DEPT. OF ELECTRICAL & ELECTRONICS ENGINEERING

SRM INSTITUTE OF SCIENCE AND TECHNOLOGY, Kattankulathur – 603 203

Title of Experiment	: **1. Verification of Kirchhoff's Laws**
Name of the candidate	: Abdul Ahad
Register Number	: RA2111028010094
Date of Experiment	: 27/09/21

Sl. No.	Marks Split up	Maximum marks (50)	Marks obtained
1	Pre Lab questions	5	
2	Preparation of observation	15	
3	Execution of experiment	15	
4	Calculation / Evaluation of Result	10	
5	Post Lab questions	5	
Total		**50**	

Staff Signature

PRE LAB QUESTIONS

1. Define Ohm's law.

Ohm's law: It states that the voltage or potential difference between two points is directly proportional to the current passing through them, and the resistance of the circuit.

$V = IR$

2. State KCL and KVL.

KCL: At any junction, sum of incoming currents is equal to the sum of outgoing currents.

KVL: The algebraic sum of element voltage around a closed loop is equal to zero.

3. Define absolute potential and potential difference

Absolute potential energy: The amount of work done required for an object to bring it to its current location from a point of infinite distance is termed as absolute potential energy.

Potential difference: It is the difference in the amount of energy that charge carriers have between two points in a circuit.

4. What is the difference between mesh and loop?

MESH: It is a loop that does not contains other loops. All meshes are loops, but all loops are not meshes.

LOOP: A loop is any closed path of branches.

5. What is super-node?

Super-node: It is a theoretical construct that can be used to solve a circuit. This is done by viewing a voltage source on a wire as a point source voltage in relation to other point voltages located at various nodes in the circuit, relative to the ground node assigned a zero or negative charge.

Experiment No. 1 **Date :** 27/09/21	**VERIFICATION OF KIRCHOFF'S LAWS**

Aim:

To verify Kirchhoff's current law and Kirchhoff's voltage law for the given circuit.

Apparatus Required:

Sl.No.	Apparatus	Range	Quantity
1	RPS (regulated power supply)	(0-30V)	2
2	Resistance	330Ω, 220Ω 1kΩ	6
3	Ammeter	(0-30mA)MC	3
4	Voltmeter	(0-30V)MC	3
5	Bread Board & Wires	--	Required

Statement:

KCL: The algebraic sum of the currents meeting at a node/junction is equal to zero.

KVL: In any closed path / mesh, the algebraic sum of all the voltages is zero.

Precautions:

1. Voltage control knob should be kept at minimum position.
2. Current control knob of RPS should be kept at maximum position.

Procedure for KCL:

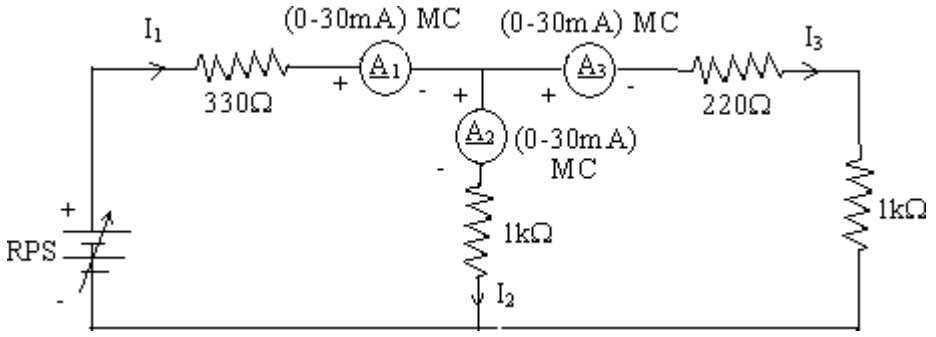
1. Give the connections as per the circuit diagram.
2. Set a particular value in RPS.
3. Note down the corresponding ammeter reading
4. Repeat the same for different voltages

Procedure for KVL:

