Lab-02

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Sec : CSE-09

Course : CSE250

Experiment Name : Introduction to series and parallel circuits.

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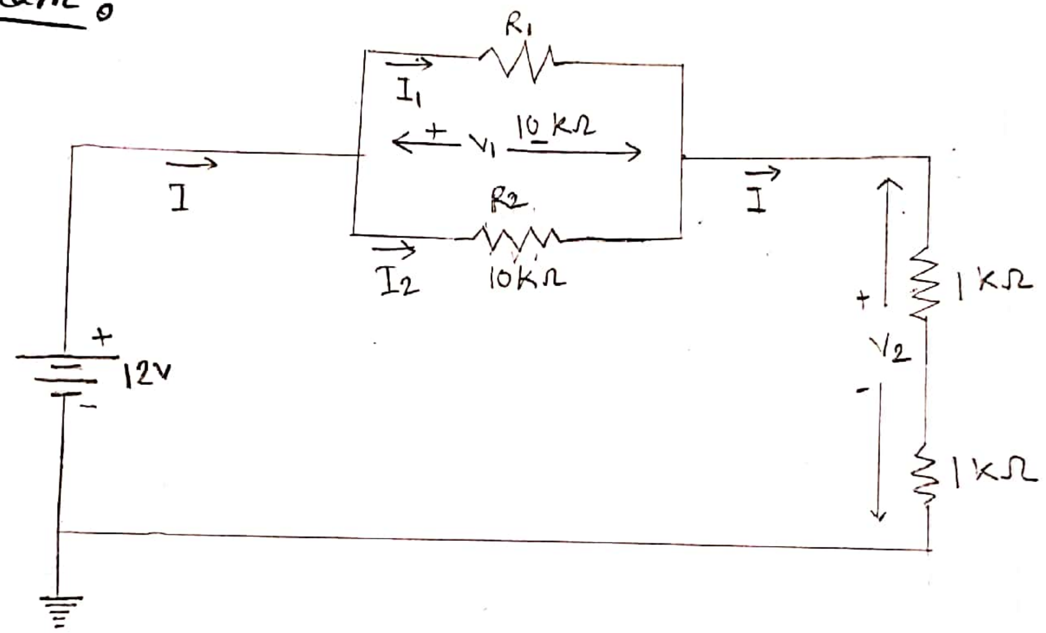
Objective : The experiment is to acquaint us with series-parallel ~~cuir~~ circuits and to give them the idea about how to connect different circuits in bread board.

Appuratus : ~~Fif~~ Figure : 1 : Multimeter Two $10k\Omega$ resistors, two $1\ k\Omega$ resistors, DC 12V power source, Jumper wires, bread-board.

Circuit Diagram :



Result/Analysis section :

i) Theoretical calculation : Figure 01 :

Total resistance of the circuit $= \left\{\left(\frac{1}{R_1}+\frac{1}{R_2}\right)^{-1} + R_3 + R_4\right\} k\Omega$

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

$$= 7\ k\Omega$$

Now, $V = IR$

$$\Rightarrow I = \frac{V}{R} = \frac{12}{7K} A = 0.001714 A = 1.714\ mA$$

As R_3 and R_4 are in series allignment the current run through them will be $1.714\ mA$.

Now voltage runs through R_1 and R_2 are,

$$V_1 = I\left(\frac{1}{R_1}+\frac{1}{R_2}\right)^{-1} = \frac{12}{17k} \times 5k = \frac{60}{7} = 8.5714 \text{ volts}.$$

Now the current runs through R_1 is,

$$I_1 = \frac{V_1}{R_1} = \frac{60/7}{10k} = 0.85714 \text{ mA}$$

Now the current runs through R_2 is,

$$I_2 = \frac{V_1}{R_2} = \frac{60/7}{10k} = 0.85714 \text{mA}$$

Thus, the voltage runs through R_3 and R_4 is,

$$V_2 = (IR_3 + IR_4) = \left(\frac{12}{7k}\times 1k\right) + \left(\frac{12}{7k}\times 1k\right)$$

$$= 1.712 + 1.712 \text{ volts}$$

$$= 3.428 \text{ volts}.$$

ii) Varification of the results from proteus simulation,

Figure 1:

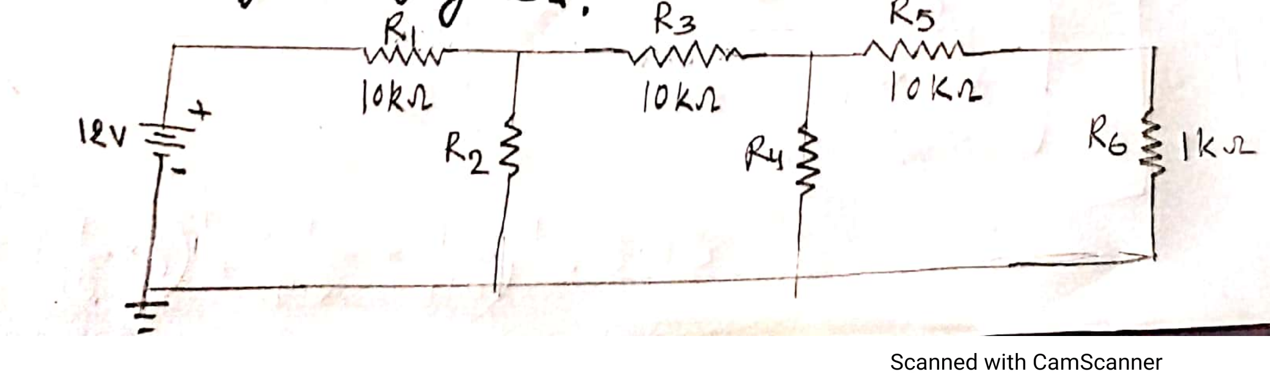
From the proteus simulation we get,

I	1.71mA
I_1	0.857mA
I_2	0.857mA
V_1	8.57V
V_2	3.42V

	Resistance	Voltage	Current
R_1	10kΩ	8.57V	0.857mA
R_2	10kΩ	8.57V	0.857mA
R_3	1kΩ	1.71V	1.71mA
R_4	1kΩ	1.71V	1.71mA

Apparatus: Figure 2: Multimeter, three 10kΩ resistors, three 1kΩ resistors, Jumper wire, bread board, DC12V power supply.

Circuit Diagram: Figure 2:



Result/Analysis : i) Theoritical calculation

Figure 2 :

$$R_{4,5,6} = \left(\frac{1}{R_4} + \frac{1}{R_5+R_6}\right)^{-1} = \left(\frac{1}{1k} + \frac{1}{11k}\right)^{-1} = \frac{11}{12}k\Omega = 916.667\,\Omega$$

$$R_{2,3,4,5,6} = \left(\frac{1}{R_2} + \frac{1}{R_3+R_{4,5,6}}\right)^{-1} = \frac{1}{1k} + \frac{1}{10k+916.667}\Big)^{-1} = 916.084\,\Omega$$

$$\therefore R_{1,2,3,4,5,6} = 10000 + \cancel{916}\,916.084\,\Omega = 10916.084\,\Omega$$

$$\therefore I_1 = \frac{V}{R} = \frac{12}{109116.084} = 0.0010993A = 1.0993\,mA$$

Now,

$$V_1 = IR$$
$$= 0.0010993 \times 10000 = 10.993 \text{ volts.}$$

$$V_2 = I \times R_{2,3,4,5,6}$$
$$= 0.0010993 \times 916.084 = 1.007 \text{ volts.}$$

$$\therefore I_2 = \frac{V_2}{R_2} = \frac{1.007}{1000} = 0.001007A = 1.007\,mA$$

$$\therefore I_3 = \frac{V_2}{R_{3,4,5,6}} = \frac{1.007}{10916.667} = 92.244 \times 10^{-6}\,A$$

$$\therefore V_3 = I_3 R_3 = 92.244 \times 10^{-6} \times 10000 = 0.922 \text{ volts}$$

$$\therefore V_4 = I_3 R_3 = 92.244 \times 10^{-6} \times 916.67 = 0.0845 \text{ volts.}$$

$$\therefore I_4 = \frac{V_4}{R_4} = \frac{0.0845}{1000} = 8.45 \times 10^{-5}\,A$$

