



RUTGERS

School of Engineering
Department of Electrical and Computer Engineering

332:494:01/599:02 – Smart Grid – spring 2021 Homework Assignment – Set 2 (updated)

General guidelines for homework assignments: Homework should be submitted online (via Canvas)

Question 1:

A balanced Y-connected voltage source with a phase voltage $V_{an} = 277\angle 0^\circ \text{V}$ delivers to a balanced delta connected load with impedance $Z_{\text{delta}} = 45 - j18\Omega$ that is in parallel with a Y-connected load with impedance $Z_Y = 30 + j15\Omega$.

- (a) Calculate the total current deliver to the loads
- (b) Calculate the total real and reactive power for the loads

Question 2:

Consider the **three-phase system** in Figure 1. From the generator bus (marked as B1) power is delivered to a load of 150MW and 60Mvar at bus 3 and a load of 120MW and 60Mvar at bus 4 (**all values in 3-Phase**). The line voltage magnitude at bus 4 (B4) for load 2 needs is kept at 69 kV.

- (a) Find the per-unit representation of the system with a power base value of:
 - Option one: single-phase value of 100MVA for the power and phase voltage base value of $23/\sqrt{3}$ kV at bus B1
 - **Option two: three-phase value of 300MVA for the power and line voltage base value of 23 kV at bus B1**

Per the option you chose:

1. Find the base values for the systems in figure 1
 2. Find all per-unit line impedances: transformers T1 and T2 impedances
 3. Find all per-unit values for all given powers, impedances, and voltages
- (b) What is the line voltage magnitude at the generating source at bus 1 (magnitude of the line voltage at B1)?
 - (c) Find the real and reactive power for the generator (remember, it's a three phase system).

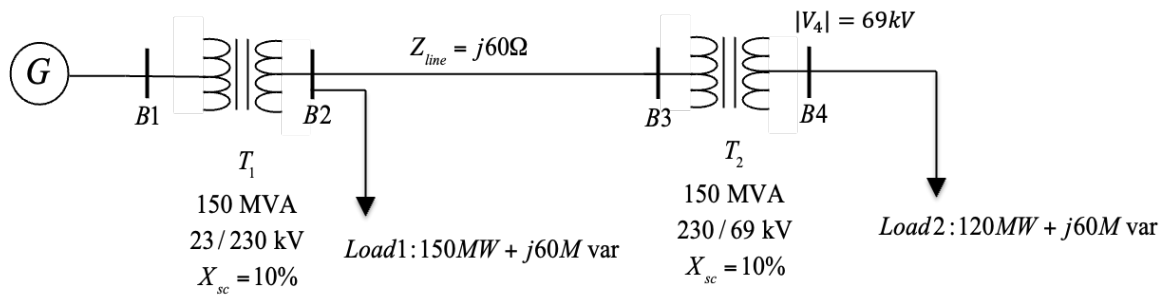


Figure 1(a): one line diagram for system in question 2

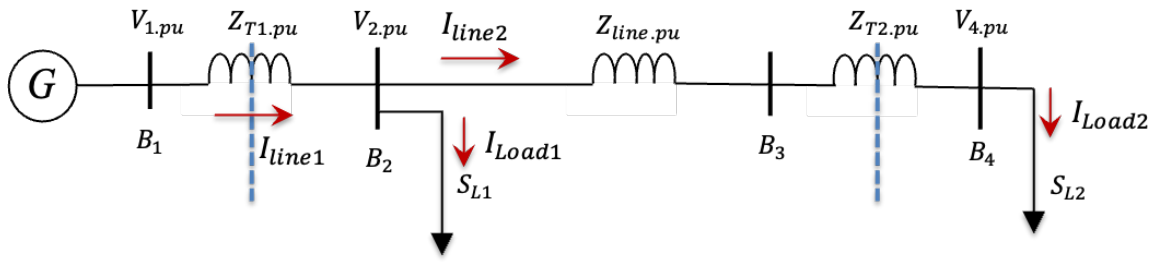


Figure 1(b): one-line diagram for system in question 2 **in per-unit**

Question 3:

The three-phase power and line-line voltage, are given for the electric power system in figure 2. For the per-unit analysis, a base value of 100MVA is chosen for the three-phase power and a base value of 20kV is chosen for the line voltage on generator 1 end.

