

EE1002 Lab3: Kirchhoff's Voltage and Current Laws

Safety Precautions

1. Always turn off power when you reconnect the circuit.
2. Double check your circuit and the voltage source setting before reapplying power.

I. OBJECTIVES

1. To understand the Kirchhoff's Voltage and Current Laws.
2. To build and measure DC circuits.
3. To verify the calculated voltages of a circuit using Kirchhoff's Voltage Law with measurement.
4. To verify the calculated currents of a circuit using Kirchhoff's Current Law with measurement.

II. EQUIPMENT AND MATERIALS

1. Variable DC power supply
2. Multimeter
3. Solderless breadboard
4. Resistors ($330\ \Omega \times 1$, $510\ \Omega \times 2$, and $1\ \text{k}\Omega \times 3$)

III. THEORY

A. Kirchhoff's Voltage Law

The Kirchhoff's Voltage Law (KVL) states that the algebraic SUM of the potential differences in any loop must be equal to zero:

$$\sum_{k=1}^n V_k = 0$$

B. Kirchhoff's Current Law

The Kirchhoff's Current Law (KCL) states that the algebraic SUM of all the currents entering and leaving a node must be equal to zero:

$$\sum_{k=1}^n I_k = 0$$

IV. PROCEDURE

A. Kirchhoff's Voltage Law

1. Build Circuit I as shown in Figure 1.

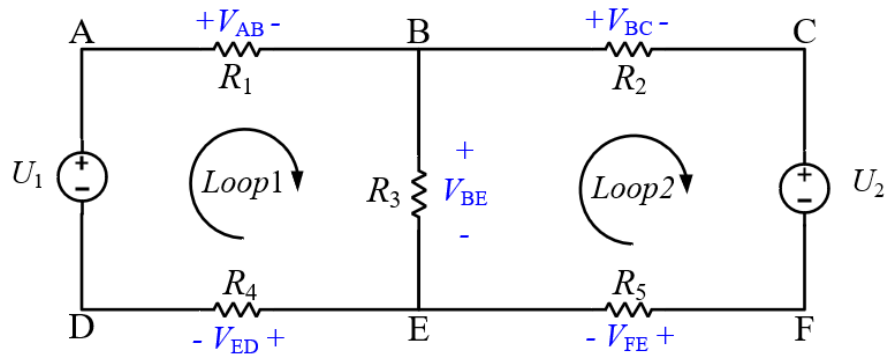


Figure 1. Configuration of Circuit I for KVL experiment with two loops: $R_1 = 510 \, \Omega$, $R_2 = R_3 = R_4 = 1 \, \text{k}\Omega$, and $R_5 = 330 \, \Omega$.

2. Set the voltages of the DC sources to $U_1 = 4.0 \, \text{V}$ and $U_2 = 6.0 \, \text{V}$. Fill in Tables I and II with the measured and calculated voltages across the resistors.

Table I. Loop-1 Voltage

Voltages (V)	V_{AB}	V_{BE}	V_{ED}	V_{DA}	ΣV (SUM)
Calculation*					
Measurement					
Errors					—

Table II. Loop-2 Voltage

Voltages (V)	V_{BC}	V_{CF}	V_{FE}	V_{EB}	ΣV (SUM)
Calculation*					
Measurement					
Errors					—

* Please provide full steps of the calculation in your Lab report.

B. Kirchhoff's Current Law

1. Build Circuit II as shown in Figure 2.
2. Set the voltage of the DC sources to $U_3 = 3.0 \, \text{V}$ and $U_4 = 6.0 \, \text{V}$. Fill in Tables III and IV with the measured and calculated currents of the resistors.

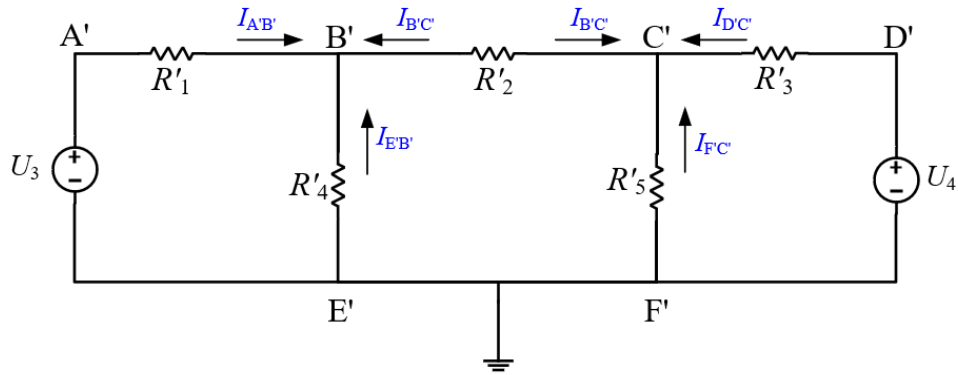


Figure 2. Configuration of Circuit II for KCL experiment: $R'_1 = R'_5 = 510\ \Omega$, $R'_2 = 330\ \Omega$, and $R'_3 = R'_4 = 1\ \text{k}\Omega$.

Table III. Currents at Node B'

Currents (mA)	$I_{A'B'}$	$I_{E'B'}$	$I_{C'B'}$	ΣI (SUM)
Calculation*				
Measurement				
Errors				—

Table IV. Currents at Node C'

Currents (mA)	$I_{B'C'}$	$I_{F'C'}$	$I_{D'C'}$	ΣI (SUM)
Calculation*				
Measurement				
Errors				—

* Please provide full steps of the calculation in your Lab report.

IV. DISCUSSION

1. Explain the discrepancy between the measured and calculated results.
2. Calculate the powers delivered to R_3 and R_5 in Circuit I (Figure 1).
3. Calculate the powers delivered to R'_3 and R'_5 in Circuit II (Figure 2).
4. In Figure 1 (Part A), what will happen to the various voltages if the voltages of the sources U_1 and U_2 are both doubled? Explain your answer.
5. In Figure 2 (Part B), what will happen to the various currents if the voltages of the sources U_3 and U_4 are both reduced by 50%? Explain your answer.

V. REFERENCES

“Fundamentals of Electric Circuits” by C. K. Alexander and M.O. Sadiku, (Edition 7), McGraw Hill, 2021.