# PSPICE Assignment #1

John Doe
EGR 260
Circuit Analysis
Due date: 9-9-19

**Problem 1. <u>Analysis of a Bridge Circuit</u>**

## A. <u>Problem Description:</u>

1) Analyze the bridge circuit below by hand to determine $I_4$, $V_6$, and the power dissipated by the 4kΩ 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. <u>Preliminary Analysis:</u>
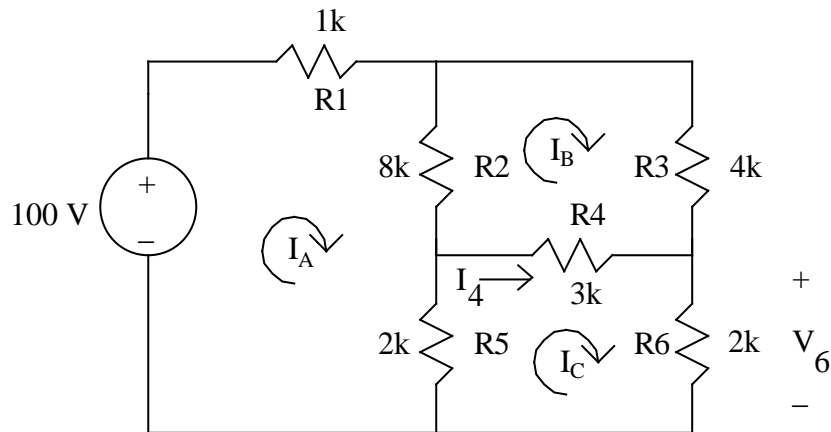


<u>Mesh Analysis is used to first solve for $I_A$, $I_B$, and $I_C$ :</u>

<u>KVL, mesh A:</u>  $-100 + 1I_A + 8(I_A - I_B) + 2(I_A - I_C) = 0$

<u>KVL, mesh B:</u>  $4I_B + 3(I_B - I_C) + 8(I_B - I_A) = 0$

<u>KVL, mesh B:</u>  $2I_C + 2(I_C - I_A) + 3(I_C - I_B) = 0$

$$\begin{bmatrix} 11 & -8 & -2 \\ -8 & 15 & -3 \\ -2 & -3 & 7 \end{bmatrix} \cdot \begin{bmatrix} I_A \\ I_B \\ I_C \end{bmatrix} = \begin{bmatrix} 100 \\ 0 \\ 0 \end{bmatrix}$$

