ECE470 POWER SYSTEMS I
Homework Set 1

1. Using 100 MVA and 115 kV as base values, express 138 kV, 50 MVA, 251 A, and 52.9 Ω in per-unit.

2. The per-unit impedance of an electric load is 1.5. The base power is 750 kVA, and the base voltage is 13.8 kV.
   a) Find the per-unit impedance of the load if 1500 kVA and 27.6 kV are selected as base values.
   b) Find the ohmic value of the impedance.

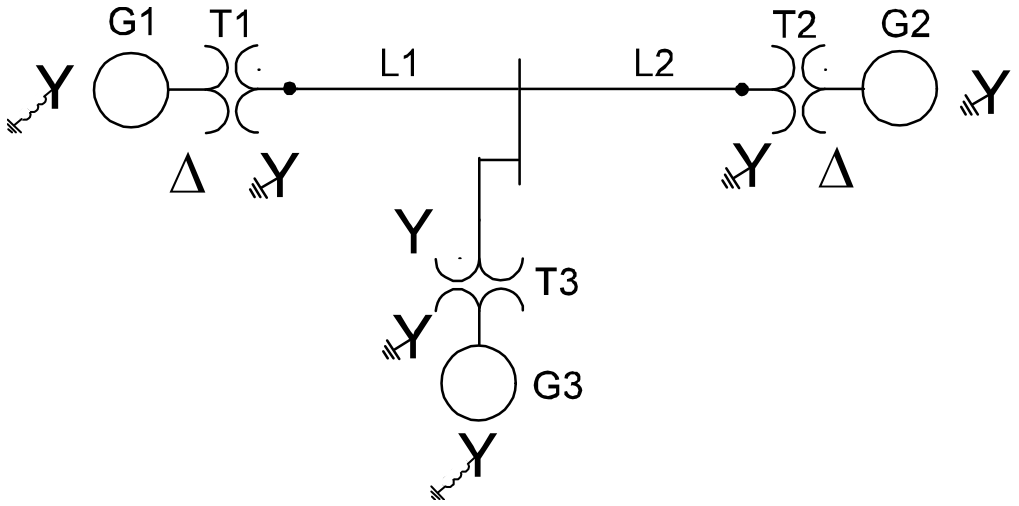
3. A 750 MVA, 25 kV ac generator has a synchronous reactance of 1.5 per unit. The generator is connected to a circuit for which the specified bases are 100 MVA, 500 kV. Find:
   a) The per-unit value of the generator synchronous reactance on the specified bases.
   b) The ohmic value of the synchronous reactance.

4. A single-phase source is connected to an electrical load. The load draws a 0.6 pu current at 1.10 pu voltage while taking a real power of 0.4 pu at a lagging power factor. Choose a base voltage of 8 kV and a base current of 125 A. Calculate the following:
   a) Real power in kW.
   b) Reactive power in kVAR.
   c) Power factor.
   d) The ohmic values of the resistance and the reactance of the load (assume series).

5.
The single-line diagram of a 3ϕ power system is shown below. The system data, on equipment rating bases are:

Generator 1:	20 MVA,	13.8 kV,	X_s"= 0.2 pu
Generator 2:	30 MVA,	18 kV,	X_s"= 0.2 pu
Generator 3:	30 MVA,	20 kV,	X_s"= 0.2 pu
Transformer T_1:	25 MVA,	13.8/220 kV,	X = 10%
Transformer T_2: (3x1ϕ)	10 MVA,	18/127 kV,	X = 10 %
Transformer T_3:	35 MVA,	22/220 kV,	X = 10 %
Line L1	80 Ω, 220 kV		
Line L2	100 Ω,	220 kV	

Using 50 MVA, 13.8 kV base in the circuit of generator 1, draw the impedance diagram with all reactances marked in pu.



6.

The single-line diagram of a 3ϕ power system is shown below. The system data, on equipment rating bases are:

G1	18 kV	20 MVA	X = 0.2
G2	18 kV	20 MVA	X = 0.2
G3	13.8 kV	30 MVA	X = 0.2
3ϕ Y – Y Trans.	20/138 kV	20 MVA	X = 10%
3ϕ Y – Δ Trans.	13.8/138 kV	15 MVA	X = 10%
L1-2	138 kV		X = 40 Ω
L1-3	138 kV		X = 20 Ω
L2-3	138 kV		X = 20 Ω

Draw the impedance diagram using 50 MVA, 138 kV base in the zone of each line.