

Name: ANSWERS

ECE 530

Exam #1

Thursday, October 24, 2013

75 Minutes

Closed book, closed notes
One 8.5 by 11 inch note sheet allowed
Simple calculators allowed

1. _____ / 26

2. _____ / 20

3. _____ / 24

4. _____ / 30

Total _____ / 100

1. (26 points total)

A generator bus (with a 1.0 per unit voltage) supplies a load through a transmission line with per unit (100 MVA base) impedance of $0.05 + j0.1$ and no line charging. Rather than assuming a constant power load, assume that the load varies linearly with the load bus voltage. At 1.0 per unit voltage the load is 150 MW, 50 Mvar. Starting with an initial voltage guess of $1.0 \angle 0^\circ$, do two complete iterations using the Newton-Raphson power flow method, giving the load bus voltage (magnitude and angle) and the mismatches at the end of the second iteration.

$$P_2(\theta_2, V_2) = 4V_2^2 - V_2 4 \cos \theta_2 + V_2 8 \sin \theta_2 + 1.5 V_2 = 0$$

$$Q_2(\theta_2, V_2) = 8V_2^2 - V_2 4 \sin \theta_2 - V_2 8 \cos \theta_2 + 0.5 V_2 = 0$$

$$J(\theta_2, V_2) = \begin{bmatrix} V_2(4 \sin \theta_2 + 8 \cos \theta_2) & 8V_2 - 4 \cos \theta_2 + 8 \sin \theta_2 + 1.5 \\ V_2(-4 \cos \theta_2 + 8 \sin \theta_2) & 16V_2 - 4 \sin \theta_2 - 8 \cos \theta_2 + 0.5 \end{bmatrix}$$

$$X^{(0)} = \begin{bmatrix} 0 \\ 1 \end{bmatrix} \quad X^{(1)} = \begin{bmatrix} 0 \\ 1 \end{bmatrix} - \begin{bmatrix} 8 & 5.5 \\ -4 & 8.5 \end{bmatrix}^{-1} \begin{bmatrix} 1.5 \\ 0.5 \end{bmatrix} = \begin{bmatrix} -0.1111 \\ 0.8889 \end{bmatrix}$$

$$X^{(2)} = \begin{bmatrix} -0.1111 \\ 0.8889 \end{bmatrix} - \begin{bmatrix} 6.55 & 3.55 \\ -4.48 & 7.32 \end{bmatrix}^{-1} \begin{bmatrix} 0.0017 \\ 0.1942 \end{bmatrix} = \begin{bmatrix} -0.136 \\ 0.8877 \end{bmatrix}$$

$$V_2^{(2)} = 0.8877 \angle -0.136 \text{ rad}$$

