PSPICE Assignment #1

Note: The report should include a title page similar to the one shown.

John Doe
EGR 260
Circuit Analysis
Due date: 9-9-19
Problem 1. Analysis of a Bridge Circuit

A. Problem Description:
1) Analyze the bridge circuit below by hand to determine $I_A$, $V_6$, and the power dissipated by the 4$k$Ω resistor.
2) Analyze the circuit below using PSPICE.
   • Use a Bias Point analysis.
   • Only the values requested should be displayed on the schematic.
   • Move the requested values a short distance away from the circuit components or wires so that the schematic isn’t crowded by the values.
3) Compare the results of step A and step B in a table and discuss the results.

B. Preliminary Analysis:

Mesh Analysis is used to first solve for $I_A$, $I_B$, and $I_C$:

\[
\begin{align*}
\text{KVL, mesh A:} & \quad -100 + 1I_A + 8(I_A - I_B) + 2(I_A - I_C) = 0 \\
\text{KVL, mesh B:} & \quad 4I_B + 3(I_B - I_C) + 8(I_B - I_A) = 0 \\
\text{KVL, mesh B:} & \quad 2I_C + 2(I_C - I_A) + 3(I_C - I_B) = 0 \\
\end{align*}
\]

\[
\begin{bmatrix} 11 & -8 & -2 \\ -8 & 15 & -3 \\ -2 & -3 & 7 \end{bmatrix} \begin{bmatrix} I_A \\ I_B \\ I_C \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \\ 0 \end{bmatrix} \quad \Rightarrow \quad \begin{bmatrix} I_A \\ I_B \\ I_C \end{bmatrix} = \frac{1}{0} \begin{bmatrix} 0 \\ 0 \\ 0 \end{bmatrix}
\]

so

\[
I_A = 2124 \text{ mA} \quad I_B = 13.72 \text{ mA} \quad I_C = 1195 \text{ mA}
\]

Note: The hand analysis does not need to be typed.
\[ I_4 = I_C - I_B = 11.95 - 13.72 \]
\[ I_4 = -1.77 \text{ mA} \]
\[ V_6 = R_6 \cdot I_C = (2 \, \text{k}\Omega)(11.95 \, \text{mA}) \]
\[ V_6 = 23.9 \, \text{V} \]
\[ P_{4k} = R_3 \cdot (I_B)^2 = (4 \, \text{k}\Omega)(-13.72 \, \text{mA})^2 \]
\[ P_{4k} = 0.753 \, \text{W} \]

C. **PSPICE Analysis:**

**EGR 260**
**Circuit Analysis**
**Assignment #1 - Problem #**
**John Doe**

**Purpose:** Find the current through R4, the voltage across R6, and the power dissipated by R3.

**Analysis type:** Bias

This section of the report should include:
- Schematic
- Output File (only if it contains any required output information)
- Any required graphs generated by PSPICE.

**Hints for good schematics:**
- Include your name, course name and number, assignment number and problem number
- Label all nodes
- Include a Purpose statement
- List the type of analysis (and details)
- Display all attributes that are changed
- Use component names identical to the ones used in the hand analysis when possible
- Include any other useful comments

**Note:** Schematics and graphs can be printed directly from PSPICE or they can be copied into a word processing document using the Windows clipboard. Output files are text files and can be opened using a word processor and copied.
D. **Analysis/Discussion:**

The results of the hand analysis and the PSPICE analysis for Problem 1 are shown in the table below. All results are in agreement.

<table>
<thead>
<tr>
<th>Value</th>
<th>Hand Results</th>
<th>PSPICE Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>I(R4)</td>
<td>-1.77 mA</td>
<td>-1.770 mA *</td>
</tr>
<tr>
<td>V(R6)</td>
<td>23.9 V</td>
<td>23.89 V **</td>
</tr>
<tr>
<td>P(R3)</td>
<td>753 mW</td>
<td>752.6 mW</td>
</tr>
</tbody>
</table>

* The specified direction for I(R4) is to the right through R4. The current value placed on the schematic by PSPICE is to the right of R4, indicating that the current 1.770 mA is to the left. So the current to the right is –1.770 mA.

** V(R6) is found by taking the difference of the node voltages shown on the schematic. V(R6) = V(D) – V(0) = 23.89 – 0 = 23.89 V.

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**Note:** Be sure to compare PSPICE and hand values. They should agree!

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**Note:** Be sure to add notes explaining any sign differences or showing how to calculate a required value from the information provided by PSPICE.
Problem 2: (Example 4.4 in Electric Circuits, 6th Edition)

A. Problem Description:
1) Analyze the circuit below by hand to determine $V_1$ and $I_2$.
2) Analyze the circuit below using PSPICE.
   - Use a DC Sweep analysis.
   - Use a voltage printer and a current printer so that the values of $V_1$ and $I_2$ will be displayed in the OUTPUT file. Box and label the results in the OUTPUT file.
3) Compare the results of step A and step B in a table and discuss the results.

