Electric Circuit Analysis I

EEE-121

Lab Report 4

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<u>Lab 04: Kirchhoff's Laws & Voltage-and-Current Division Principles</u>

Objectives:

1- To study the validity of Kirchhoff's voltage and current laws.
2-To study the validity of the voltage and current division principles.

Equipment required:

Resistors, DMM, breadboard, DC power supply, and connecting wires.

Pre-lab:

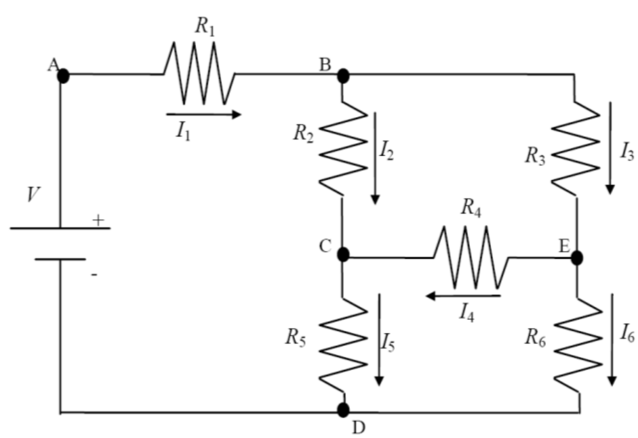
(Kirchhoffs law)

Kirchhoff's Laws are based on energy and charge conservation. Kirchhoff's voltage law is based on energy conservation and states that the algebraic sum of the potential (voltage) drops around a complete path is equal to zero. For example, in the circuit shown in figure 4.1, the relations between the circuit elements and resistances for the path ABCDA is:

$$-V + I_1R_1 + I_2R_2 + I_5R_5 = 0 \qquad \textbf{(4.1)}$$

Kirchhoff's current law is based on charge conservation, and states that the algebraic sum of the currents entering a node is zero.

A node is a point such as "B" in figure 4.1, where I_1 enters and I_2 and I_3 leave. The other nodes in figure 4.1 are "E", "D", and "C". Referring to figure 4.1, at node "B" we have:



experiment

$$I_1 - I_2 - I_3 = 0 \qquad \textbf{(4.2)}$$

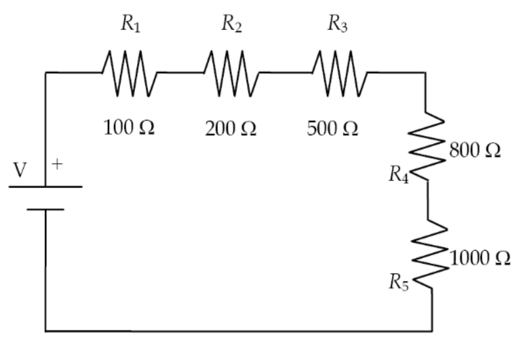
While at node “E” the relation is:

$$I_3 - I_4 - I_6 = 0 \qquad \textbf{(4.3)}$$

Pre-lab tasks:

Solve the circuits shown in figure 4.2 and 4.3 before coming to the lab. You can chose any value for resistors…..and take v as 5 v Calculate the voltages V_1 through V_5 using Voltage Divider Rule for figure 4.2 and currents I_1 through I_3 using Current Divider Rule for figure 4.3. Bring the results with you.

(A)



If voltage v is 5V, then by using voltage divider rule

V1=0.192V

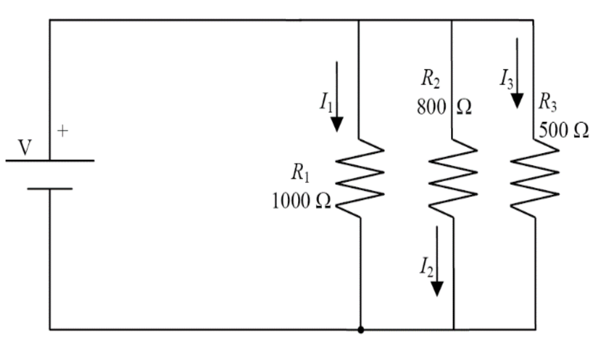
V2=0.384V

V3=0.96V

V4=1.538V

V5=1.923V

(B)