so

$I_A = 21.24$ mA
$I_B = 13.72$ mA
$I_C = 11.95$ mA

*<u>Note:</u> The hand analysis does not need to by typed.*

$I_4 = I_C - I_B = 11.95 - 13.72$

$$\boxed{I_4 = -177\,mA}$$

$V_6 = R6 \cdot I_C = (2\,k\Omega)(11.95\,mA)$

$$\boxed{V_6 = 23.9\,V}$$

$P_{4k} = R3 \cdot (I_B)^2 = (4\,k\Omega)(-13.72\,mA)^2$

$$\boxed{P_{4k} = 0.753\,W}$$

## C.  **PSPICE Analysis:**

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

Purpose:  Find the current through R4, the
across R6, and the power dissipated by
R3
Analysis type:  Bias
Point
```

## 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.

| Value | Hand Results | PSPICE Results |
|-------|-------------|----------------|
| I(R4) | -1.77 mA | -1.770 mA * |
| V(R6) | 23.9 V | 23.89 V ** |
| P(R3) | 753 mW | 752.6 mW |

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

Notes:
* 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.

> *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, 6<sup>th</sup> 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:
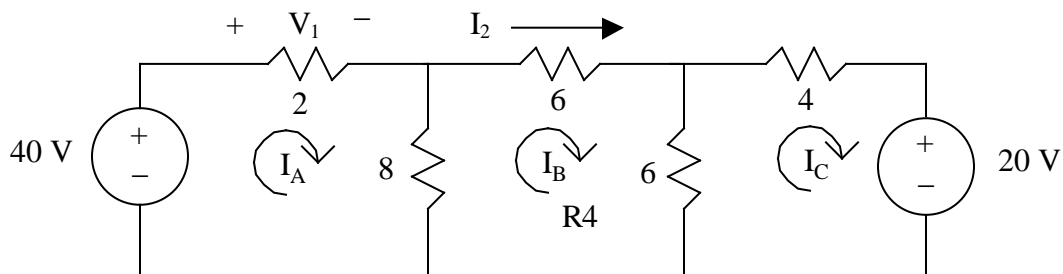


Mesh Analysis is used to first solve for IA , IB , and IC :

KVL, mesh A:  -40 + 2I<sub>A</sub> + 8(I<sub>A</sub> - I<sub>B</sub> ) = 0

KVL, mesh B:  8(I<sub>B</sub> - I<sub>A</sub>) + 6I<sub>B</sub> + 6(I<sub>B</sub> - I<sub>C</sub>) = 0

KVL, mesh B:  6(I<sub>C</sub> - I<sub>B</sub>) + 4I<sub>C</sub> + 20 = 0

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

so

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

$V_1 = 2 I_A = 2(5.6) = 11.20$ 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
and the current through R2 using a current
printer
Analysis type:  DC Sweep - Vary V1 from 40V to 40V in steps of
1V
```

DC = V(R1)          DC = I(R2)

IPRINT

R1          R2          R3
2           6           4

A                    B           C           D

40V   V1        8  R4        6  R5        20V   V2

0
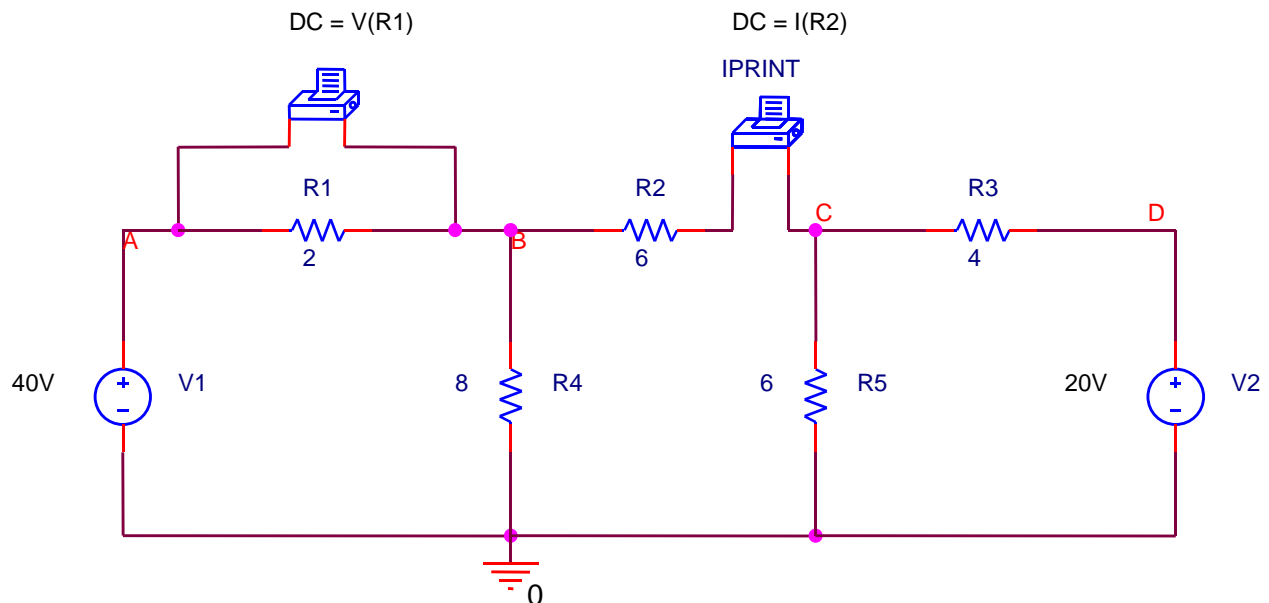
### Output File: (see next page)

