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Course : CSE250

Experiment no: 02

Name of the Experiment: Introduction to series and parallel circuits.

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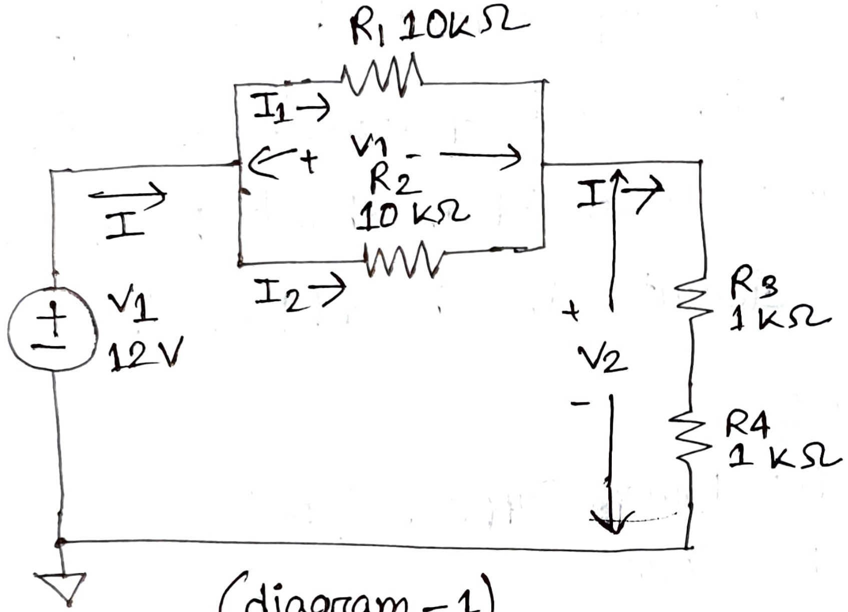
Objective: The experiment is to acquaint the students with series-parallel circuits and to give them(us) the idea about how to connect different circuits in bread board.

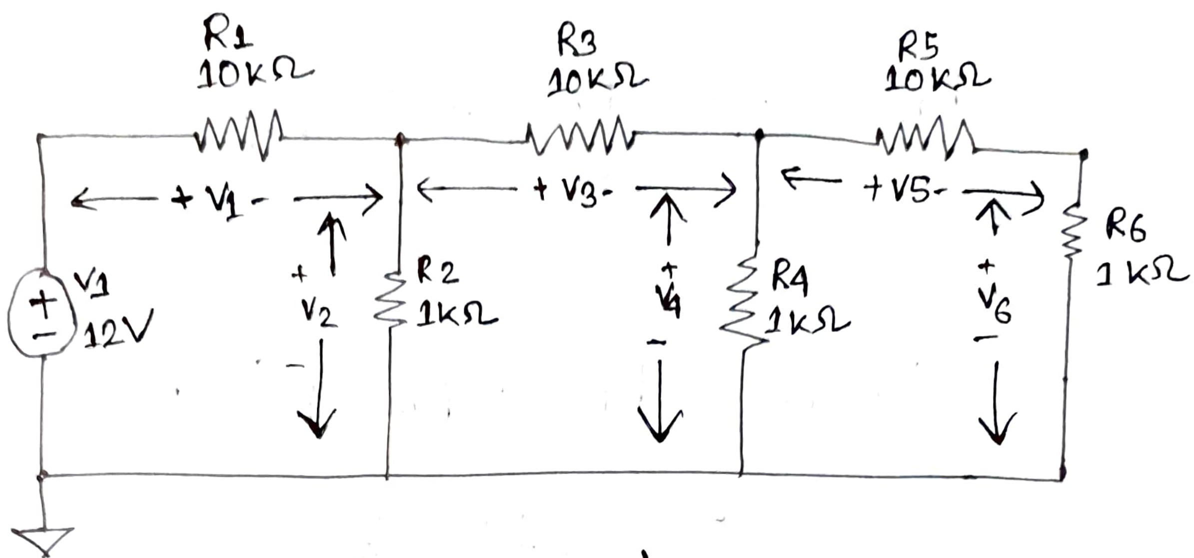
Apparatus:

