ECEN 615 Problem Set #6 Fall 2022
(counts as two regular problem sets) Due 11/17/22

1. Book Problem 9.1. Assume a linear (dc power flow approximation) system model. That is, **f(x)** = **Hx**.

2. Book Problem 9.3. Again assume a linear system model.

3. Book Problem 9.4

4. Using the Givens Rotation algorithm, manually perform a QR factorization of the matrix given below. Show your work at each step.

$$\mathbf{A} = \begin{bmatrix} 2 & 7 \\ 4 & 3 \\ 5 & 6 \end{bmatrix}$$

5. Using the pseudoinverse approach, use regression to determine the function $y = a + bx + cx^2$ that best fits the xy points (1,1), (2,5), (3,10), (4,6) (5,5). Give the matrix and its pseudoinverse.

6. Using the data for the ProblemSet4_B7Flat_DC_2022 PowerWorld case manually create an equivalent eliminating buses 1, 2, and 6. Give the bus admittance matrix for the modified system, and the impedance of the new equivalent lines.

7. In PowerWorld Simulator using the Aggieland37 case, first calculate the line flows and bus voltage magnitudes for the contingent opening of the transformers between buses 32 and 33. You may wish to store these results in a spreadsheet. Then, reopen the case (i.e., without the contingency) and in PowerWorld create an equivalent eliminating all the buses with bus numbers less than 20. Then, repeat the previous contingency, and compare the results with the full system (obviously only comparing for the retained buses and lines).

8. For the losseless two bus system from Lecture 19 (or maybe Lecture 20) (i.e., with two transmission lines each with z=j0.2), pick a value of P_L = 4 + (last two digits in your UIN/100) and determine the associated value of Q_L that is on the solvability boundary Σ.

9. In PowerWorld using the Bus37_PV_HW6 system first open two transmission lines and one generator. You may choose any two lines, except with the requirement that you not isolate any load or island the system. For the generator you may open any one, excepting the slack bus generator. Then, use the **Load Scalar** field to increase the system load until the system reaches voltage collapse. Plot the PV curve, with P being the total system load, and V being the voltage magnitude at the bus that has the lowest voltage magnitude at the point of voltage collapse. Your PV curve should have at least ten fairly uniformly spaced points.

10. Solve the following constrained minimization problem. What is the value of the Lagrange multiplier?

$$\text{Minimize } f(\mathbf{x}) = (x_1 - 3)^2 + (x_2 - 2)^2 \quad \text{such that } x_1 + x_2 = 8$$

11. Using PowerWorld case Bus5_Losses with the Load Scalar equal to 1.0, determine the eneration dispatch that minimizes system losses. (*Hint:* manually vary the generation at buses 2 and 4 until their loss sensitivity values are zero.)