If voltage is 5V, then by using current divider rule

Where Is=0.021A

Then,

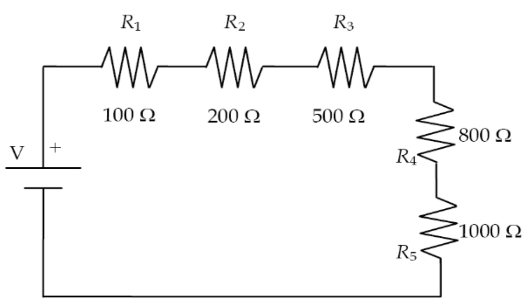
I1=9.130A

I2=7.304A

I3=4.565*10^-3

In-lab task:

Task 1: Validation of kirchhoffs voltage law and voltage divider rule



$$V = V_1 + V_2 + V_3 + V_4 + V_5$$

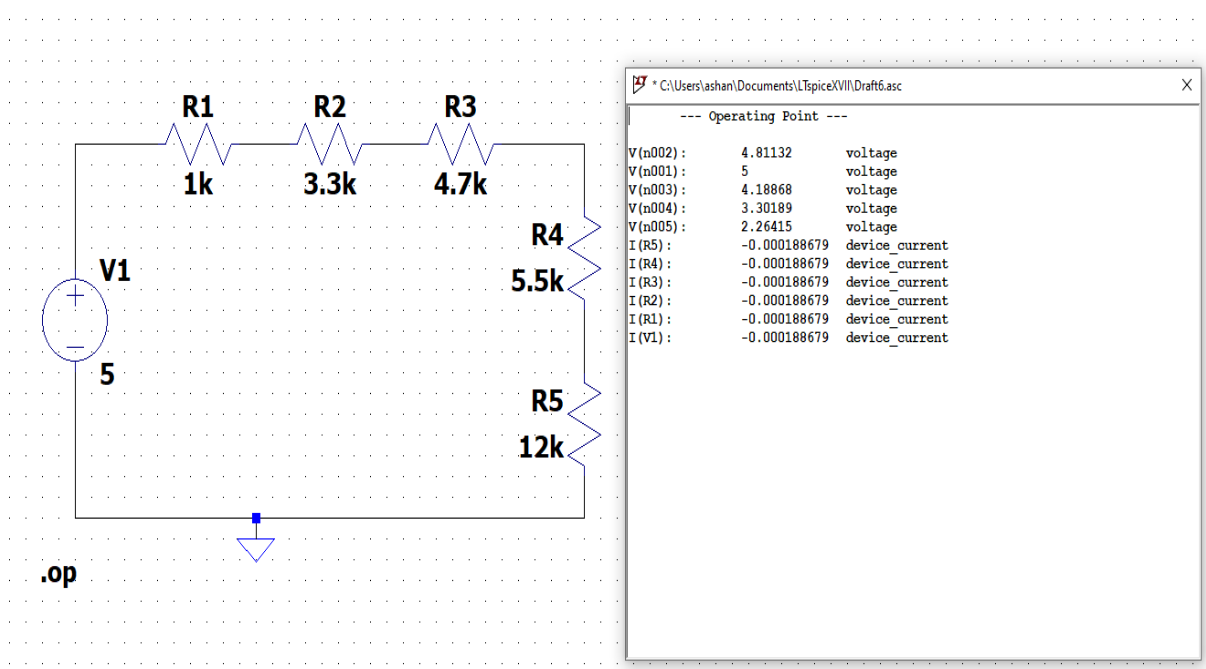
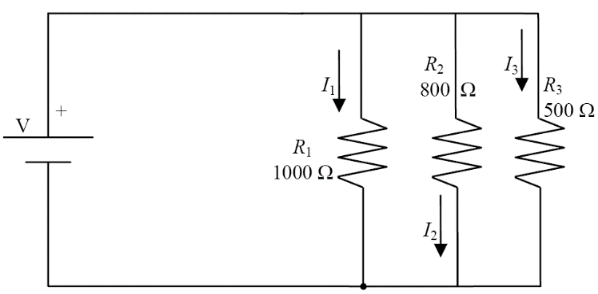
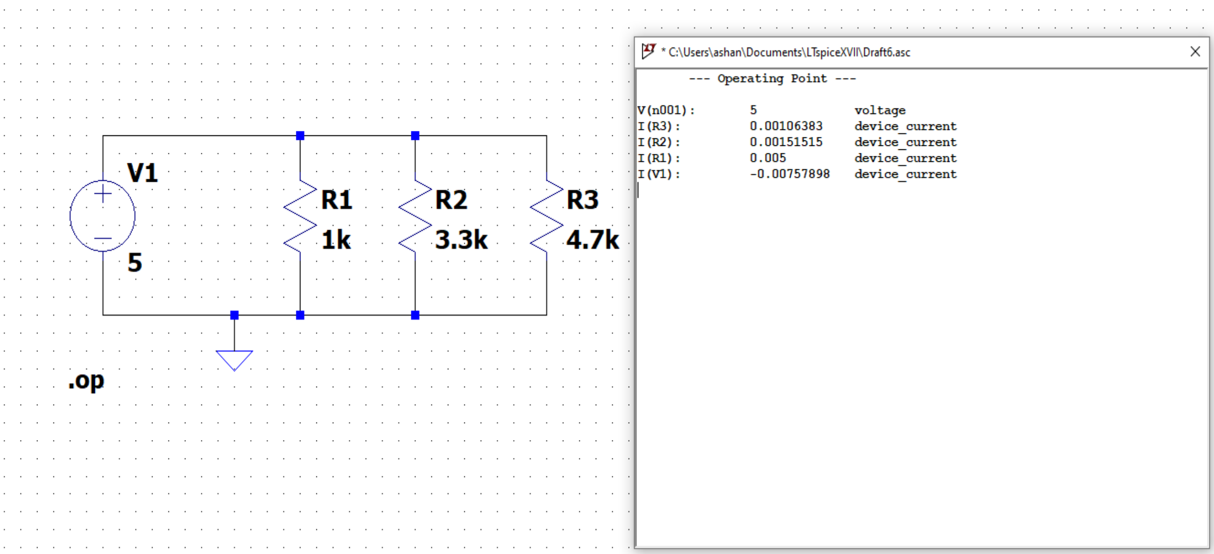