1. DC Power Supplies (VDC)
2. Resistors
3. Breadboard (PSPice)
4. Multimeter

Circuit Diagram: (for diagram-1) Using pen to draw here as pencil marks are hard to see when converted to pdf)



(diagram-1)



(diagram - 2)

<u>Result:</u>

For Figure/diagram-1/circuit diagram - 1:

Given,

$R_1 = 10\,k\Omega$, $R_2 = 10\,k\Omega$

$R_3 = 1\,k\Omega$, $R_4 = 1\,k\Omega$

$V = 12\,V$

<u>Now,</u>

As R_1 and R_2 are in parallel connection

$$R_{12} = \left(\frac{1}{10} + \frac{1}{10}\right)^{-1} k\Omega$$

$$= 5\,k\Omega$$

Again,

R_{12} and R_3 and R_4 are in series connection,

$$\therefore R = (R_{12} + R_3 + R_4)\ k\Omega$$
$$= (5 + 1 + 1)\ k\Omega$$
$$= 7\ k\Omega$$

We know

$$V = IR$$
$$\Rightarrow I = \frac{V}{R}$$
$$= \frac{12}{7}\ mA$$
$$= 1{\cdot}7142\ mA$$

According to the diagram, the current I flows through R_3 and R_4.

The value or the current passing through these two will be the same as they are in series.

$\therefore$ for, R_3, $I_3 = I = 1.7142\,mA$

For, R_4, $I_4 = I = 1.7142\,mA$

Now

If we want to find V_2 then, we see V_2 is found when we combine R_3 and R_4 and take from there.

So, $R_{34} = 1 + 1 = 2$ (Series)

$\therefore V_2 = I R_{34}$

$= 1.7142 \times 2$

$= 3.4284\,V$

Same I passing through

Now, we have our V and V_2,

So,

$$V_1 = V - V_2$$

$$= 12 - 3\cdot4284$$

$$= 8\cdot5716 \text{ V}$$

Now for R_1,

$$R_1 = 10\text{ k}\Omega$$

$$I_1 = \frac{V_1}{R_1}$$

$$= \frac{8\cdot5716}{10}$$

$$= 0\cdot85716 \text{ mA}$$

$$= 857\cdot16 \,\mu\text{A}$$

for R_2,

$$R_2 = 10\text{ k}\Omega$$

$$I_2 = \frac{V_1}{R_1}$$

$$= 857\cdot16 \,\mu\text{A}$$

For, R_3,

$R_3 = 1k\Omega$

$I_3 = I = 1.7142 mA$

$V_3 = 1.7142 \times 1$

$= 1.714$ ✓

[Even though I submitted as Pspice, I have checked all using Proteus.]

For R_4,

$R_4 = 1k\Omega$

$V_4 = 1.714$

$I_4 = I = 1.7142 mA$

Data Table for diagram-1:

V_1 (V)	V_2 (V)	V_{total}	I_1 (μA)	I_2 (μA)	I_{total} (μA)
8.5716	3.4284	12	857.16	857.16	17.14.32 μA

17.14.32 μA

$= 1.71432 mA$

For diagram-2:

Given,

$$R_1 = 10\,k\Omega\,;\; R_3 = 10\,k\Omega$$

$$R_5 = 10\,k\Omega\,;$$

$$R_2 = R_4 = R_6 = 1\,k\Omega$$

$$V_1 = 12\,V$$

Now

Firstly, R_5 and R_6 are in series connection.

$$R_{56} = (10 + 1)$$
$$= 11\,k\Omega$$

Now

R_{56} and $R4$ are in parallel

$$R_{456} = \left(\frac{1}{R_{56}} + \frac{1}{R_4}\right)^{-1}$$
$$= \left(\frac{1}{11} + 1\right)^{-1}$$
$$= 0.9167\,k\Omega$$