## 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.

| Value | Hand Results | PSPICE Results |
|-------|-------------|----------------|
| $V_1$ | 11.20 V | 11.20 V |
| $I_2$ | 2.000 A | 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 ]

  ****      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 I2 = 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 V1 = 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?
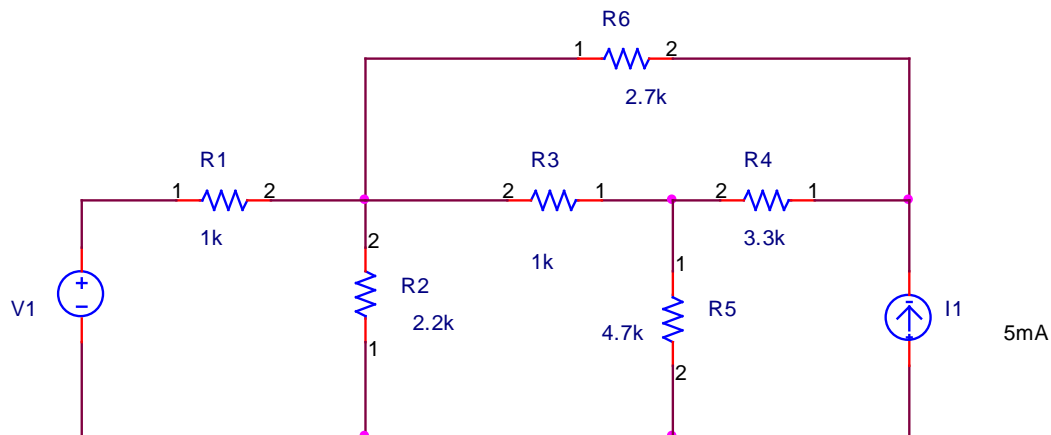


