

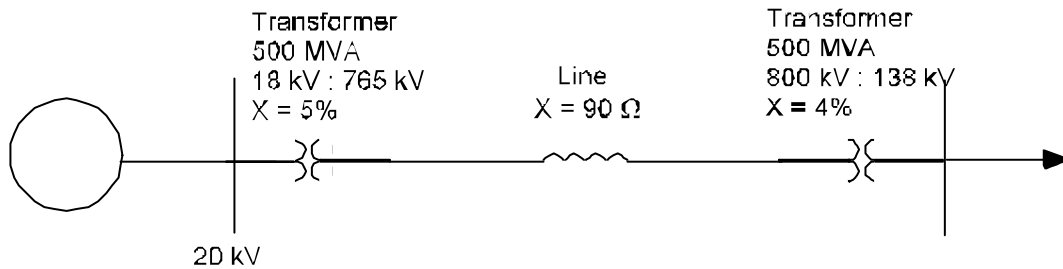
ECE470 POWER SYSTEMS I

Homework Set 5

1.

In the system shown below, the **generator** bus is to be held at 20 kV. Its current is metered at 8 kA, 0.8 lagging. Working on bases of 250 MVA and 765 kV in the line circuit:

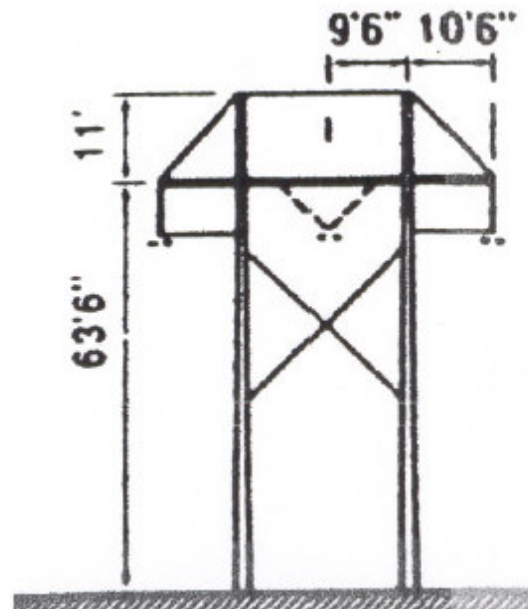
- draw the pu reactance diagram,
- determine the resulting load terminal voltage (kV), and
- determine the resulting load MVA and power factor.



2.

A 345 kV overhead transmission line consists of Cardinal ACSR on H-frame wood poles as shown. The inter-phase spacing is 20', while the intra-phase conductor spacing is 18" with two conductors/bundle. The line is 250 miles long and operates at 80 °C.

- Determine the pi equivalent circuit in terms of: R , X_L , X_C .
- Determine the nominal charging current.
- Determine the BIL of the line if there are 16 insulators per string and the minimum clearance to ground is 9'-6".

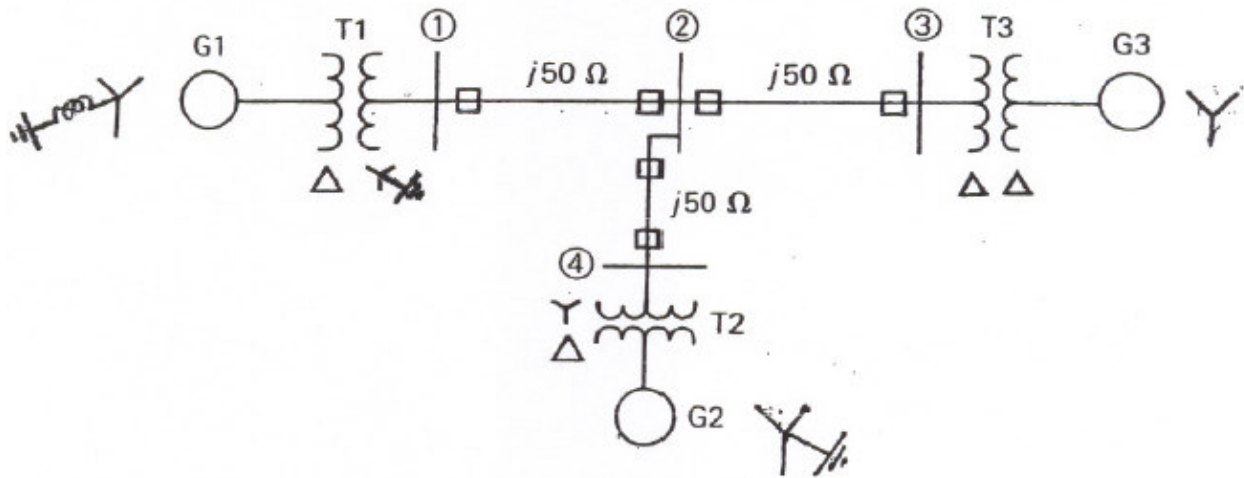


3.

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

G1	13.8 kV	500 MVA	X = 0.2	
G2	18 kV	750 MVA	X = 0.5	
G3	20 kV	1000 MVA	X = 0.3	
T1	15 : 500kV	500 MVA	X = 12%	
T2	20 : 289kV	250 MVA	X = 10%	3 x 1ϕ units
T3	22 : 500kV	1000 MVA	X = 10%	
L1-2	500 kV		X = 50 Ω	
L2-3	500 kV		X = 50 Ω	
L2-4	500 kV		X = 50 Ω	

Draw the impedance diagram using 1000 MVA, 500 kV base in the zone of each line.



4. A 22 kV, 60 Hz, four-pole, Y-connected, **cylindrical-rotor**, synchronous machine has the following ratings: Armature current = 4724 A, Field current = 600 A, Synchronous Reactance = 1.5 pu. The excitation voltage (E_f) at the rated speed is 22 kV (line) when the field current is 250 A.

- Determine the MVA rating of the machine.
- Construct the capability curve for rated generator operation.
- Determine the power factor and the load angle for rated conditions.
- Determine the driving torque if the Rotational Losses are 5 MW.

(Neglect all other losses).