EE 5240 - Homework #3 Due: Tues Feb 7th, 9am
Spring Semester 2023 - Mork

Objectives: Starting to program in MatLab (making "m" files), building up [Y_{BUS}] from system transmission line and transformer data.

1) Print out the 17-bus New Zealand system (link to pdf file is on the course web page). The base MVA for this data is 100. RMS L-L voltage levels for each bus are given as the last three characters of each bus name. All R, X, and full-line B values are in per unit.
   a) There is a double-circuit line connecting buses 1 and 3. Sketch out a pi-equivalent and label the per unit admittance values corresponding to one line. Sketch another pi-equivalent and label total admittance values for the two lines in parallel.
   b) Starting with a system [Y_{BUS}] that does not include these two lines (lines are switched out of service), detail quantitatively what modifications need to be made to [Y_{BUS}] when the two lines are switched in. If we then switch one of the two lines out, how must [Y_{BUS}] be modified?
   c) For nominal voltage operation, what is the total-line charging MVAR for these two lines?
   d) For the converged load flow shown, make note of the phasor voltages at buses 1 and 3. For one of the two lines, note the P and Q flow from bus 1 toward bus 3, and for the same line for bus 3 toward bus 1. Why are they not equal? Referring back to the pi-equivalent you developed in part a), and making use of the known values of $\mathbf{V}_1$, $\mathbf{V}_3$, R, X, and B, calculate: 1) the phasor current flowing thru R + jX from bus 1 toward bus 3; 2) the phasor current flowing from bus 1 down through the shunt susceptance on the bus 1 side of the pi-equivalent; 3) the phasor current flowing from bus 3 down through the shunt susceptance on the bus 3 side of the pi-equivalent; 4) calculate all Ps and Qs that are absorbed or produced in the R, X, and B elements of the pi-equivalent; 5) using **VI*** relationship, calculate the total complex power S = P + jQ flowing into the line from Bus 1 and into the line from Bus 3; 6) show numerically that all P and Q is accounted for and thus explain why the P and Q inflows to the line are different at each end. What is the transmission efficiency of this line?

2) Develop a MatLab m-file function called "show_pol" that displays a complex number in polar form. For example, if z is a complex number, then the matlab command "show_pol(z)" would display z's magnitude and angle. Provide a printout of the code you write, and demonstrate that it works (paste from the screen).

3) Learn about the "open" command in MatLab and how use it to open and edit a matrix or vector. Attach your brief notes and a screen image to show that you've learned how to use it.

4) Learn about the "**fopen**" and "**fget**" functions that can be used to open a file for I/O. We will be using it to open and read system data from an IEEE-standard CDF file. Visit the Univ of Wash link on the course web page. Print out the document on CDF file formats and download & print the IEEE standard 14-bus case. Hand in some detailed notes on how the line data and transformer data are stored. Is it evident as to whether susceptance values are half-line or full-line? Is it apparent which side ("from" or "to") that transformer tap values and impedances are referred to?

Coming up next: Newton-Raphson load flow formulation, more fun programming with MatLab.