BIRZEIT UNIVERSITY

Electrical and Computer Engineering Department

Power Systems (ENEE4403)

"Power World Simulator Project"

First semester 2017/2018   10/12/2017

Figure.6.23 below shows a 7-bus power system, which was taken from the course textbook, parameters and other system modelling information (line impedances, load values … etc.) are given in tables. For this system:
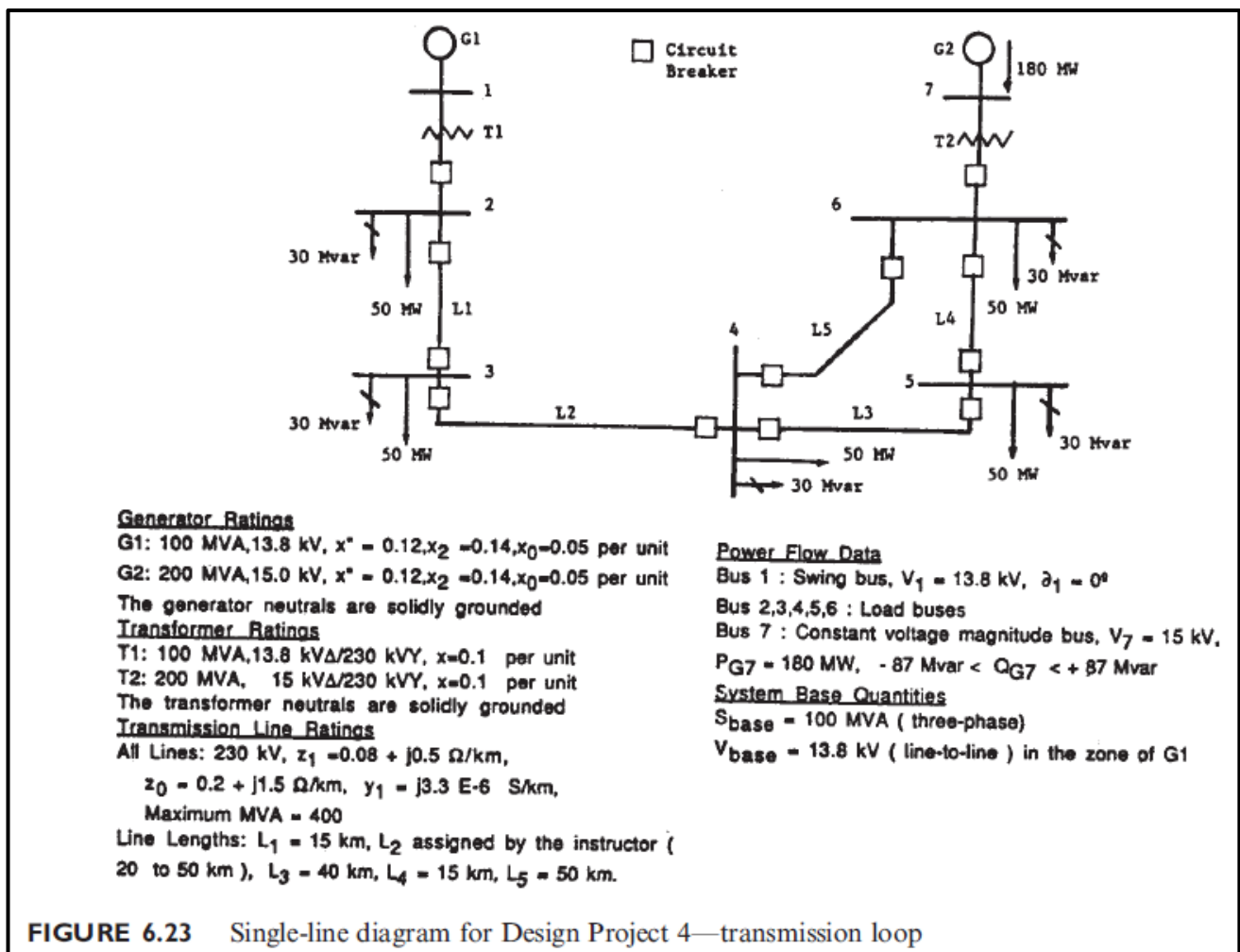

