332:494:01/599:02 – Smart Grid – Spring 2021
Homework Assignment – Set 5

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

Question 1:

To solve the following equations by the Newton–Raphson method

$$2x_1^2 + x_2^2 - 10 = 0$$
$$x_1^2 - x_2^2 + x_1 x_2 - 4 = 0$$

(a) Develop the iterative equation for $\begin{bmatrix} x_1^{(k+1)} \\ x_2^{(k+1)} \end{bmatrix}$

(b) For and initial guess of $\begin{bmatrix} x_1^{(0)} \\ x_2^{(0)} \end{bmatrix} = \begin{bmatrix} 1 \\ 1 \end{bmatrix}$ calculate $\begin{bmatrix} x_1^{(1)} \\ x_2^{(1)} \end{bmatrix}$ and the value of the stopping criteria ε

note: $\begin{bmatrix} a & b \\ c & d \end{bmatrix}^{-1} = \frac{1}{ad-bc}\begin{bmatrix} d & -b \\ -c & a \end{bmatrix}$

Question 2:

For the following 4-Bus network with the given line and bus impedances
(a)   Derive the 4x4 bus admittance matrix Y_{bus} for the power grid in Figure 1.
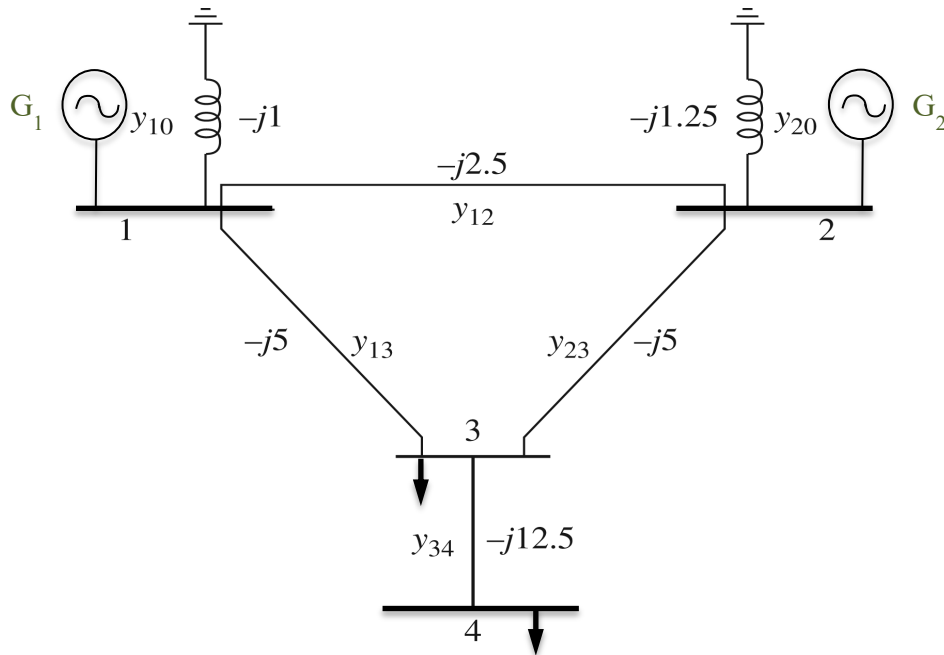
Figure 1: 4 buses grid

(b) Assume bus 1 as the slack (with $V_1 = 1.0\angle0°$), G_2 generates active power of 0.75 pu and absorbs reactive power of 0.35 pu. Buses 2 and 3 are load buses with a per unit load of $S_3 = 1 + j0.5\ pu$ and $S_4 = 1.5 + j0.75\ pu$.
Write the iterative Gauss-Seidel method-based equations $V_2^{(k+1)}, V_3^{(k+1)}, and\ V_4^{(k+1)}$. All equation should be function of the voltages only $(V_1, V_2^{(k)}, V_3^{(k)}, V_4^{(k)}, V_2^{(k+1)}, V_3^{(k+1)}, and\ V_4^{(k+1)})$.

Question 3:

	Question: Line Modeling		Answer
3.1	Transmission line conductance is usually neglected in power system studies	(a) True (b) False	
3.2	If the distance between conductors is large compared to the distances between sub-conductors of each conductor, then the GMD between conductors is approximately equal to the distance	(a) True (b) False	

	between conductor centers		
3.3	Underground lines have higher line inductance	(a) True (b) False	
3.4	Overhead lines have higher line capacitance	(a) True (b) False	
3.5	Bundling increase line inductance in overhead lines	(a) True (b) False	
3.6	Increasing a cable diameter by 2 will reduce the line resistance per meter of the cable by		

Question 4:

	Question: In a synchronous generator…		Answer
4.1	The rotor angular velocity is synchronized with the grid frequency	(a) True (b) False	
4.2	An over excited generators has a positive power factor angle	(a) True (b) False	
4.3	Change in the field winding current effects the induced armature voltage	(a) Yes (b) No	
4.4	If the mechanical power in a generator shaft is kept constant, the power angle will not change	(c) True (d) False	
4.5	The 'pullout power' refers to the minimal power for which the system will fail and shutoff	(c) True (d) False	
4.6	Hydraulic turbines rotational speed is low compared with steam turbines	(a) True (b) False	
4.7	A generator's internal inductance represents only winging losses	(c) True (d) False	
4.8	Armature always refers to the static part of a generator or a motor	(c) True (d) False	
4.9	In a four-pole generator the rotor angular velocity will be 3600 rpm	(a) True (b) False	
4.10	An under excited generator is generating reactive power	(a) True (b) False	