$$\therefore I_5 = \frac{V_4}{R_{5,6}} = \frac{0.80845}{11000} = 7.682 \times 10^{-6}\,A$$

$$\therefore V_5 = I_5 R_5 = 7.682 \times 10^{-6} \times 10000 = 0.0768 \text{ Volts}$$

$$\therefore V_6 = I_5 R_6 = 7.682 \times 10^{-6} \times 1000$$
$$= 0.00768\,V$$

ii) Varification of the results from proteus,

Figure 2: From the proteus file, we get,

V_1	10.993
V_2	1.00704
V_3	0.92247
V_4	0.0845
V_5	0.7687
V_6	0.00768

	Resistance	Current
R_1	10kΩ	0.001099
R_2	1kΩ	0.0010070
R_3	10kΩ	9.224×10^{-5}
R_4	1kΩ	8.456×10^{-5}
R_5	10kΩ	1.768×10^{-5}
R_6	1kΩ	1.760×10^{-6}

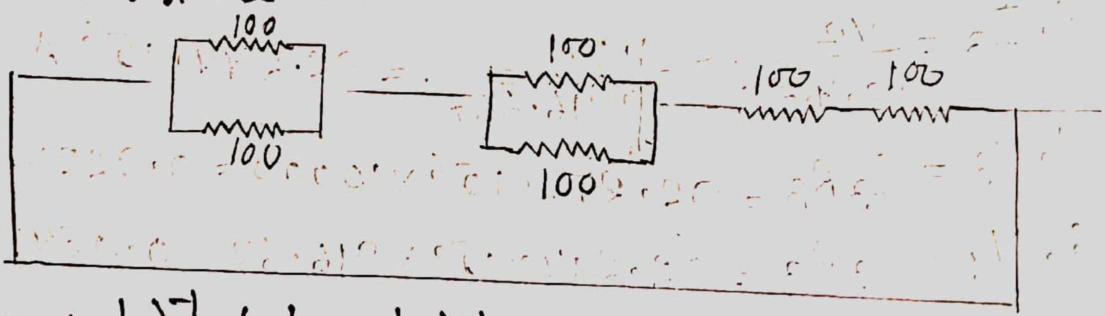
Question and Answers:

1) The calculated value of the currents are $I = 1.71mA$;

$I_1 = 0.85\,mA$; $I_2 = 0.857\,mA$.

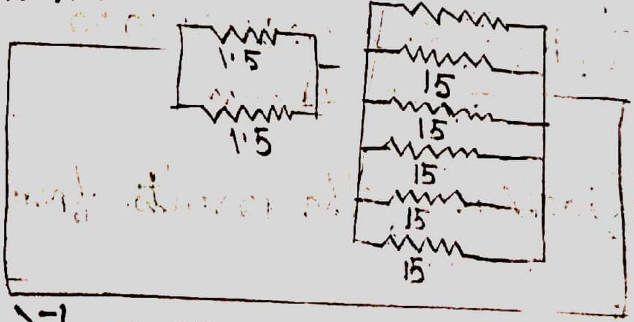
Thus, there is no discrepencies.

2) If we put two 100 ohm parallel resistors then connect with another two 100 ohm parallel resistors and lastly put last two 100 ohm resistors in series, we will get 300 ohm resistance value.



