Name: ____________________________

ECE 476

Exam #2

Tuesday, November 15, 2016
75 Minutes

Closed book, closed notes
One new note sheet allowed, one old note sheet allowed

1. _________ / 20

2. _________ / 20

3. _________ / 20

4. _________ / 20

5. _________ / 20

Total _________ / 100

1. (20 points total)

The zero, positive and negative sequence bus impedance matrixes for a three bus, three phase power system are given below. Determine the per unit fault current (sequence values only) for a single line to ground (SLG) fault involving phase "A" at bus 2. The prefault voltage at all buses is 1.0 per unit. Assume the fault impedance is zero.

$$\mathbf{Z}^0 = j\begin{bmatrix} 0.1 & 0 & 0 \\ 0 & 0.2 & 0 \\ 0 & 0 & 0.1 \end{bmatrix} \qquad \mathbf{Z}^+ = \mathbf{Z}^- = j\begin{bmatrix} 0.12 & 0.08 & 0.04 \\ 0.08 & 0.12 & 0.06 \\ 0.04 & 0.06 & 0.08 \end{bmatrix}$$

2. (20 points total)

The fuel-cost curves for a two generator system are given as follows:

$$C_1(P_{G1}) = 1000 + 20 * P_{G1} + 0.01 * (P_{G1})^2$$

$$C_2(P_{G2}) = 400 + 15 * P_{G2} + 0.025 * (P_{G2})^2$$

Generator limits are: $100 \le P_{G1} \le 300$
$200 \le P_{G2} \le 600$

For a load of 600 MW, use the lambda iteration method to determine the values of λ^M, $P_{G1}(\lambda^M)$ and $P_{G2}(\lambda^M)$ after two iterations. Show the values of all variables at each iteration. Use starting values of $\lambda^L = 20$ and $\lambda^H = 60$. **Be sure to consider the generator limits; you may ignore any penalty factors.**

3. (20 points total)

For the system

$$f_1(\mathbf{x}) = 10\, x_1 \sin x_2 + 2 = 0$$

$$f_2(\mathbf{x}) = 10\, (x_1)^2 - 10\, x_1 \cos x_2 + 1 = 0$$

(15 pts) a. Using the Newton-Raphson method, determine the values of x_1 and x_2 after the second iteration. Use $x_1 = 1$, $x_2 = 0$ as an initial guess.

(5 pts) b. Is $x_1 = 0.5$, $x_2 = 0$ a good initial guess? Why or why not.

4. (Short Answer: 20 points total – five points each)

A. Give two reasons why the slack (reference) bus is needed for the power flow problem.

B. IEEE Std 1366-2012 defines SAIDI as a measure to quantify small event blackouts. Briefly tell what SAIDI is and what it measures.

C. What is the purpose of power system economic dispatch, and what is a necessary condition for an economic dispatch of the generation?

D. An ideal inductor with L = 1 H is connected in series with an ac voltage source (**v(t) = sin(t) volts**) and a switch. The switch, which is initially open, is closed at t = 0. Sketch the current through the circuit (as a function of time) for the first few cycles for $t \geq 0$.

5. (20 points total)

True/False – Two points each. Circle T if statement is true, F if statement is False.

T F 1. An important assumption in the dc power flow is that all the transmission line reactances are zero.

T F 2. PTDFs can be used to show the linear impact of a power transfer.

T F 3. As presented in class, the economic dispatch factor at the slack bus is always unity.

T F 4. In the MISO LMP market the LMPs can sometimes become negative.

T F 5. While the power flow equations may have multiple solutions, it is quite easy to prove that the Newton-Raphson algorithm will only converge to the desired solution. That is, to the one with the highest voltage magnitudes.

T F 6. During economic dispatch calculations on the high voltage transmission system it is quite common for the incremental impact of the change in the generation at bus k on system losses, $\frac{\partial P_{Losses}}{\partial P_{Gk}}$, to exceed 100%

T F 7. In three-phase systems using symmetrical components, the positive sequence is used to represent the non-zero neutral currents.

T F 8. To model a line-to-line fault the on an otherwise balanced system the zero sequence network is connected in series with the positive sequence network.

T F 9. Because of the use of directional relays, line carrier communication is never used to help in the detection of transmission line faults.

T F 10. During the August 14th 2003 blackout, many of the lines that tripped were due to the misoperation of differential relays.