EGR 260 Due date: _____
Circuit Analysis (See Due Dates table)
File: N260PS2

PSPICE Assignment # 2

General Information:

- It is required that you use ORCAD Version 10.5 or later.
- Follow the guidelines illustrated in the **"PSPICE SAMPLE REPORT"** as you create your schematics and write your report.

Reference:

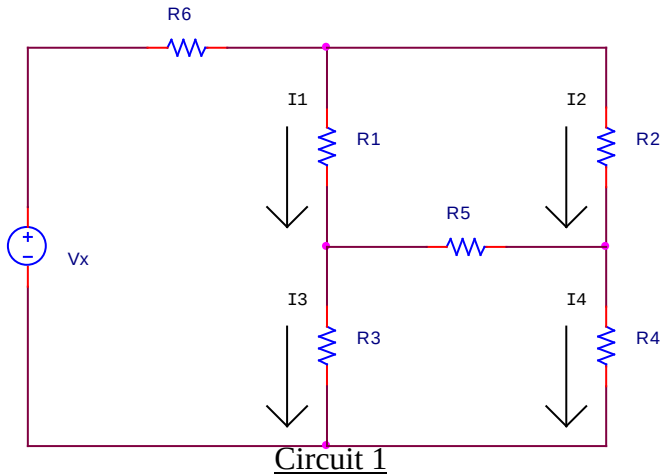
Read Chapters 1 - 3 in Schematic Capture Using Cadence PSPICE, 2nd Edition by Herniter
Handout: PSPICE Example - *Maximum Power Transfer* (*Varying a Component Value)*
Handout: PSPICE Example - *Op Amp Circuit using a Library Model (uA741)*
Handout: PSPICE Example - *Op Amp Example using a General Op Amp Model*

Assignment:

For each circuit, determine resistor values based on your StudentID as follows:

- Replace R1 by the first digit of your StudentID (in kΩ), R2 by the second digit (in kΩ), etc. If you have a 0 digit in your StudentID, use 10 kΩ instead of 0 kΩ.
- For example, if your StudentID is 2302613, then R1 = 2 kΩ, R2 = 3 kΩ, R3 = 10 kΩ, etc.
- Be sure to add text to each schematic as required (see Sample Report).
- Be sure to add text to each graph as required (see Sample Report).

1. **Using DC Sweep to vary a voltage source**
   - A) **Hand Analysis:** Analyze Circuit 1 by hand with V_x = 25V to determine the currents I_1, I_2, I_3, and I_4 . Use the analysis method of your choice. Neatly show all work.
   - B) **PSPICE Analysis:** Use a DC Sweep analysis in PSPICE to vary V_x from 0 to 100V and to graph I_1, I_2, I_3, and I_4 versus V_x. Use text in PROBE (PSPICE's graphing package) to label each current on the graph. Use cursors to locate and label the value of each current when V_x = 25V.
   - C) **Discussion:** Compare the currents when V_x = 25V from steps A and B above in a table (they should agree) and discuss the results.



Circuit 1

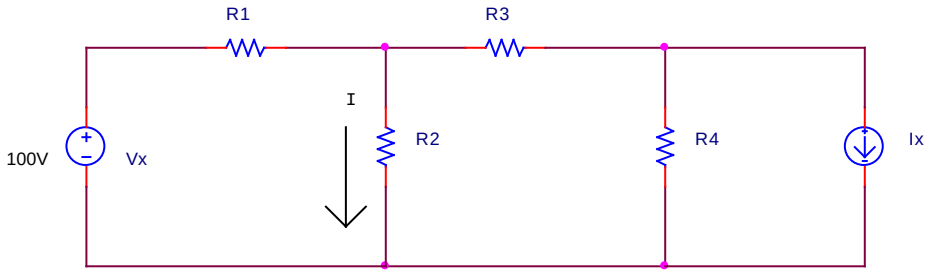
2. **Using DC Sweep to vary a current source**

Examining Circuit 2 with superposition shows that the 100V source provides a downward current through R2 and the current source provides an upward current through R2. For some value of I_x, the two currents should cancel resulting in zero current through R2. PSPICE will be used to find the value of Ix where I = 0.

A) **PSPICE Analysis:** Analyze Circuit 2 and use a DC Sweep analysis to vary the current source (you determine the range). Graph I(R2) versus Ix and label the point where I(R2) = 0. (It may be necessary to zoom in on the point to get a more accurate value.)

B) **Hand Analysis:** none required

C) **Discussion:** List the value of Ix where I equals zero. Explain why I(R2) positive on part of the graph and negative on the other part in terms of superposition.



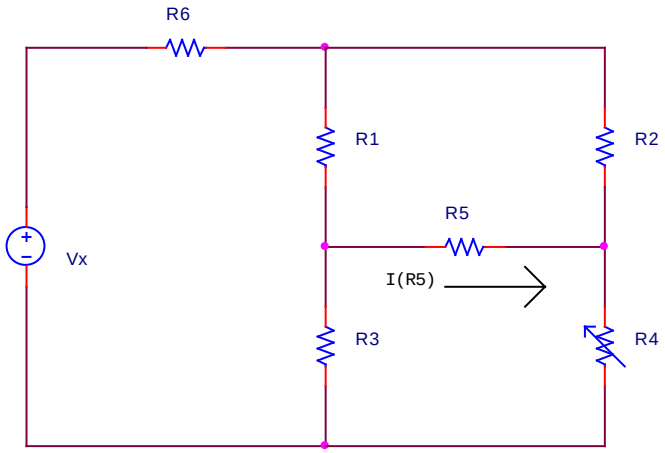
Circuit 2

3. **Using DC Sweep to vary a resistance**

A) **Hand Analysis:** Resistors R1 through R5 in the circuit below form what is referred to as a "bridge circuit." It can be shown that a bridge circuit is "balanced" when R1·R4 = R2·R3 and when the bridge circuit is balanced I(R5) equals zero. Using resistor values based on your EmpliID for R1, R2, R3, R5, and R6, determine the value of R4 required such that the bridge in Circuit 3 is balanced.

