Per Unit System

Exercise 1:

A generator has a reactance of 0.25 pu, based on 18 kV, 500 MVA. The generator is connected to a power system that uses base values of 20 kV, 100 MVA. Calculate

a) the reactance of the generator in Ohm.

b) the reactance in per unit based on 20 kV, 100 MVA base values.

Exercise 2:

A single phase two-winding transformer is rated 25 kVA, 1100/440 V, 50 Hz. The equivalent leakage impedance of the transformer referred to the low voltage side is 0.06 Ω. Using transformer rating as bases values, determine the per-unit leakage impedance referred to low voltage and referred to high voltage winding.

Exercise 3:

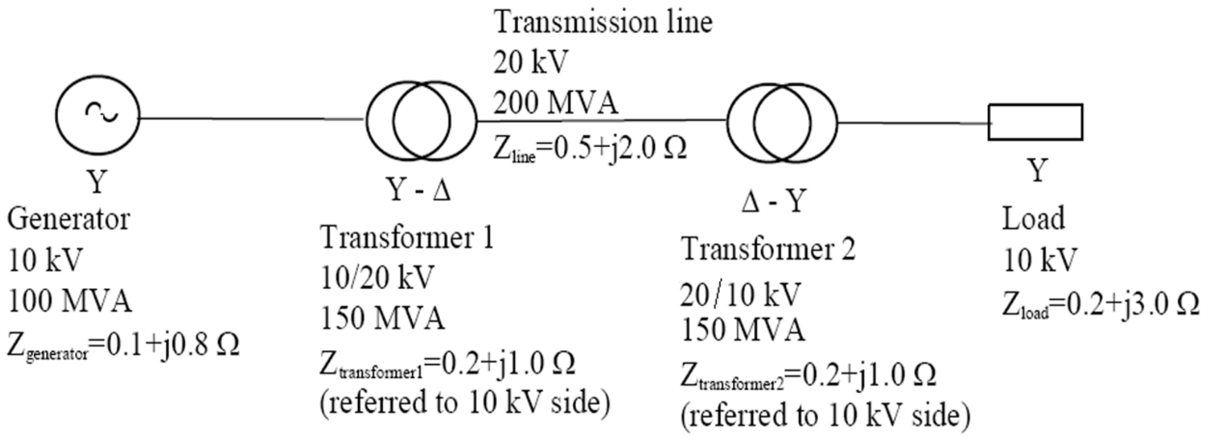
A three-phase Y-Δ 400MVA, 240kV/24kV transformer has an equivalent series impedance referred to the high-voltage (HV) side of (1.2 + j6) Ω per phase. The transformer supplies a 400MVA, 0.8AR three-phase load with a terminal voltage of 24kV on its low-voltage (LV) side. The primary winding is fed from a cable with an impedance of (0.6 + j1.2) Ω per phase.

1) Determine the line-to-line voltage across the HV terminals of the transformer and at the transmitting end of the cable.

2) Using the transformer's rated values as base quantities, express all impedances in per unit; then determine, in pu, the voltages across the transformer's primary winding and at the cable's end.

Exercise 4:

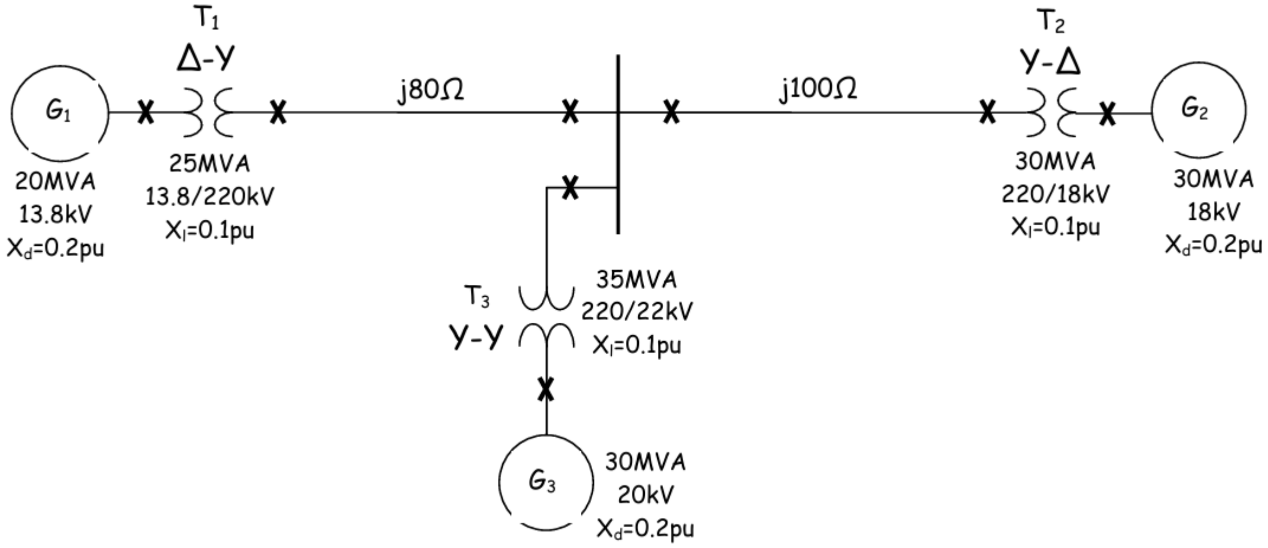
Find the per unit value for each component and draw the impedance diagram.



Find the load current, actual current in every component and voltage drop in every component if the load voltage is 1pu.
Repeat the previous by replacing the load with a new value of (50 + j 100) Ω.

Exercise 5:

The figure shows a single line diagram of a network. Select a common base of 50MVA and 13.8kV on the G_1 generator side. Draw the per unit impedance diagram.



Exercise 6:

The single-line diagram of a three-phase system is shown in the figure below. The transformer reactance is 20% on a 100 MVA, 23/115 kV basis, and the line impedance is Z = j66.125 Ω. The load at node 2 is S_2 = 184.8 MW + 6.6 MVAr, and at node 3 is S_3 = 0 MW + 20 MVAr. The voltage at node 3 must be fixed at 115/0° kV. Working in per unit, determine the voltage at nodes 2 and 1.