

ECE470 POWER SYSTEMS I

Homework Set 1

1. Using 50 MVA and 25 kV as base values, express 22.5 kV, 60 MVA, $\sqrt{3} \times 200$ A, and 2.5 Ω in per-unit.

2. The per-unit impedance of an electric load is 1.2. The base power is 25 MVA, and the base voltage is 11.5 kV.
 - a) Find the per-unit impedance of the load if 50 MVA and 23 kV are selected as base values.
 - b) Find the ohmic value of the impedance.

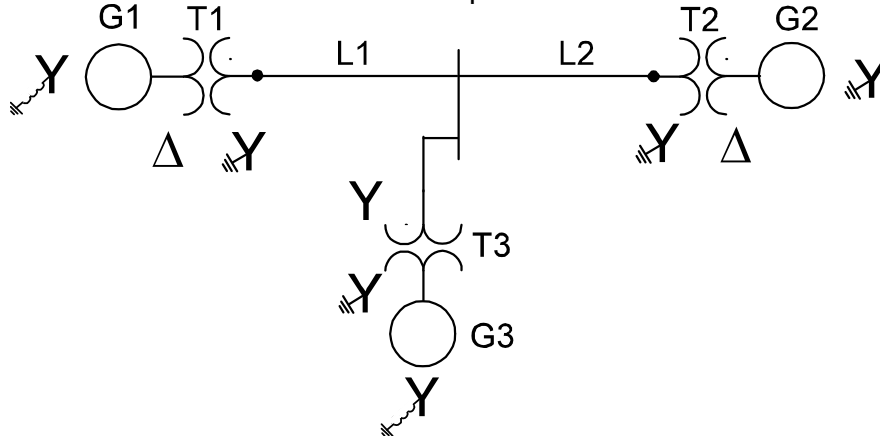
3. A 400 MVA, 12.5 kV generator has a synchronous reactance of 1.6 per unit. It is connected to a circuit for which the specified bases are 500 MVA, 250 kV. Find:
 - a) The per-unit value of the generator synchronous reactance on the specified bases.
 - b) The ohmic value of the synchronous reactance.

4. A **single-phase** source is connected to a load. The load draws 1.5 pu current at 83 $\frac{1}{3}$ % voltage while taking a real power of 0.75 pu at a lagging power factor. Choose a base voltage of 2.4 kV and a base current of 250 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 3 ϕ 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 : (3x1 ϕ)	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 3 ϕ 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	$X = 0.2$
3 ϕ Y – Y Trans.	20/138 kV	20 MVA	$X = 10\%$
3 ϕ Y – Δ Trans.	13.8/138 kV	15 MVA	$X = 10\%$
L1-2	138 kV	$X = 40 \Omega$	
L1-3	138 kV	$X = 20 \Omega$	
L2-3	138 kV	$X = 20 \Omega$	

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