B) **PSPICE Analysis:** Analyze Circuit 3 with V_x = 100V using a DC Sweep analysis in PSPICE to vary R4 (use a variable resistor part and remember to change SET to 1 and to display the value on the schematic). Vary R4 from 0.1*(the valued determined in part A) to 10*(the value determined in part A) using 50 points per decade. Graph I(R5) versus R4 and mark the point where I(R5) = 0. The value of R4 at this point should match the value found in step A.

C) **Discussion:** Compare the results of steps A and B in a table and discuss the results.



Circuit 3

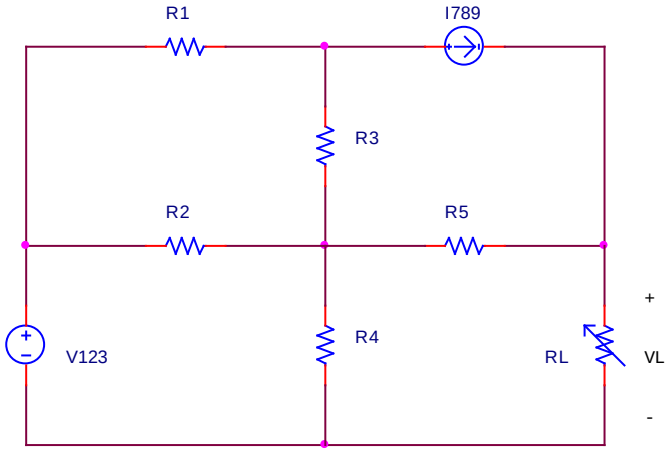
4. **Maximum Power Transfer**

Let V123 = the 1st three non-zero digits of your StudentID in volts and I789 = the last 3 non-zero digits of your StudentID in mA. For example, if your StudentID is 2302613, then V123 = 232V, and I789 = 613 mA.

A) **Hand Analysis:** Analyze Circuit 4 by hand in order to determine the value of R_L such that maximum power is delivered to R_L and to determine the value of maximum power that is delivered to R_L.

B) **PSPICE Analysis:** Use PSPICE to analyze Circuit 4 where R_L varies from $0.1R_{Th}$ to $10R_{Th}$ using the value of R_{Th} determined in step A. Use at least 50 points per decade in the analysis. Plot P_L vs R_L with R_L on a log scale using PROBE (you can plot the function V_L*V_L/R_L). Place a cursor on the maximum point on this graph (use the PEAK function in PROBE) and mark the point. This point will correspond to R_{th} and P_{max}.

C) **Discussion:** Compare the values of R_{th} and P_{max} determined in steps A and B in a table and discuss the results.



Circuit 4

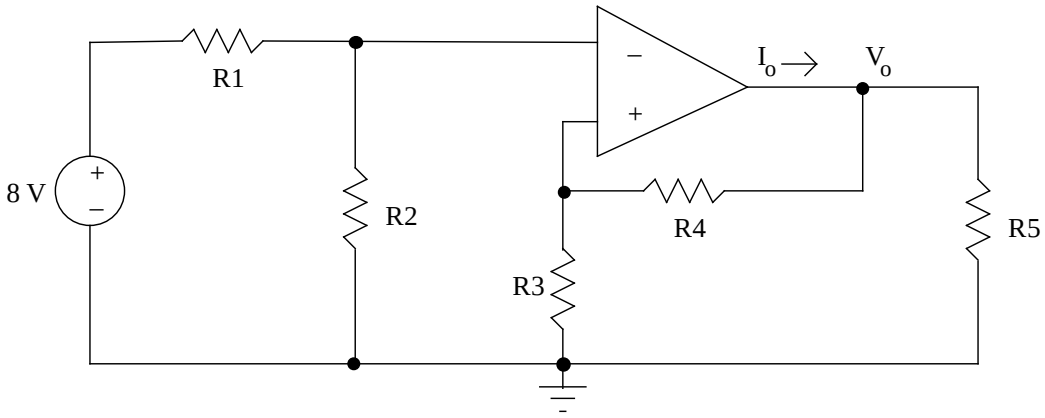
5. **Operational Amplifiers**

A) **Hand Analysis:** Analyze Circuit 5 **by hand** to determine the voltage V_o and the current I_o specified in the problem. Neatly show all calculations.

B) **Analysis by PSPICE using a uA741 op amp:** Determine the voltage V_o and the current I_o in Circuit 2 using PSPICE with the op amp replaced by the uA741 op amp. Be sure to use a supply voltage large enough such that the op amp is not saturated. Use a voltage printer and a current printer to display the values of V_o and I_o.

C) **Analysis by PSPICE using an op amp model consisting of a resistor and a dependent source:** Determine voltage V_o and the current I_o in Circuit 5 using PSPICE with the op amp replaced by the general op amp model (i.e., a voltage-controlled voltage source and a huge resistor). Use a voltage printer and a current printer to display the values of V_o and I_o.

D) **Comparison:** Compare the results of steps B, C, and D in a table and discuss the results. Be sure to discuss how you determine the values of the supply voltages in part B.



Circuit 5