RUTGERS

School of Engineering
Department of Electrical and Computer Engineering

332:494:01/599:02 – Smart Grid – Spring 2021
Homework Assignment – Set 4

General guidelines for homework assignments: Homework should be submitted online (via Canvas)

Question 1:

For the power system given in figure 1 bus 1 is a slack bus with $V_1 = 1\angle 0^\circ\, pu$, bus 2 is a load bus (PQ) with $S2 = 300MW + j1270MVAr$ and $S3 = 400MW + j220MVAr$. The line impedances are $Z12 = 0.01 + j0.03\, pu$ and are $Z13 = 0.02 + j0.04\, pu$. The base power is $100MVA$.

(a) Use the Gauss-Seidel method to write the expression to calculate $V_2^{(k+1)}$ *and* $V_3^{(k+1)}$ as a function of $V_2^{(k)}, V_3^{(k)}$

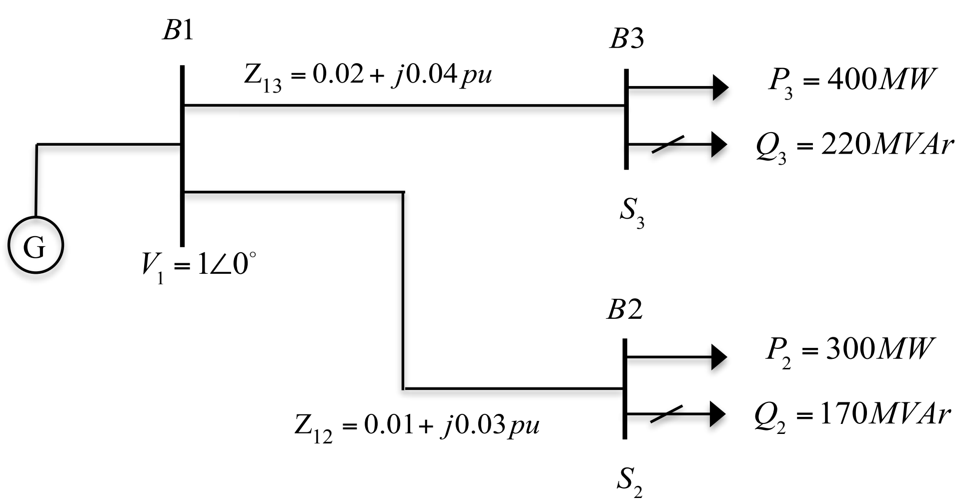

Figure 1

(b) If after several iterations the voltages at buses B2 and B3 converge to $V_2 = 0.9046 - j0.073$ and $V_3 = 0.7618 - j0.116$ determine the following:

1. Power flowing from bus 1 out to bus 2: $S_{12} =$
2. Power flowing from bus 1 to bus 3: $S_{13} =$
3. Power generated by the source: $S_1 = S_{GEN} =$
4. Line losses for the line connecting bus 1 to bus 2: $S_{loss.12} =$
5. Line losses for the line connecting bus 1 to bus 3: $S_{loss.13} =$

Question 2:

For the power system given in figure 2 bus 1 is a slack bus with $V_1 \;\; = 1\angle 0° \;\; pu$ and bus 2 is a load bus (PQ) with $S2 = 280MW + j60Mvar$. The line impedance is $0.02 + j0.04\ pu$ and the base power is $100MVA$

a) Use the Gauss-Seidel method to write the expression to calculate $V_2^{(k+1)}$ as a function of $V_2^{(k)}$ and solve for $V_2^{(1)}\ \ if\ V_2^{(0)} = 1\angle 0° \;\; pu$

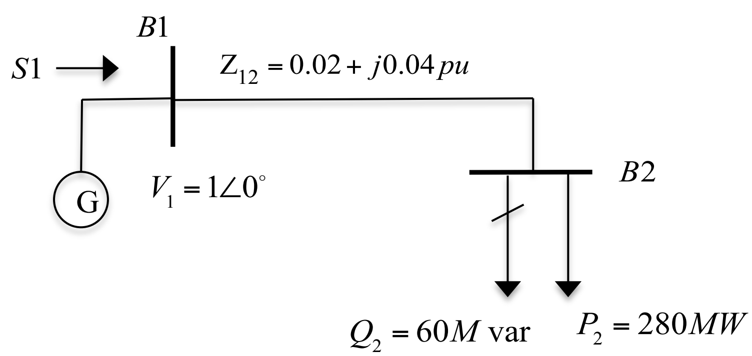

Figure 2

b) If after several iterations the voltage at bus 2 converges to $V_2 \;\; = 0.9 - j0.1$ determine the poser S_1
c) For part (b) determine the line losses for the line connecting bus 1 and bus 2

Question 3:

For the power system in figure 3, assume a base power of 100MVA

(a) Find the admittance matrix Y

(b) Write the equations for the Gauss-Seidel iteration: $V_2^{(k+1)},\ V_3^{(k+1)} and\ \ V_4^{(k+1)}$ and given an initial estimate that $V_2^{(0)} = V_3^{(0)} = V_4^{(0)} = 1\angle 0° \;\; pu$ find $V_2^{(1)}, V_3^{(1)}, and\ V_4^{(1)}$

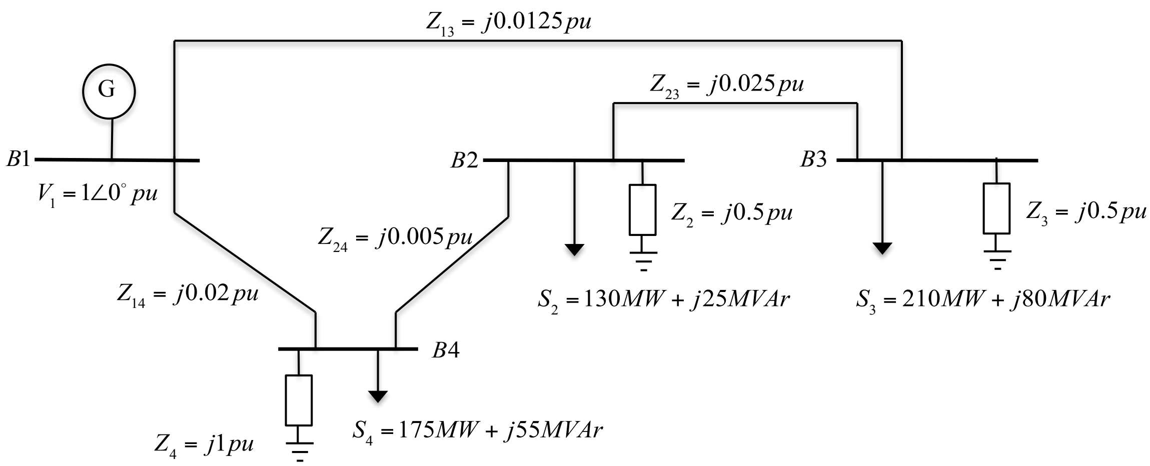
$Z_{13} = j0.0125pu$
G
$Z_{23} = j0.025pu$
$B1$
$B2$
$B3$
$V_1 = 1\angle 0^\circ\ pu$
$Z_2 = j0.5pu$
$Z_3 = j0.5pu$
$Z_{24} = j0.005pu$
$Z_{14} = j0.02pu$
$S_2 = 130MW + j25MVAr$
$S_3 = 210MW + j80MVAr$
$B4$
$Z_4 = j1pu$
$S_4 = 175MW + j55MVAr$

Figure 3