B. Preliminary Analysis:

Mesh Analysis is used to first solve for $I_A$, $I_B$, and $I_C$:

KVL, mesh A: $-40 + 2I_A + 8(I_A - I_B) = 0$

KVL, mesh B: $8(I_B - I_A) + 6I_B + 6(I_B - I_C) = 0$

KVL, mesh B: $6(I_C - I_B) + 4I_C + 20 = 0$

\[
\begin{bmatrix}
10 & -8 & 0 \\
-8 & 20 & -6 \\
0 & -6 & 10 \\
\end{bmatrix}
\begin{bmatrix}
I_A \\
I_B \\
I_C \\
\end{bmatrix}
= 
\begin{bmatrix}
40 \\
0 \\
-20 \\
\end{bmatrix}
\]

so $I_A = 5.60$ A, $I_B = 2.00$ A, $I_C = -0.80$ A

$V_1 = 2I_A = 2(5.6) = 11.20$ V

$V_1 = 11.20$ V

$I_2 = I_B = 2.00$ A

$I_2 = 2.00$ A
C. **PSPICE Analysis:**

**Schematic:**

EGR 260
Circuit Analysis
Assignment #1 - Problem
John Doe

Purpose: Find the voltage across R1 using a voltage printer and the current through R2 using a current printer.

Analysis type: DC Sweep - Vary V1 from 40V to 40V in steps of 1V

![Circuit Diagram]

DC = V(R1)

DC = I(R2)

**Output File:** (see next page)

D. **Analysis/Discussion:**

The results of the hand analysis and the PSPICE analysis for Problem 2 are shown in the table below. All results are in agreement.

<table>
<thead>
<tr>
<th>Value</th>
<th>Hand Results</th>
<th>PSPICE Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>V₁</td>
<td>11.20 V</td>
<td>11.20 V</td>
</tr>
<tr>
<td>I₂</td>
<td>2.000 A</td>
<td>2.00 A</td>
</tr>
</tbody>
</table>

*Note: Be sure to display the DC properties of the current printer (IPRINT) and the voltage printer (VPRINT2).*
**Profile: "SCHEMATIC1-dc sweep" [ D:\EGR260\PSPICE\pspice sample report 2-SCHEMATIC1-dc sweep.sim ]**

**** CIRCUIT DESCRIPTION

******************************************************************************

*Libraries:
* Local Libraries :
* From [PSPICE NETLIST] section of C:\Program Files\OrcadLite\PSpice\Pspice.ini file:
  .lib "nom.lib"
  .lib "class.lib"

*Analysis directives:
  .DC LIN V_V1 40V 40V 1V
  .PROBE V(*) I(*) W(*) D(*) NOISE(*)
  .INC ".\pspice sample report 2-SCHEMATIC1.net"

**** INCLUDING "pspice sample report 2-SCHEMATIC1.net" ****

* source PSpice SAMPLE REPORT 2

 R_R1    A  B  2
 R_R4    0  B  8
 R_R5    0  C  6
 V_V1    A  0  DC 40V AC 0
 V_PRINT1 N01261 C 0V
 .PRINT  DC I(V_PRINT1)
 .PRINT  DC V([A],[B])
 R_R2    B N01261 6
 R_R3    C  D  4
 V_V2    D  0  DC 20V AC 0
 .END

**** DC TRANSFER CURVES  TEMPERATURE = 27.000 DEG C

******************************************************************************

 V_V1      I(V_PRINT1)
 4.000E+01  2.000E+00  so I_2 = 2.00 A

**** 09/29/ 22:28:11 ************** PSpice Lite  **********************

** Profile: "SCHEMATIC1-dc sweep" [ D:\EGR260\PSPICE\pspice sample report 2-SCHEMATIC1-dc sweep.sim ]

**** DC TRANSFER CURVES  TEMPERATURE = 27.000 DEG C

******************************************************************************

 V_V1      V(A,B)
 4.000E+01  1.120E+01  so V_1 = 11.20 V

JOB CONCLUDED
TOTAL JOB TIME .06

Note: The .OUT file is often long. You can edit it and just include the key parts if you wish.

Note: Include the “Netlist.” It describes the circuit connections by node for each device.

Note: Box or highlight the key outputs and identify them by their assigned name.
Problem 3: Varying a voltage source

A. Problem Description:
   1) No hand analysis is required.
   2) Analyze the circuit below using PSPICE. Vary the voltage source from 0 to 30V in increments of 0.5V to find the value of V1 where the current through R3 is zero.
      - Use a DC Sweep analysis.
      - No OUTPUT file is required with the report.
      - Be sure to include appropriate text on both the schematic and on the graph.
   3) Discuss the results. Why does the current through R3 become zero?

B. Preliminary Analysis: (none required)

C. PSPICE Analysis:
   Schematic:

   ![Schematic Diagram]

   EGR 260
   Circuit Analysis
   John Doe
   PSPICE Assignment #1, Problem 3

   Purpose: Vary the voltage source, V1, from 0 to 30 V in order to determine the value of V1 such that the current through R3 is zero.

   Analysis Type: DC Sweep - Vary V1 from 0 to 30V in 0.5V increments.
D. Analysis/Discussion:

As seen from the graph above, the current through resistor R3 becomes approximately zero when the voltage source V1 equals 12.637 V. The principle of superposition is useful in understanding this result. Superposition states that the current through R3 can be found by finding the current found due to each independent source separately with all others “killed” and then by adding the contributions due to each source. In simple terms, the voltage source sends a current to the right through R3 and the current source sends a current to the left through R3. These currents add. When V1 = 12.637 V, the two currents are equal and cancel each other, resulting in no current passing through R3.