Table 1

Element		Voltage across element (V)	Calculated	Measured	Simulated
R1 (Ω)	1k	V1	0.18	0.18	0.19V
R2(Ω)	3.3k	V2	0.59	0.86	0.63V
R3(Ω)	4.7k	V3	0.84	0.61	0.88V
R4(Ω)	5.5k	V4	0.99	1.06	1.04V
R5(Ω)	12k	V5	2.16	2.24	2.26V

Task 2: Validation of kirchhoffs current law and current divider rule





Element		Current through element (mA)	Calculated	Measured	Simulated
		I (through Voltage Source)	7.52	7.32	7.57mA
R1 (Ω)	1k	I1	4.88	4.98	5mA
R2(Ω)	3.3k	I2	1.04	1.07	1.51mA
R3(Ω)	4.7k	I3	1.60	1.52	1.06mA

Post lab:

(Questions)

1. What is path/loop? How many paths/loop are there in Fig 4.1?
   Answer: A loop is any closed path in a circuit. A loop is a closed path formed by starting at a node, passing through a set of nodes, and returning to the starting node without passing through any node more than once. The loops in a circuit are seven.

2. Two resistors R_1 and R_2 are connected in series. The voltage drop across R_1 is larger than R_2. What can we infer about comparative values of the resistances? Is $R_1>R_2$ or $R_1<R_2$.
   Answer: According to ohms law resistance is greater than voltagevoltage drop across R1 will be greater than voltage drop across R2 as **R1 > R2**. Option B is the answer.

Critical analysis:

This lab leads to the understanding of loops, Validation of KVL and KCL and then proving the Krichoff’s Laws. We also experimentally prove KVL and KCL on hardware and verify the values with the help of Ltspice software. We also use Voltage and Current division rules to find the desired results