Now

R_3 and R_{456} are in series connection

$$R_{3456} = R_3 + R_{456}$$

$$= 10 + 0.9167$$

$$= 10.9167 \text{ k}\Omega$$

R_{3456} and R_2 are in parallel connection

$$R_{23456} = \left(\frac{1}{R_2} + \frac{1}{R_{3456}}\right)^{-1} \qquad | R_2 = 1$$

$$= \left(1 + \frac{1}{10.9167}\right)^{-1}$$

$$= 0.9160 \text{ k}\Omega$$

R_1 and R_{2346} are in series connection

$$R_{123456} = R_{total} = (10 + 0.9160)$$

$$= 10.9160 \text{ k}\Omega$$

Now

we know,

$$V = IR$$

$$\Rightarrow I = \frac{V}{R}$$

$$= \frac{12}{10.9160}$$

$$= 1.0993 \, mA$$

According to the diagram,

$$V_1 = I_1 R_1$$

$$= I R_1$$

$$= 1.0993 \times 10$$

$$= 10.993 \, V$$

So, $V_2 = V - V_1$

$$= 12 - 10.993$$

$$= 1.007 \, V$$

Now, we see I and I_1 are same

$$\therefore \quad I_1 = I$$
$$= 1.0993 \, mA$$

Now, for R_2,

$$V_2 = I_2 R_2$$
$$\Rightarrow I_2 = \frac{V_2}{R_2}$$
$$= \frac{1.007}{1}$$
$$= 1.007 \, mA$$

For, R_3

$$I_3 = I - I_2$$
$$= 1.0993 - 1.007$$
$$= 0.0923$$

OR

$$\frac{V_2}{R_{3456}}$$
$$= \frac{1.007}{10.916}$$
$$= 0.0923$$

~~Same~~ Same

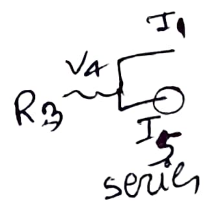
$$\therefore V_3 = I_3 R_3$$
$$= 0.0923 \times 10$$
$$= 0.923V$$

Now

$$V_4 = (V_2 - V_3)$$
$$= (1.007 - 0.923)$$
$$= 0.084\ V = 84.56\ mV$$

So, $$I_4 = \frac{V_4}{R_4}$$
$$= \frac{0.084}{1}$$
$$= 0.084\ mA$$

Again



$$I_5 = \frac{V_4}{(10+1)}$$
$$= \frac{0.084}{11}$$
$$= 7.63 \times 10^{-3}$$
$$= 0.00764\ mA$$

Now

$$V_5 = I_5 R_5$$
$$= 0.00764 \times 10$$
$$= 0.0764$$

Again

$$V_6 = V_4 - V_5$$
$$= 0.084 - 0.0764$$
$$= 7.6 \times 10^{-3}$$
$$= 0.0076\,V$$
$$= 7.6\,mV$$ (for future help (PSpice))

Finally

$$I_6 = \frac{V_6}{R_6}$$
$$= \frac{0.0076}{1}$$
$$= 0.0076\,mA$$
$$= 7.6\,\mu A$$

Data Table:

(volts)

V_1	V_2	V_3	V_4	V_5	V_6	V_{total}
10993	1.007	0.923	0.084	0.0764	0.0076	13.091

For I (All mA)

I_1	I_2	I_3	I_4	I_5	I_6	I_{total}
1.0993	1.007	0.0923	0.084	0.00764	0.00764	~~2.00788~~ mA

1.1985 (Except $I = I_1$)

Here, 1.09 is almost same as 1.1

Discussion:

For diagram-1:

From my hand calculation, the value of V_{total} is 12. The value exactly matches with my PSpice file. Also, my calculated value for I_{total} is 1714.32 mA or 1.71432 mA, the value on pspice is 1·714mA. This exactly matches.

For diagram-2:

Now, the volts that I have hard calculated sums to 13·091V which should have been 12V according to the PSpice file that I ran. Also the I is a bit different than what I ran. Initially, this could be because of the decimal points or some other factors.

Discussion:

In this lab I was introduced to PSpice. Apart from learning how to properly use the tool to get our desired circuits and results, I learnt the program wait chain analysis which ~~mi~~ might be out of context. Also, I learnt that there could be errors in manual and program simulation data.

