EE 455 Power Systems Dynamics and Protecction
Due Wednesday, February 9, 2022, to Canvas by 2:30 PM
100 HW points

Computer Project 1

Assignment

The Excel data file provided (CHW1data.xlsx) describes a 7 line 6 bus power system and provides necessary impedance data and pre-fault voltages. All loads are solidly grounded Y, i.e. $Z_n = 0$. Generators are solidly grounded if GenGround = 1, and ungrounded if GenGround = 0. The file also includes the faults to be evaluated for the project. You should expect the grader to modify the fault data for assessment purposes!

Write a program that can calculate the fault current magnitude for each of the following fault types at any of the buses of the system: 3 Phase, SLG, DLG (use I_{bf} as the fault current), LL. Your program should read the specific fault location, fault type, fault impedance and results bus from the data file, and calculate and output the magnitude of the fault current in each phase at the point of the fault, and the magnitude of the fault current flowing on each phase of each component (transmission line, transformer, shunt element, generator) attached to the results bus.

You may use Python (preferred) or Matlab (or other computer language with permission from me).

Turn in a technical report describing your algorithm. Explain how you verified your code is working. Your technical report should be well formatted and have a professional appearance. Turn in your code as .py or .m files. Name the main program file chw1.py or chw1.m (so we can find it to test the program). Provide results for the faults in the data file as an appendix in your report. These faults are:

Fault Type	**Faulted Bus**	Z_f	**Results Bus**
3 Phase	1	0 p.u.	2
SLG	2	0.1 p.u.	6
LL	4	0 p.u.	1
DLG	5	0.1 p.u.	4

Turn in your report to Canvas.

Hint

You can check the correctness of your program by creating very simple systems where you can hand calculate the fault currents and compare to your program results.

Why Python

While Matlab work will be accepted, Python is preferred. Why?

- Most of you are familiar with Python from your signal processing courses and/or EE 455.
- Python syntax is closer to C (which is used in real world application programs when performance is an issue) than Matlab syntax. This is the strongest reason to use Python.
- Python is free.
- Python is portable. The same Python code runs on Mac, PC, and Unix.
- Python performance is similar to Matlab. (Based on a shallow review of the Web. Performance is not an issue in this project.)
- Matlab matrix operation syntax is cleaner than Python, but Python is cleaner on everything else.
- About the only web site that prefers Matlab to Python is Mathworks – who sell Matlab.

A Python Tutorial

The "official" Python tutorial is at

https://docs.python.org/3/tutorial/index.html

If you have a question about any specific thing in Python, do a web search for "python <thing>" and you will find lots of help, including but not limited to the official documentation.

Python Version

Use Python 3, not Python 2. As of January 2022 the latest version is 3.10.2. There are a few syntax changes between Version 2 and Version 3, notably in the print statement. Python can be downloaded from python.org.

Packages

Where Matlab has *toolboxes*, Python has *packages* (also called libraries or modules), collections of functions for specific purposes. Python requires packages for some of the functions that appear in vanilla Matlab. While some functions are essentially identical to Matlab (`sin`, `cos`), others have different names, arguments or invocations (as a method in Python, for example). Packages require some set up outside the program (installation in your Python interpreter) and invocation in the program (`import` statement). Relatively few packages are needed for this project. You may need the following packages:

- `math` (for `sin, cos`)
- `cmath` (for `rect`, conversion from polar to rectangular coordinates, `.conjugate` method)
- `openpyxl` (for `load_workbook`, `.save` method)
- `numpy` – for vector `max` and `min`, and `linalg.solve` for $[A]\underline{x} = \underline{b}$.