Generator Ratings
G1: 100 MVA,13.8 kV, x" = 0.12, x_2 =0.14, x_0=0.05 per unit
G2: 200 MVA,15.0 kV, x" = 0.12, x_2 =0.14, x_0=0.05 per unit
The generator neutrals are solidly grounded
Transformer Ratings
T1: 100 MVA,13.8 kVΔ/230 kVY, x=0.1 per unit
T2: 200 MVA, 15 kVΔ/230 kVY, x=0.1 per unit
The transformer neutrals are solidly grounded
Transmission Line Ratings
All Lines: 230 kV, z_1 =0.08 + j0.5 Ω/km,
   z_0 = 0.2 + j1.5 Ω/km, y_1 = j3.3 E-6 S/km,
   Maximum MVA = 400
Line Lengths: L_1 = 15 km, L_2 assigned by the instructor (
20 to 50 km), L_3 = 40 km, L_4 = 15 km, L_5 = 50 km.

Power Flow Data
Bus 1 : Swing bus, V_1 = 13.8 kV, ∂_1 = 0°
Bus 2,3,4,5,6 : Load buses
Bus 7 : Constant voltage magnitude bus, V_7 = 15 kV,
P_{G7} = 180 MW,   - 87 Mvar < Q_{G7} < + 87 Mvar
System Base Quantities
S_{base} = 100 MVA (three-phase)
V_{base} = 13.8 kV (line-to-line) in the zone of G1

FIGURE 6.23   Single-line diagram for Design Project 4—transmission loop

For the generator data: X'', X_2, and X_0 are the positive, negative, and zero sequence impedances respectively to be inserted in the fault parameters tab.

For the transmission line data: Z_1 is the transmission line parameters $(R + jX)$ and Y_1 is the shunt charging B in per length units. Z_0 is the zero sequence impedances to be inserted in the fault info tab after converting to per unit.

1. Calculate per unit impedances for all transmission lines using the program, and **show results in a table (go to model explorer and select "branches input" show this table)**, required data is given under the one-line diagram of the system.
   - The length of line 2 depends on the last two digits of your student ID number:
   - If the last two digits of your student ID number are between 30 and 50, then the length of L2 is equal to those digits in km. For example, if the last two digits are (43) then L2 length is 43 km.
   - If the last two digits of your student ID number are > 50, then the length of L2 is equal to those digits divided by 2 rounded to the nearest integer in km. For example, if the last two digits are (87) then ($87/2 = 43.5$ rounded to 44) L2 length is 44 km.
   - If the last two digits of your student ID number are < 30 then the length of L2 is 35 km.

2. Insert the system in power world simulator using the data under figure, and solve the case showing the load flow results:
   - One-line diagram of the system in run mode, with transmission lines and transformers loading percentage pie charts, and bus voltages shown beside each bus.
   - Y_{Bus} matrix.
   - The table of bus voltages and angles per unit, and load values on each bus.
   - State tables for all branches (transmission lines and transformers), showing loading values and losses. Discuss results: e.g. transformers loading values.
3. Add a 33 MVAR "switched shunt" to bus 4 and repeat step 2, discuss the differences (bus voltages and transformer's loading percentages).
4. Using fault analysis tool, perform 3-phase symmetrical fault on each one of the system's buses, showing the values of fault current and bus voltages during fault.

References:

1. Glover, J. and Sarma, M. (2012). Power System Analysis and Design, 5th Edition. Brooks/Cole. Pacific Grove, California.
2. https://peer.asee.org/a-power-systems-analysis-project.pdf
3. https://www.powerworld.com/files/Simulator16_Help_Printed.pdf

The End 😊