Ans: to the que no: 01

According to bux instructions, I have already added the recorded register values in the data tables. I have also calculated the current values. Now, further analysing shows some or slight discrepancies in the records. such as, In pspice file the value of voltage (total) is slightly (13.091-12) = 1.091 lower than what I have calculated in hand.

Ans: to the que no: 02

We have 6 ~~regist~~ resistors.

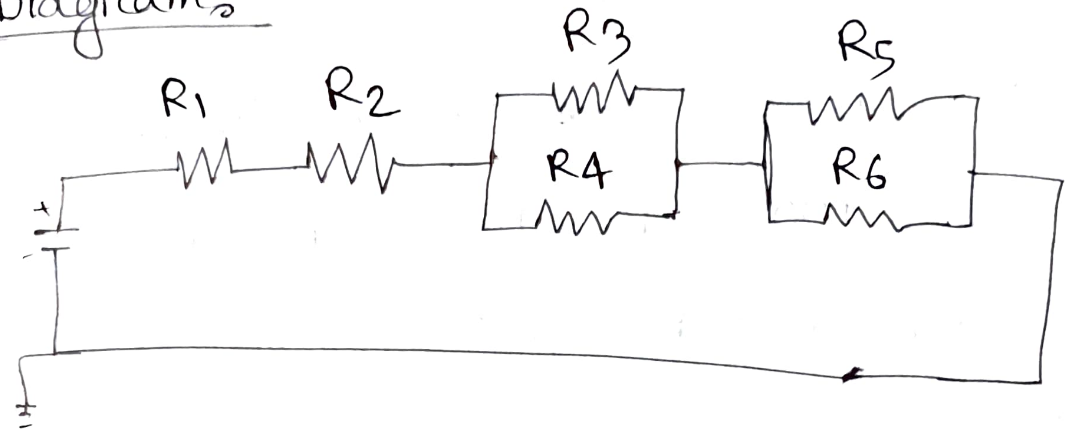
$R_1 = 100\,\Omega$, $R_2 = 100\,\Omega$, $R_3 = 100\,\Omega$

$R_4 = R_5 = R_6 = 100\,\Omega$

Now

Our target is to get $300\,\Omega$ combining all of them. (It would have used 3 in series and keep the rest 3 but that is not possible here). So, according to my calculations or what I have noticed, If we parallel connect two same value resistor, the combined resistance becomes half. So we can get $50 \times 2 = 100$ then $(100 + 100 + 100)$ in series. So, this is the simplest diagram I can think of right now.

Diagram:



So, R_1 and R_2 in series

$$R_{12} = (100 + 100) = 200\ \Omega$$

R_3 and R_4 Parallel

$$R_{34} = \left(\frac{1}{100} + \frac{1}{100}\right)^{-1} = 50\ \Omega$$

Same for R_5, R_6, $\quad R_{56} = 50\ \Omega$

$$\therefore R_{total} = 200\Omega + 50\Omega + 50\Omega$$

$$= 300\ \Omega$$

Ans

Ans: to the que no: 03

we have,

$$R_1 = 1{\cdot}5 \ k\Omega$$

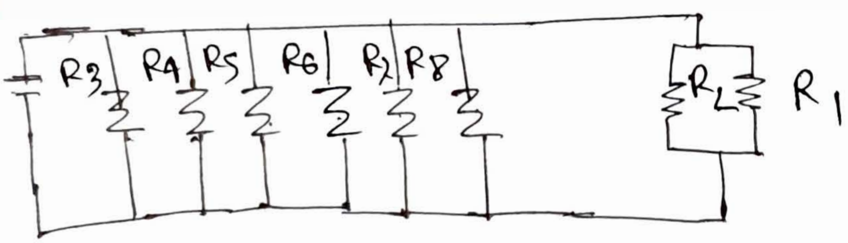
$$R_2 = 1{\cdot}5 \ k\Omega$$

and

$$R_3 = R_4 = R_5 = R_6 = R_7 = R_8 = 15 \ k\Omega$$

$\cancel{\left(\frac{1}{15}\times 6\right)}^{-1}$ $\cancel{\left(\frac{1}{1{\cdot}5}\times 2\right)}$

The simplest diagram idea is to parallel connect the different types and the ~~seris~~ connect them in series.

