Lab #06: Voltages in Circuits

Pre-lab Exercise: Review corresponding sections in the textbook and understand the measurement of voltages on different loads in circuits.

Equipment Needed: Circuits Experiment Board; Multimeter; Resistors; D-cell Battery; Wire leads.

Purpose: The purpose of this lab will be to continue experimenting with the variables that contribute to the operation of an electrical circuit.

Procedure:
Connect the three equal resistors that you used in previous experiment into the series circuit shown below, using the springs to hold the leads of the resistors together without bending them. Connect two wires to the D-cell, carefully noting which wire is connected to the negative and which is connected to the positive.

Now use the voltage function on the Multimeter to measure the voltages across the individual resistors and then across the combinations of resistors. Be careful to observe the polarity of the leads (red is +, black is -). Record your readings below.

Series Circuit: connect the parallel circuit shown below in Fig. 1, using all three resistors. Measure the voltages across each of the resistors

![Series Circuit Diagram]

Figure 1.

\[ R_1 = \quad V_1 = \quad \]
\[ R_2 = \quad V_2 = \quad \]
\[ R_3 = \quad V_3 = \quad \]
\[ R_{12} = \quad V_{12} = \quad \]
\[ R_{23} = \quad V_{23} = \quad \]
Parallel Circuit: Now connect the parallel circuit shown below in Fig. 2, using all three resistors. Measure the voltages across each of the resistors and the combination taking care with polarity as in the previous case. (Keep all three resistors connected throughout the time you are making your measurements.

**Fig. 2**

$R_{123} = \underline{\quad \quad \quad} \quad \quad V_{123} = \underline{\quad \quad \quad}$

**Combination Circuit:** Now connect the circuit as shown in Fig. 3, using the three resistors. Use the resistors readings that you used in experiments in laboratory No.4. Measure the voltages across each of the resistors and the combinations.

**Fig. 3**

$R_1 = \underline{\quad \quad \quad} \quad \quad V_1 = \underline{\quad \quad \quad}$

$R_2 = \underline{\quad \quad \quad} \quad \quad V_2 = \underline{\quad \quad \quad}$

$R_3 = \underline{\quad \quad \quad} \quad \quad V_3 = \underline{\quad \quad \quad}$

$R_{123} = \underline{\quad \quad \quad} \quad \quad V_{123} = \underline{\quad \quad \quad}$
Choose three resistors having different values. Repeat all above measurements for three circuits shown in Figures 1, 2, and 3.

**Series Circuit**

\[ R_1 = \quad V_1 = \quad \]
\[ R_2 = \quad V_2 = \quad \]
\[ R_3 = \quad V_3 = \quad \]
\[ R_{12} = \quad V_{12} = \quad \]
\[ R_{23} = \quad V_{23} = \quad \]
\[ R_{123} = \quad V_{123} = \quad \]

**Parallel Circuit**

\[ R_1 = \quad V_1 = \quad \]
\[ R_2 = \quad V_2 = \quad \]
\[ R_{123} = \quad V_{123} = \quad \]

**Combination Circuit**

\[ R_1 = \quad V_1 = \quad \]
\[ R_{23} = \quad V_{23} = \quad \]
\[ R_{123} = \quad V_{123} = \quad \]

Discussing the following questions using the data you have taken:
1. On the basis of the data you recorded for the circuit in the Figure 1, what is the pattern for how voltage gets distributed in a series circuit with equal resistances?

2. According to the data you recorded with Figure 1 but with the different set of resistors, what is the pattern for how voltage gets distributed in a series circuit with different resistances? Is there any relationship between the size of the resistance and the size of the resulting voltage?

3. Utilizing the data from the circuit in the Figure 2, what is the pattern for how voltage distributes itself in a parallel circuit for equal resistances? Based on the data from same circuit assembled with different resistances, what is the pattern for how voltage distributes itself in a parallel circuit for unequal resistances? Is there any relationship between the size of the resistance and the size of the resulting voltage?

4. Do the voltages in your combination circuits (Figure 3) follow the same rules as they did in your circuits that were purely series or parallel? If not, state the rules you see in operation.

**Reference**

| Black  | 0 |
| Brown | 1 |
| Red | 2 |
| Orange | 3 |
| Yellow | 4 |
| Green | 5 |
| Blue | 6 |
| Violet | 7 |
| Gray | 8 |
| White | 9 |

<table>
<thead>
<tr>
<th>Fourth Band</th>
<th>None ±20%</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Silver ±10%</td>
</tr>
<tr>
<td></td>
<td>Gold ±5%</td>
</tr>
<tr>
<td></td>
<td>Red ±2%</td>
</tr>
</tbody>
</table>