CSE250

Circuits and Electronics

Experiment 02

Introduction to Series and Parallel Circuits

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Section: 19

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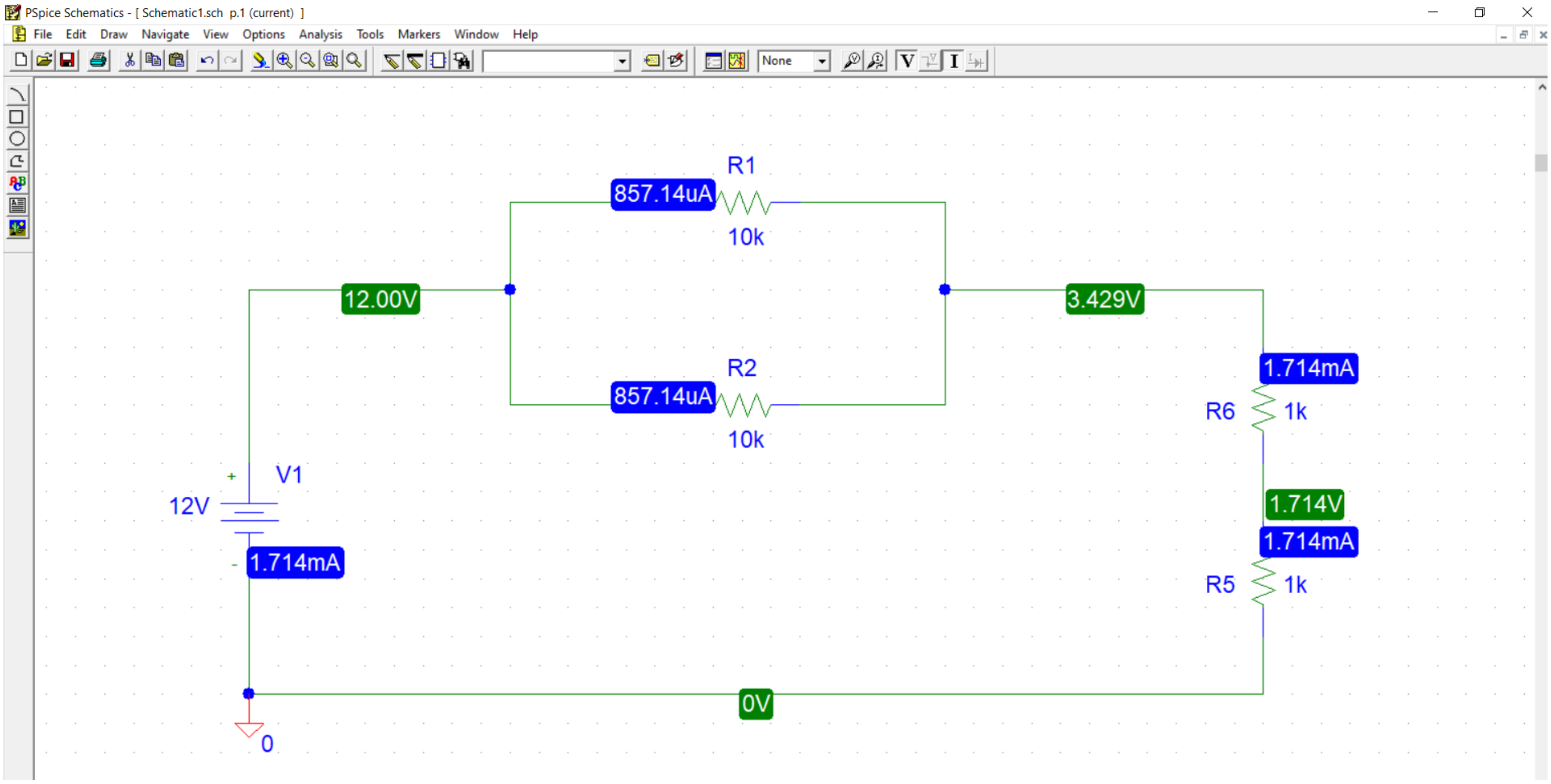
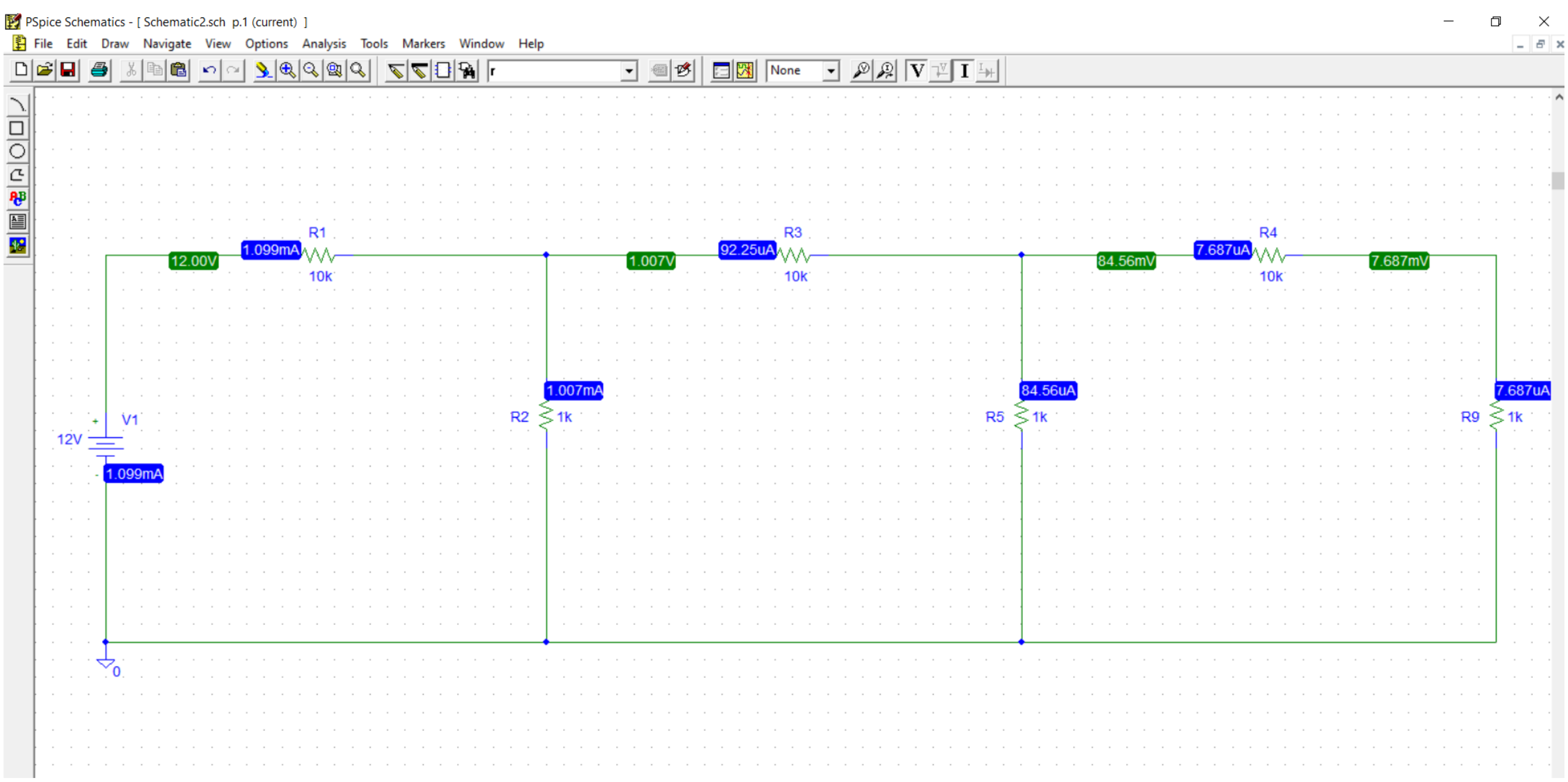