- Find the base values for the systems in figure 2
- Find all per-unit line impedances: transformers T1 and T2 impedances; generators G1 and G2 impedances.
- Find all per-unit values for all given powers, and voltages
- Find load1 impedance
- Find the current flow through the load

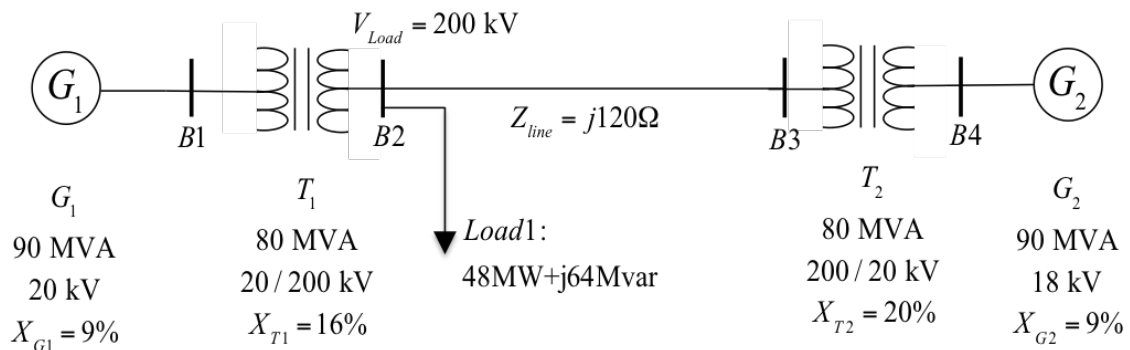


Figure 2 (a): one-line diagram for system in question 3

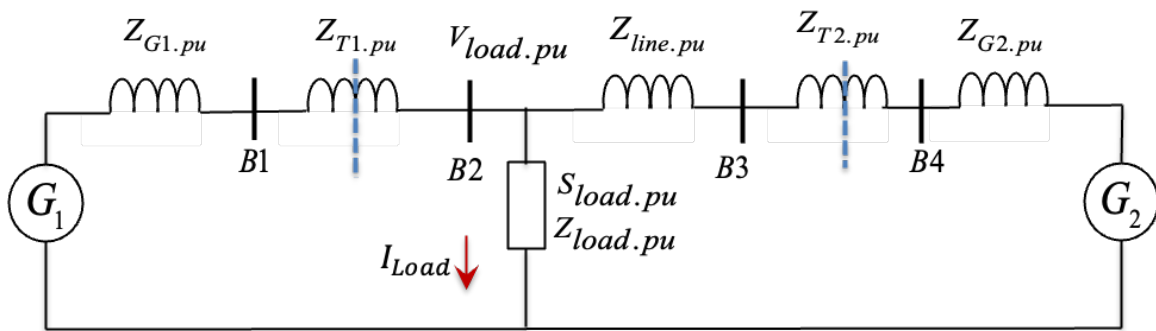


Figure 2 (b): one-line diagram for system in question 3 **in per-unit**

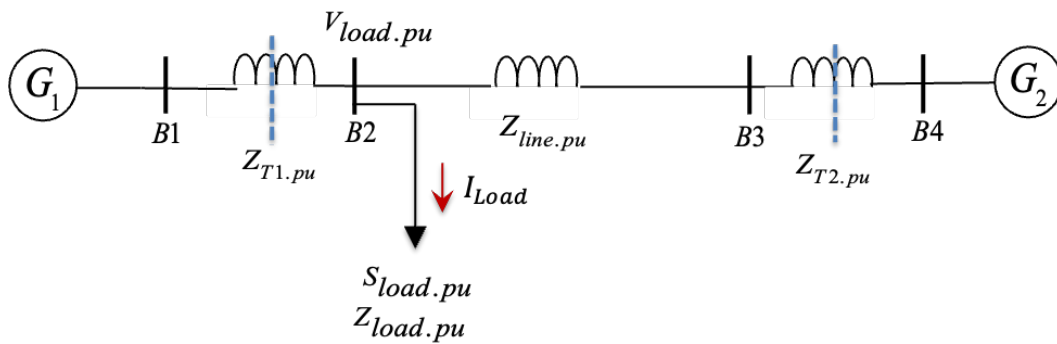


Figure 2 (c): OR another representation... one-line diagram for system in question 3 **in per-unit**