Lab 5: Thevenin's Theorem and Intro to Python

Background:

Objectives:

- Practice finding Thevenin voltage and Thevenin resistance
- Introduce Python in Jupyter Notebooks and on repl.it platforms
- Use Python to do calculations
- Store resorts in Python variables

Required Equipment:

- LTspice XVII
- MS Excel or equivalent spreadsheet program

1 Prelab:

1. Read through this entire lab assignment.
2. Create all of the required Excel tables that perform the required calculations.
3. Complete the exercises in the **Lab_5_Notes-Calculations_with_Python.ipynb** file.
   (a) Download the file to your computer.
   (b) In a browser where you are already logged into your PCC Gmail account, go to **https://colab.research.google.com**. Go to File –> Upload notebook.
   (c) Upload the **.ipynb** file.
   (d) Complete all of the exercises in the file to familiarize yourself with how to do calculations in Python.
4. Go to **https://repl.it/@dankruger/ENGR221-Lab05-Thevenin**. This is an environment where you can run python outside of a Jupyter notebook. This is a more typical type of environment to run Python where you put all of your code into a single text file (with the **.py** extension). Clicking Run will run all of the code in this file.

5. Once you make changes to this file, you should notice the URL changes to something with a randomly generated name. You can create a repl.it account, which will allow you to save, rename, and organize any files/projects you generate. You will add your calculations to this file later in the lab.

2 Part A Procedure:

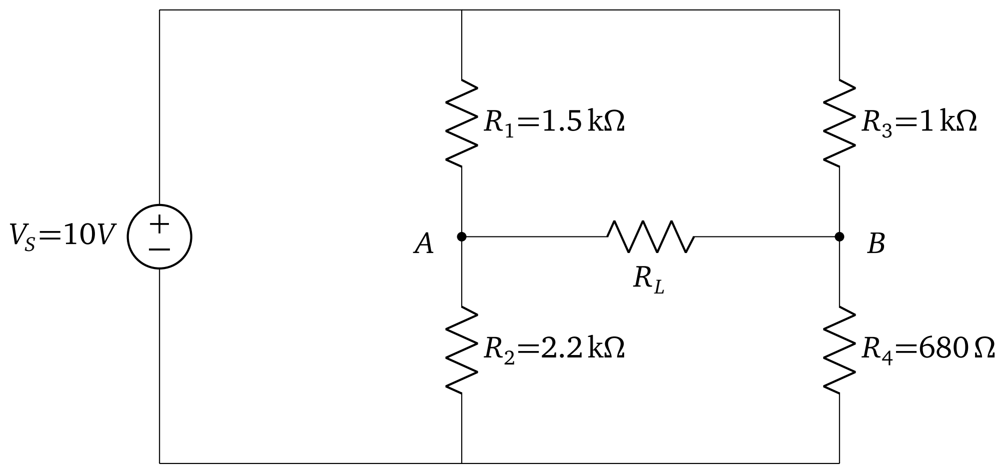

Figure 1: Bridge Circuit

1. Write a Python script that calculates V_{AB} and the power dissipated by R_L (P_L) for each of the values for R_L given below. You calculations should be based on the values of the Python variables VS, R1, R2, R3, R4, and RL and they should yield results in micro watts. Use the values for these variables as given in Figure 1. For the changing RL values, simply change RL's value and rerun your code. Do not make multiple copies of your code for each RL value.
   (a) 390 Ω
   (b) 680 Ω
   (c) 1.2 kΩ
   (d) 2.2 kΩ
   (e) 3.9 kΩ
   (f) ∞Ω (For this value in Python, use 10^7. This can be entered as 10e7.)
2. Your Python script should store its results the variables VAB and PL. Remember, Python is case sensitive.
3. Have your script print these two results to the screen with labels. An example of how to this is included with the original file.

3 Part B Procedure:

1. At the bottom of your script file, add a line of code that prints the following string to the screen:
   *************** Part B ***************
   Put your Part B code below this line of code.

2. Examine the circuit shown in Figure 1. Expand your Python script to solve for the circuit's Thevenin equivalent circuit from the perspective of R_L based on the mentioned Python variables (VS, R1, R2, etc.). This means finding V_{th} and R_{th}. Store your result for V_{th} in a variable called Vth and R_{th} in a variable called Rth.

3. Have your script print these two results to the screen with labels.

4. After your code is working, save a copy of it to your computer. You can leave whatever value of R_L you used last.

4 Part C Procedure:

1. At the bottom of your script file, add a line of code that prints the following string to the screen:
   *************** Part C ***************
   Put your Part C code below this line of code.

2. Using the Theveinin equivalent circuit for the circuit in Figure 1 (note: this is different than the Figure 1 circuit) have your script calculate V_{AB} and the power dissipated by R_L (P_L) for each of the R_L values given in Part A. Your power results should be in micro watts. Store these in the variables VABth and PLth. Again, do not make duplicate copies of your code. Simply change RL's value and rerun your code.

3. Create a new Excel file and make a table. The columns in the table should be fore VAB, PL, VABth, and PLth. Make sure all values of power are in micro watts. Put all of the values for R_L downwards into the rows of the table.

4. Record all of your results for both circuits in the table for each value of R_L.

5. Compare the results from the 2 different circuits using percent error in a fifth column.

5 Deliverables:

1. Save your Python code to a file called **lab5.py**. After this code is run, it should have easily readable and labeled screen output showing the variables VAB, PL, Vth, Rth, VABth, and PLth.

2. Save your Excel file with the extension **.xlsx**.

3. Submit these 2 files to this lab's D2L folder.