PSpice Schematics - [Schematic1.sch p.1 (current)]
File Edit Draw Navigate View Options Analysis Tools Markers Window Help
None
R1
857.14uA
10k
12.00V
3.429V
R2
857.14uA
10k
1.714mA
R6
1k
V1
12V
1.714V
1.714mA
R5
1k
1.714mA
0V
0


PSpice Schematics - [Schematic2.sch p.1 (current)]
File Edit Draw Navigate View Options Analysis Tools Markers Window Help
None
R1
12.00V
1.099mA
10k
R3
1.007V
92.25uA
10k
R4
84.56mV
7.687uA
10k
7.687mV
1.007mA
R2
1k
84.56uA
R5
1k
7.687uA
R9
1k
V1
12V
1.099mA
0

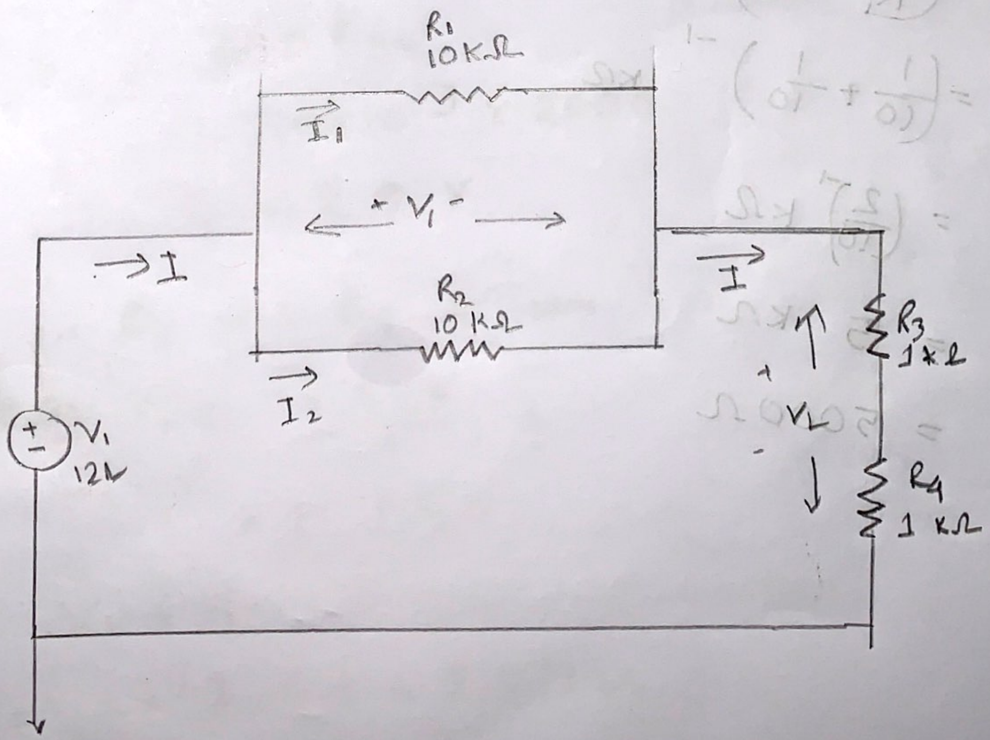
Experiment 2

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

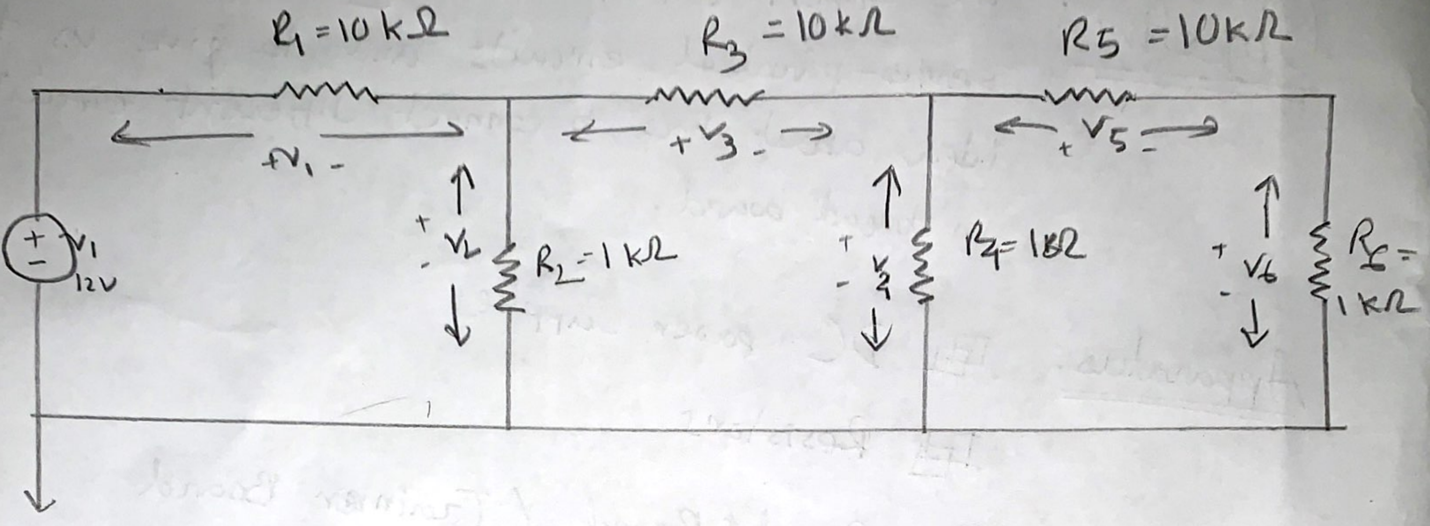
Apparatus:

- DC power supplies
- Resistors
- Bread Board / Trainer Board
- Multimeter

Circuit diagram:



Circuit Diagram :



Result / Analysis : 1 :—

$$R_1 = R_2 = 10\,K\Omega$$
$$R_3 = R_4 = 1\,K\Omega$$

$$R_{12} = \left(\frac{1}{R_1} + \frac{1}{R_2}\right)^{-1} K\Omega$$

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

$$= \left(\frac{2}{10}\right)^{-1} K\Omega$$

$$= 5\ K\Omega$$

$$= 5000\,\Omega$$

$R_{34} = R_3 + R_4$

$= (1+1)\ k\Omega$

$= 2\ k\Omega$

$= 2000\ \Omega$

$R_{total} = (5000 + 2000)\Omega$

$= 7000\ \Omega$

$= 7\ k\Omega$

So, total Current, $I = \frac{V}{R}$ $\quad V = 12V$

$= \frac{12\ V}{7000\ \Omega}$

$= 1.714 \times 10^{-3} A.$

Voltage, $V_2 = I \times R_{34}$

$= 1.714 \times 10^{-3} \times 2000$

$= 3.429\ V$

Voltage in R_3 and R_4 is same.

So, ~~V_{R_3}~~ $V_2 = \frac{3.429}{2}\ V$

$= 1.715V$

$V = V_1 + V_2$

$\therefore V_1 = 12 - 3.429 = 8.571\ V.$

Voltage in R_1 and R_2 are same

$\therefore V_1 = 8.571.$

So, $I_1 = \frac{V_1}{R_1} = \frac{8.571}{10000} = 8.571 \times 10^{-4} A$

Again, $I_2 = \frac{V_2}{R_2} = \frac{8.571}{10000} = 8.571 \times 10^{-4} A.$

Result / Analysis 2 :

$R_1 = R_3 = R_5 = 10 K\Omega$

$R_2 = R_4 = R_6 = 1 K\Omega$

$$R_{56} = R_5 + R_6$$
$$= (10+1) K\Omega$$
$$= 11000 \Omega$$

$$R_{456} = \left(\frac{1}{R_4} + \frac{1}{R_{56}}\right)^{-1} K\Omega$$
$$= \left(\frac{1}{1000} + \frac{1}{11000}\right)^{-1} \Omega$$
$$= 916.67 \Omega$$

