EE1002 Lab 3: Kirchhoff's Law (Online experiment)

I. OBJECTIVES

1. To get familiar with online simulator.
2. To build and simulate basic DC circuits with simulator.
3. To calculate the voltages of a circuit with Kirchhoff's Voltage Law.
4. To calculate the currents of a circuit with Kirchhoff's Current Law.

II. EQUIPMENT AND MATERIALS REQUIRED

1. Computer
2. Browser
3. Online simulator Circuit-Sandbox (https://spinningnumbers.org/circuit-sandbox/index.html)

Part I: Kirchhoff's Voltage Law

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

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

I. PROCEDURE

1. First pick resistors and a voltage source from the right column.

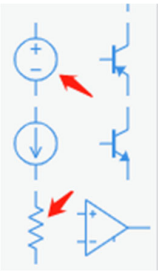

Fig. 1. Voltage source and resistor in the component list

2. You can rotate the components by using the tool on the left of the software menu. Double-click the voltage source and resistor to change their names and values.

(a) (b)

Fig.2. Setting of (a) voltage and (b) resistor.

3. Place the cursor at the component terminal and draw lines to build the circuit as shown in Fig.3. It is important to place the "ground" symbol that can be found from the right column.

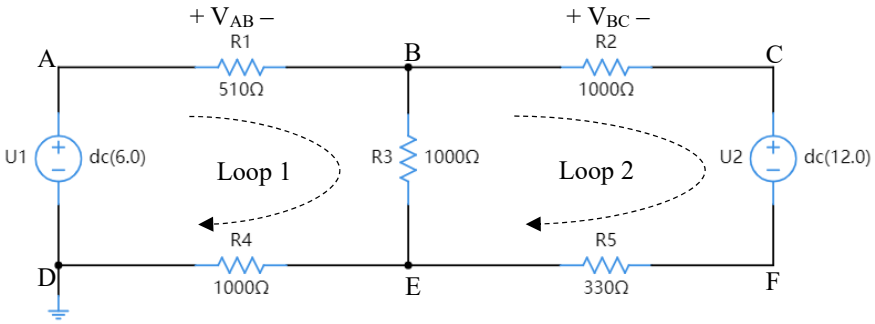

Fig.3. Circuit configuration for KVL online simulation

Fig. 4. Ground in the component lists

4. Now, you can run the simulation using the icon "DC" solver. In using the "DC" solver, the simulated results will be shown in the circuit directly. Be careful about the voltage direction in the circuit.

Fig. 5. Start the simulation

5. Fill in Tables I and II with the calculated and simulated data.

Table I. Loop-1 Voltage

Voltages (V)	V_{AB}	V_{BE}	V_{ED}	V_{DA}	ΣV
Calculation*					
Simulation**					

Table II. Loop-2 Voltage

Voltages (V)	V_{BC}	V_{CF}	V_{FE}	V_{EB}	ΣV
Calculation					
Simulation					

* *You should provide your mathematical analysis and calculation in your Lab Report.*
** *The simulated results should be shown in the report.*

Part II: Kirchhoff's Current Law

Kirchhoff's Current Law (KCL) states that the algebraic sum of ALL currents entering and leaving a node must be equal to zero.

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

1. Current probes are used to measure the current passing through the resistors.

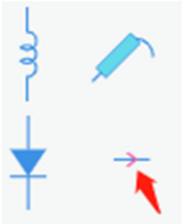

Fig. 6. Current probes in the component lists

2. Build a circuit as shown in Fig.7 in the simulator.

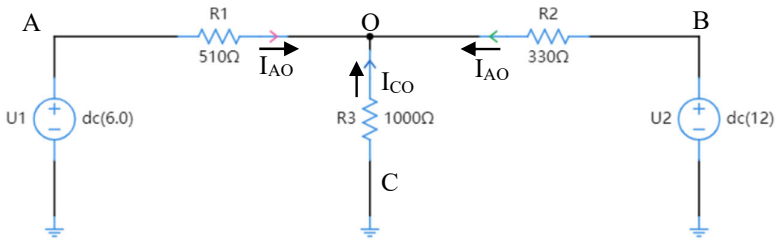

Fig.7. Circuit configuration for KCL online simulation

3. Run the simulation with "DC" solver. Note the current direction in the circuit.

4. Fill in Table III with the calculated and simulated data.

Table III

Currents (mA)	I_{AO}	I_{BO}	I_{CO}	ΣI
Calculation*				
Simulation**				

* *You should provide your mathematical analysis and calculation in your Lab Report.*
** *The simulated results should be shown in the report.*

V. DISCUSSION

1. In Part I, explain why the measured voltages across the resistors using a voltmeter are practically lower than the calculations and simulations.
2. In Part II, what will happen to the currents of the resistors if the internal resistance of the voltage sources is considered?

REFERENCES

1. M. O. Sadiku, S. M. Musa and C. K. Alexander, Applied Circuit Analysis, McGraw Hill, 2012.
2. C. K. Alexander and M.O. Sadiku, Fundamentals of Electric Circuits, 5th Edition, McGraw Hill, 2012.

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