

ECE 476 – Power System Analysis Fall 2017

Homework 2

In-class quiz: Thursday, September 14, 2017

Problem 1. A three-phase line, which has an impedance of $(2 + j4) \Omega$ per phase, feeds two balanced three-phase loads that are connected in parallel. One of the loads is Y-connected with an impedance of $(30 + j40) \Omega$ per phase, and the other is Δ -connected with an impedance of $(60 - j45) \Omega$ per phase. The line is energized at the sending end from a 60-Hz, three-phase, balanced voltage source of $120\sqrt{3}$ V (rms, line-to-line). Determine:

1. The current, real power, and reactive power delivered by the sending-end source.
2. The line-to-line voltage at the load.
3. The current per phase in each load.
4. The total three-phase real and reactive powers absorbed by each load and by the line.

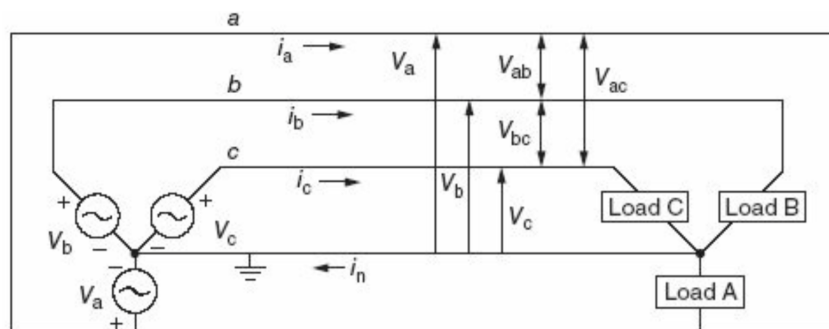
Check that the total three-phase complex power delivered by the source equals the total three-phase power absorbed by the line and loads.

Problem 2. Two three-phase generators supply a three-phase load through separate three-phase lines. The load absorbs 30 kW at 0.8 power factor lagging. The line impedance is $(1.4 + j1.6) \Omega$ per phase between generator G1 and the load, and $(0.8 + j1) \Omega$ per phase between generator G2 and the load. If generator G1 supplies 15 kW at 0.8 power factor lagging, with a terminal voltage of 460 V line-to-line, determine:

1. The voltage at the load terminals.
2. The voltage at the terminals of generator G2.
3. The real and reactive power supplied by generator G2.

Assume balanced operations.

Problem 3. An unbalanced three-phase, Y-connected power system is shown in the figure below. The three phases have voltages $\bar{V}_a = 100\angle 0^\circ$ V, $\bar{V}_b = 100\angle -120^\circ$ V, $\bar{V}_c = 100\angle 120^\circ$ V. The impedances of loads A, B, C are $\bar{Z}_a = 10 \Omega$, $\bar{Z}_b = -j10 \Omega$, $\bar{Z}_c = j10 \Omega$.



1. What are the currents of each phase $\bar{I}_a, \bar{I}_b, \bar{I}_c$?
2. What is the current on the neutral line \bar{I}_n ?
3. What are the line voltages $\bar{V}_{ab}, \bar{V}_{bc}, \bar{V}_{ca}$?
4. Provide the phasor diagram of the phasors including the phase voltages, line voltages, phase currents and the current on the neutral line.