$$R_{3456} = R_3 + R_{456}$$
$$= 10000 + 916.67 = 10916.67 \Omega$$

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

$$= \left(\frac{1}{1000} + \frac{1}{10916.67}\right) \Omega$$

$$= (1.092 \times 10^{-3})^{-1} \Omega$$

$$= 916.08 \Omega$$

$$R_{Total} = R_1 + R_{23456}$$

$$= (10000 + 916.08) \Omega$$

$$= 10916.08 \Omega$$

$$\approx 10916 \Omega$$

$$I_{total} = \frac{V}{R}$$

$$= \frac{12}{10916} A$$

$$= 1.099 mA$$

Now, $V_1 = I_{R_1} \times R_1$

$$= 1.0993 \times 10^{-3} \times 10000$$

$$= 10.993 V$$

$$V = V_1 + V_2$$

$$\Rightarrow V_2 = V - V_1$$

$$\Rightarrow V_2 = 12 - 10.993$$

$$= 1.007 V$$

Again, $I_{R_2} = \dfrac{V_2}{R_2}$

$$= \frac{1.007}{1000}$$

$$= 1.007 \text{ mA}$$

Now, $I_{R_3} = I - I_{R_2}$

$$= 1.0993 - 1.007 \text{ mA}$$

$$= 0.0933 \text{ mA}$$

$$V_3 = I_{R_3} \times R_3$$

$$= 0.0923 \times 10^{-3} \times 10000$$

$$= 0.923 V.$$

$$V_4 = V_2 - V_3$$

$$= 1.007 - 0.923 \text{ V}$$

$$= 0.084 \text{ V}$$

$$I_{R_4} = \frac{V_4}{R_4}$$

$$= \frac{0.084}{1000}$$

$$= 8.4 \times 10^{-5} \text{ A}$$

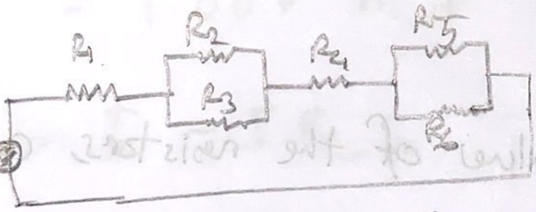
Question and Answers :

1. Using the recorded value of the resistors, calculate the value of the currents and check if there is any discrepancies.

⇒ The following circuits were provided with some unknown voltages and unknown currents. The circuits was constructed In P-spice and simulated. The voltage and current values were measured and placed into Knichhoffs Current Law, Kirchhoffs Voltage Law an equations to determine whether they turned out as predicted. Those valuses used to measure resistance.

The sum of the voltages in a closed loop should be 0. If KVL is true. ~~But the voltages has some neglectable~~ a The sum of voltages produced while not exactly 0 but close to 0. Therefore, we can say that KVL was true. Another error was in the values of the resistor chosen. This could be accounted for part of discrepancy. So, all the discrepancies between tested and expected values were small, therefore all 3 of the laws could be considered valid.

2. You are given six 100 Ω resistors. Arrange these resistors as to provide an effective resistance value of 300Ω.



given that $R_1 = R_2 = R_3 = R_4 = R_5 = R_6 = 100\Omega$

So, R_2 ~~and~~, R_3 Parallel and R_5, R_6 Parallel

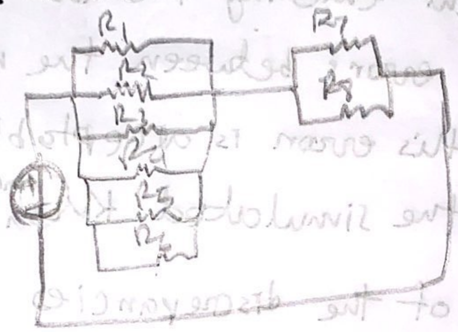
$$R_{23} = \left(\frac{1}{100} + \frac{1}{100}\right)^{-1} = 50\Omega$$

$$R_{56} = \left(\frac{1}{100} + \frac{1}{100}\right)^{-1} = 50\Omega$$

$$\therefore R_{123456} = 100 + 50 + 100 + 50 = 300\Omega$$

3. You are given two 1.5 kΩ resistors and six 15 kΩ resistors. Arrange these resistors as to provide an effective resistance value of 3.25 kΩ.

⇒



given that, $R_1 = R_2 = R_3 = R_4 = R_5 = R_6 = 15 k\Omega$

$R_7 = R_8 = 1.5 k\Omega$

So, $R_1, R_2, R_3, R_4, R_5, R_6$ are parallel and R_7, R_8 are parallel.

$$So,\ R_{123456} = \left(\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \frac{1}{R_4} + \frac{1}{R_5} + \frac{1}{R_6}\right)^{-1}$$

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

$$= 2.5\ k\Omega$$

$$Again,\ R_{78} = \left(\frac{1}{R_7} + \frac{1}{R_8}\right)^{-1}$$

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

$$= .75.$$

$$\therefore R = 2.5 + .75 = 3.25\ k\Omega.$$ Ans.

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Discussion :

The simulation of the circuit verified Kirchhoff's Current Law. PSpice found the sum of the two currents exiting the node to the equal to the current entering the node. ~~But~~ However, the experimental had some errors between the measured and calculated I's. Although, this error is acceptable in stating that KCL is true. Also, the simulated KVL and ohm's law were also valid. So, we can say that, all of the discrepancies between tested and expected values were small. Therefore, the experiments ~~will be~~ could be considered valid.