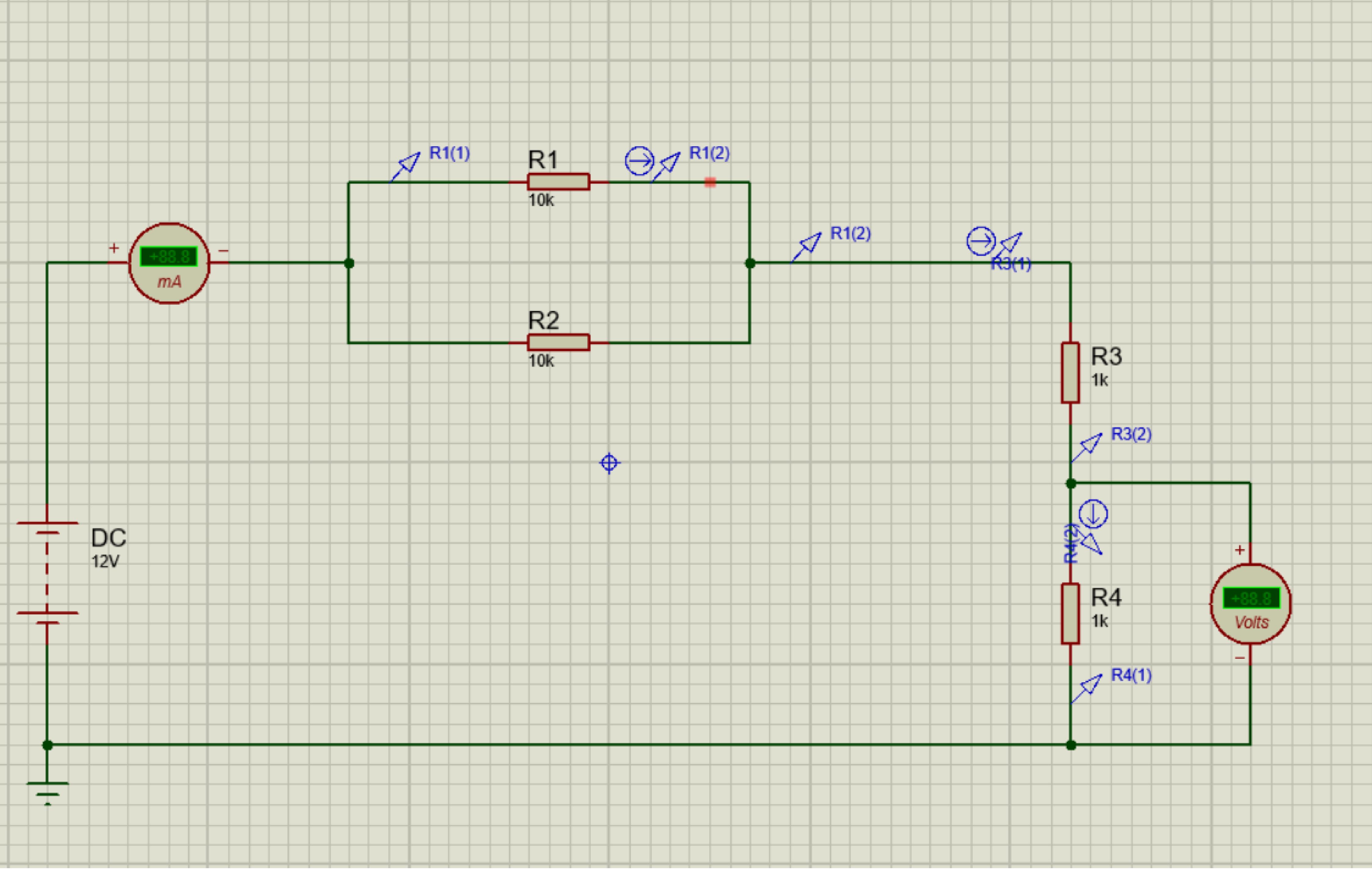
$$\left(\frac{1}{100}+\frac{1}{100}\right)^{-1}+\left(\frac{1}{100}+\frac{1}{100}\right)^{-1}+100+100 = 300\,\Omega$$

3) If we put two parallel 1.5 k ohm resistors then connect it with six parallel 15 kohm resistors in series, we will get 3.25 k ohm resistance value.

