line currents?
e. What is the phase current, $I_P$?
f. What is the per phase impedance for each load?
g. What is the total average power delivered by the source?

h. Design a 3-phase, Δ-connected, balanced corrective load that will change the total power factor of all three loads to 0.9 lagging. Remember that the average power delivered and the line voltage magnitude may not change.
i. Draw a per phase circuit assuming a Y-Δ system and repeat parts (b-h)

4. A balanced, 3-phase Y-connected source is connected to two balanced, 3-phase loads as given below:
Z1: Absorbs 3-phase average power of 12 kW at PF=0.257 lagging.
Z2: Absorbs 3-phase average power and reactive power of 6 kW and 15 kVAR, respectively.

The system has a line current magnitude of 300 Arms.

a. What are the line-to-neutral and line-to-line voltages?
b. Assuming a Y-Δ system, what are the phase voltage and phase current?
c. Find the load impedances assuming both are Δ-connected?
d. Find the load impedances assuming both are Y-connected?
e. Design a balanced, 3-phase Y-connected load that will minimize the line current magnitude. Assuming that the line voltage and average power do not change.