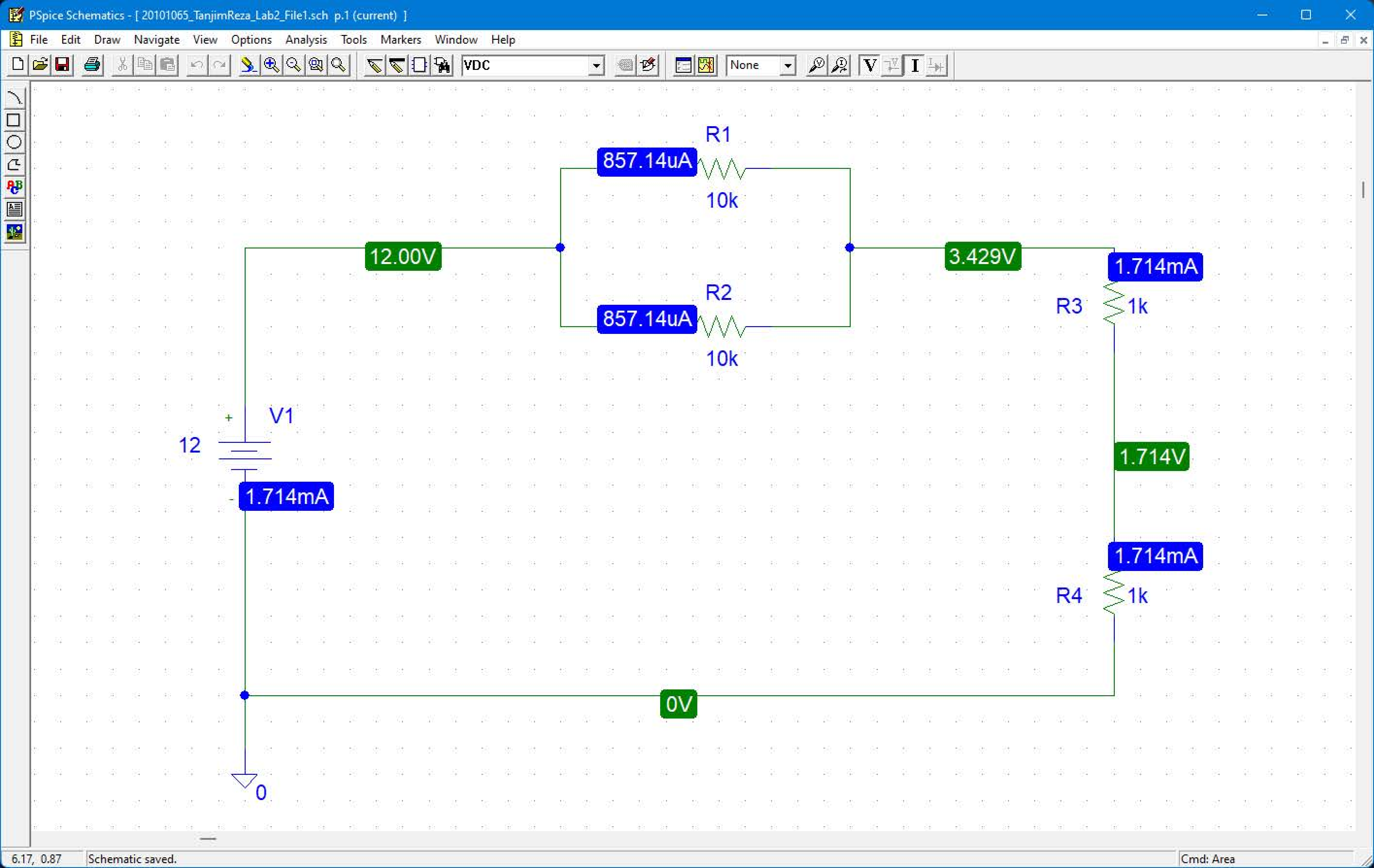


$\therefore$ R_1 and R_2 in parallel $\left(\frac{1}{1{\cdot}5}\times 2\right)^{-1} = 0{\cdot}75 \ \Omega$