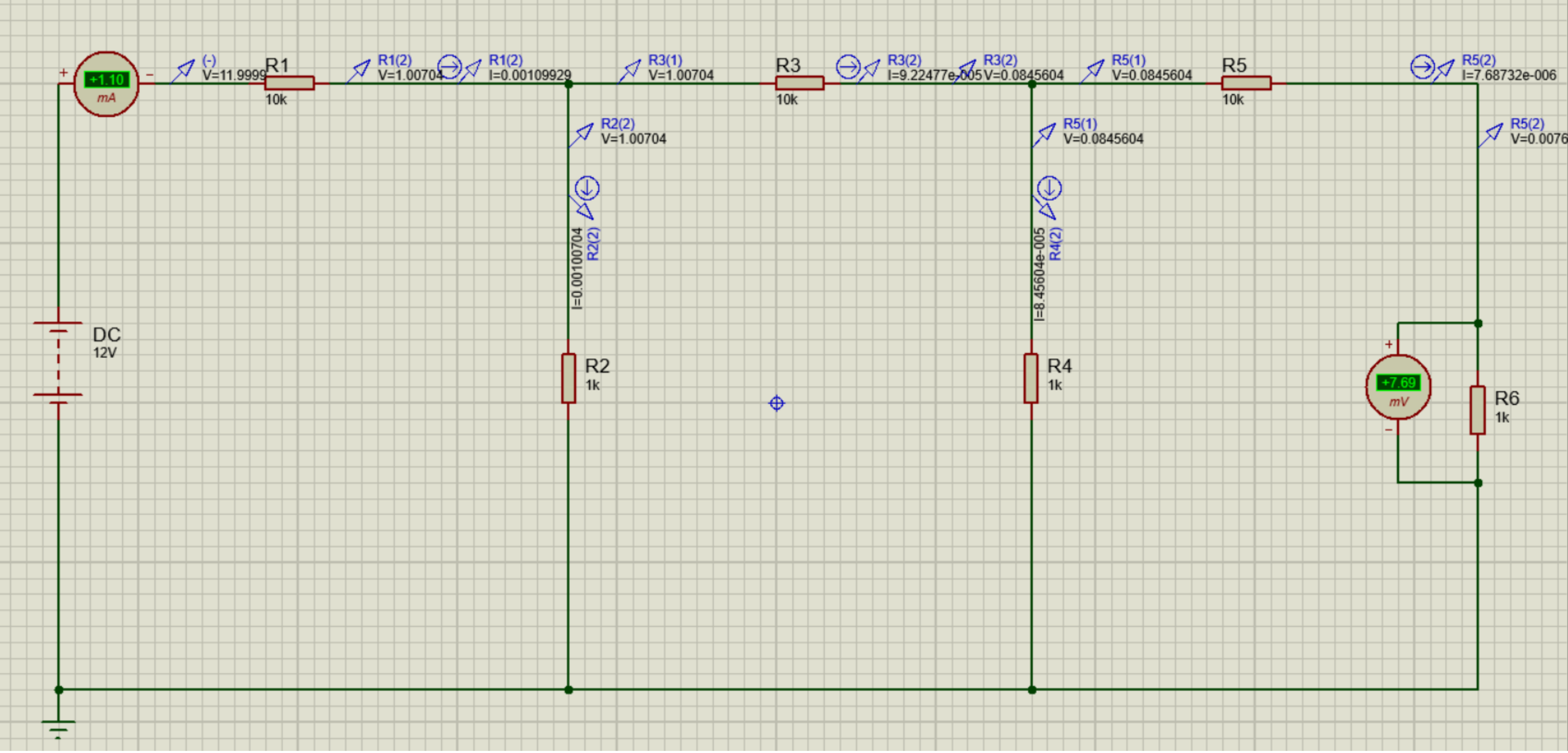


$$\left(\frac{1}{15}\times6\right)^{-1}+\left(\frac{1}{1.5}+\frac{1}{1.5}\right)^{-1} = 3.25$$

<u>Discussion</u> : By comparing voltage and current values we can decide that our experimentation is correct, as the theoritical values and proteus file values match each other.



R1(1)
R1
10k
R1(2)
R2
10k
R1(2)
R3(1)
+88.8
mA
+
−
R3
1k
R3(2)
DC
12V
R4(2)
R4
1k
+88.8
Volts
+
−
R4(1)



+1.10
mA
(-)
V=11.9999
R1
10k
R1(2)
V=1.00704
R1(2)
I=0.00109929
R3(1)
V=1.00704
R3
10k
R3(2)
I=9.22477e-005
R3(2)
V=0.0845604
R5(1)
V=0.0845604
R5
10k
R5(2)
I=7.68732e-006
R2(2)
V=1.00704
R2(2)
I=0.00100704
R5(1)
V=0.0845604
R4(2)
I=8.45604e-005
R5(2)
V=0.0076
DC
12V
R2
1k
R4
1k
+7.69
mV
R6
1k