## B. Preliminary Analysis:  (none required)
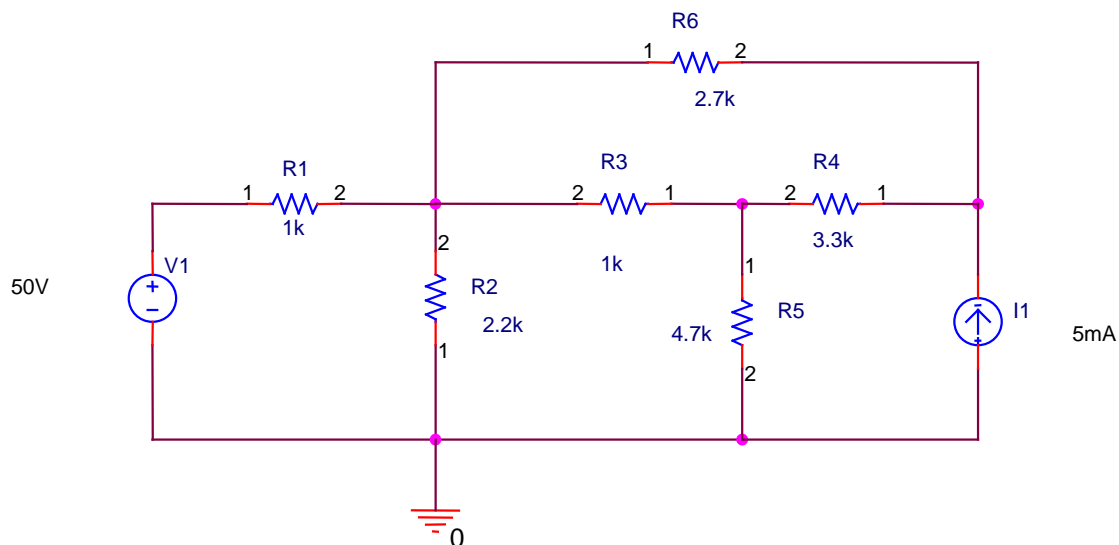
## C. PSPICE Analysis:

### Schematic:

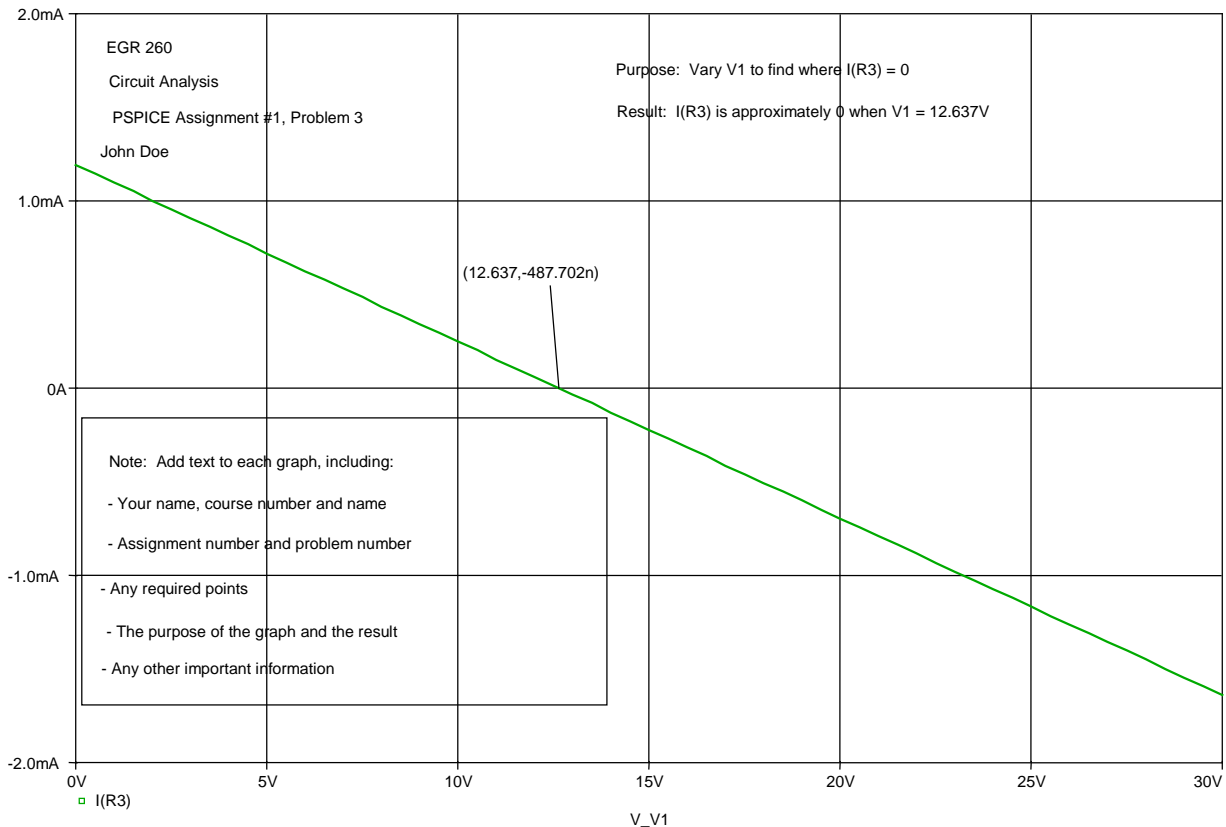```
EGR 260
Circuit Analysis
John Doe
PSPICE Assignment #1, Problem
3
Purpose:  Vary the voltage source, V1,  from 0 to 30 V in
determine the value of V1 such that the current through R3 is
zero
Analysis Type:  DC Sweep - Vary V1 from 0 to 30V in 0.5V
increments
```

## Graphical Results:



2.0mA

EGR 260

Circuit Analysis

PSPICE Assignment #1, Problem 3

John Doe

Purpose: Vary V1 to find where I(R3) = 0

Result: I(R3) is approximately 0 when V1 = 12.637V

1.0mA

(12.637,-487.702n)

0A

Note: Add text to each graph, including:

- Your name, course number and name

- Assignment number and problem number

- Any required points

- The purpose of the graph and the result

- Any other important information

-1.0mA

-2.0mA

0V    5V    10V    15V    20V    25V    30V

I(R3)

V_V1

## 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.