R_3 to R_8 are in parallel $\left(\frac{1}{15}\times 6\right)^{-1} = 2{\cdot}5 \ k\Omega$

R_{12} and $R_{3\to8}$ in series $= (0{\cdot}75 + 2{\cdot}5) \ k\Omega$

$$= 3{\cdot}25 \ k\Omega$$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File Edit Draw Navigate View Options Analysis Tools Markers Window Help
VDC
None
R1
857.14uA
10k
12.00V
3.429V
R2
857.14uA
10k
1.714mA
R3
1k
+
V1
12
-
1.714mA
1.714V
1.714mA
R4
1k
0V
0
6.17, 0.87
Schematic saved.
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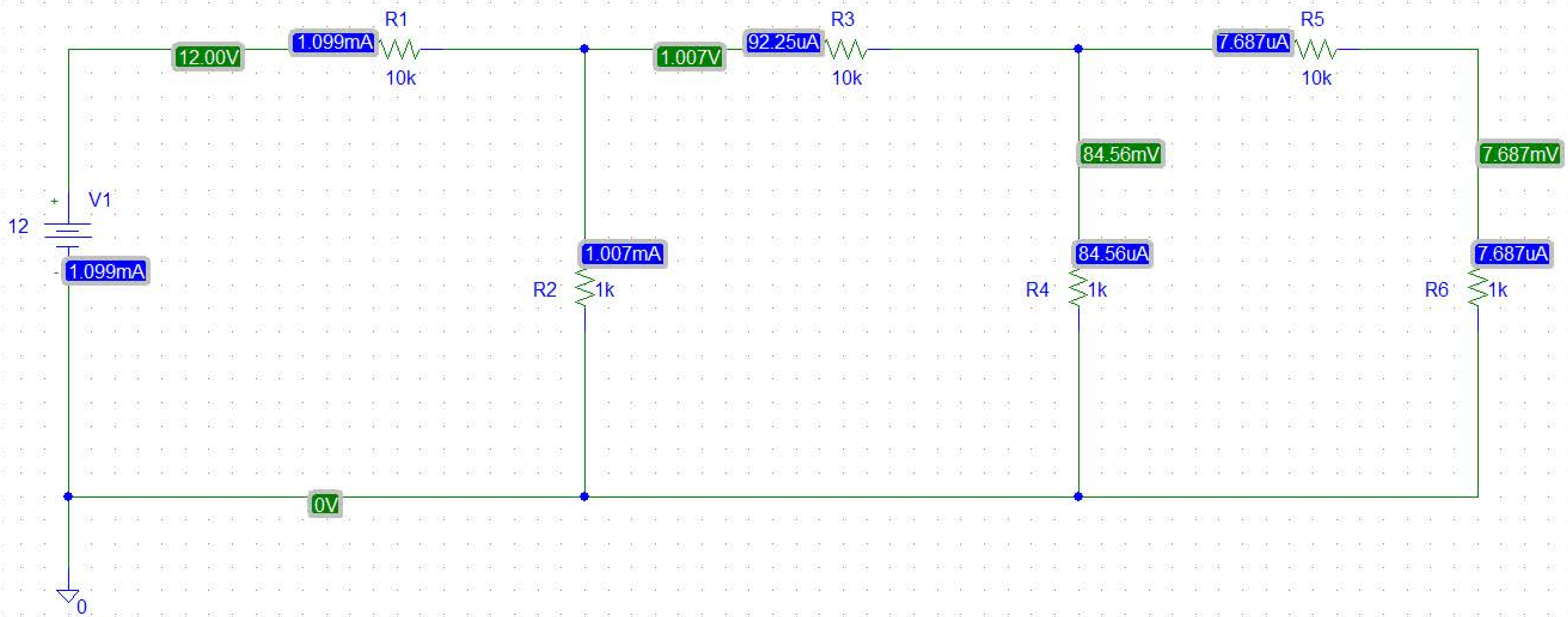
PSpice Schematics - [*20101065_TanjimReza_Lab2_File2.sch p.1 (stale)]

File Edit Draw Navigate View Options Analysis Tools Markers Window Help



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