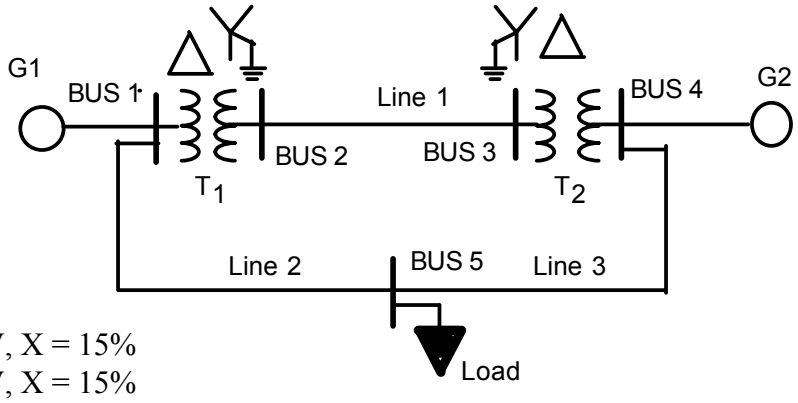
ECE 523: Homework #1

Due Session 7 (Sept. 9 on campus, Sept. 23 for Engineering Outreach)

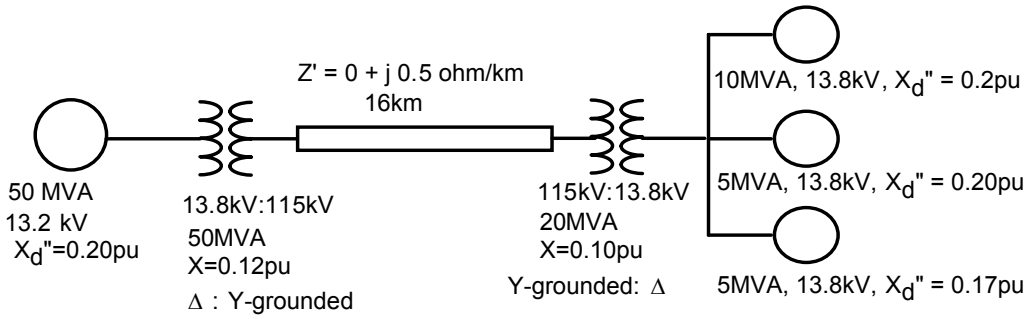
1. Sketch a per phase, per unit equivalent circuit for the system below. Use a system MVA base of 100MVA, and a voltage base of 220 kV on the high voltage transmission line section.



Using the following equipment nameplate data:

G1:	50 MVA, 13.8 kV, X = 15%
G2:	25 MVA, 14.4 kV, X = 15%
T1:	60 MVA, 13.8 : 230 kV, X = 10%
T2:	30 MVA, 230 : 13.8 kV, X = 10%
Line 1:	10 + j100 Ohm
Line 2:	5 + j50 Ohm
Line 3:	5 + j50 Ohm
Load:	25 MVA, 0.9pf lagging

2. A three-phase generator feeds three large synchronous motors over a 16km, 115kV transmission line, through a 115kV:13,8kV transformer bank, as shown below.
(a) Draw a per unit, per phasequivalent circuit with all reactances indicated in per unit on a 100 MVA base and 13.8kV or 115kv base.



(b) The generator is controlled to maintain the voltage at the motor bus at 1.0pu at an angle of 0 degrees. The three motors are operating at full rating and 90% PF lagging. Determine the voltage required at the generator terminals assuming that there is no voltage regulating taps or similar equipment in this system.

(c) Calculate the voltage required behind the subtransient reactance for the generator and each of the motors

(d) Calculate the line current in Amperes

3. Draw the per unit, Thevenin equivalent circuit for the system below looking out from the load bu if:

(a) The generator internal voltages are equal in magnitude and angle (label both as E_1 and present your results as a function of E_1)
(b) The generator internal voltages are not equal (label one as E_1 and the other E_2 in your solution, and present your results as a function of E_1 and E_2)

Impedance values (all on consistent bases, no change of base needed):

G1: X = 0.1 pu
G2: X = 0.1 pu
Line 1: X = 0.1 pu
Line 2: X = 0.1 pu
Load: Z = j 0.1 pu