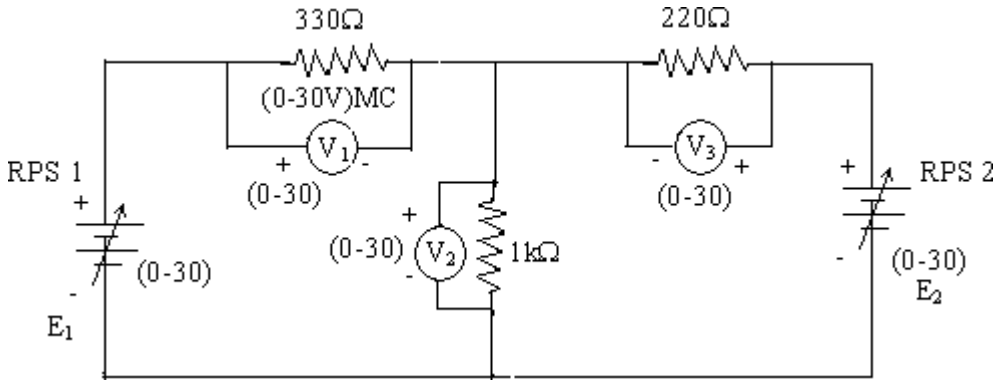
1. Give the connections as per the circuit diagram.
2. Set a particular value in RPS.
3. Note all the voltage reading
4. Repeat the same for different voltages

HARDWARE SETUP:

Circuit for KCL verification:



Circuit for KVL verification:



KCL - Theoretical Values:

Sl. No.	Voltage E	Current			$I_1 = I_2 + I_3$
		I_1	I_2	I_3	
	Volts	mA	mA	Ma	mA
1	10	11.36	6.24	5.12	11.36
2	20	22.66	12.36	10.30	22.66
3	30	34.1	18.53	15.37	34.1

KCL - Practical Values:

Sl. No.	Voltage E	Current			$I_1 = I_2 + I_3$
		I_1	I_2	I_3	
	Volts	mA	mA	mA	mA
1	10	11.37	6.25	5.12	11.37

2	20	22.74	12.5	10.24	22.74
3	30	34.11	18.74	15.36	34.11

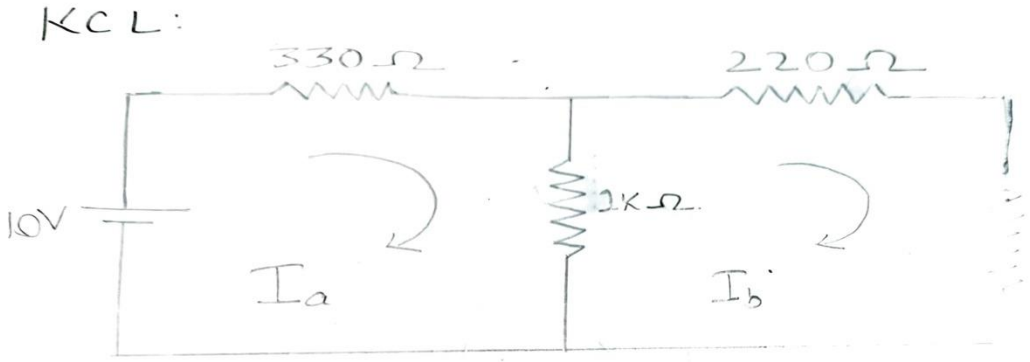
KVL – Theoretical Values

Sl.No.	RPS		Voltage			KVL $E_1 = V_1 + V_2$
	E_1	E_2	V_1	V_2	V_3	
	V	V	V	V	V	V
1	10	10	1.17	8.83	-1.16	10
2	20	10	7.62	12.37	2.37	19.9
3	30	10	14	16	6	30

KVL - Practical Values

Sl.No.	RPS		Voltage			KVL $E_1 = V_1 + V_2$
	E_1	E_2	V_1	V_2	V_3	
	V	V	V	V	V	V
1	10	10	1.17	8.83	-1.17	10
2	20	10	7.63	12.37	2.37	20
3	30	10	14.1	15.9	5.9	30

Model Calculations:



$330I_a + 1000I_a - 1000I_B = 10$

$1300I_a - 1000I_b = 10$

$220I_b + 1000I_b + 1000(I_b - I_a) = 0$

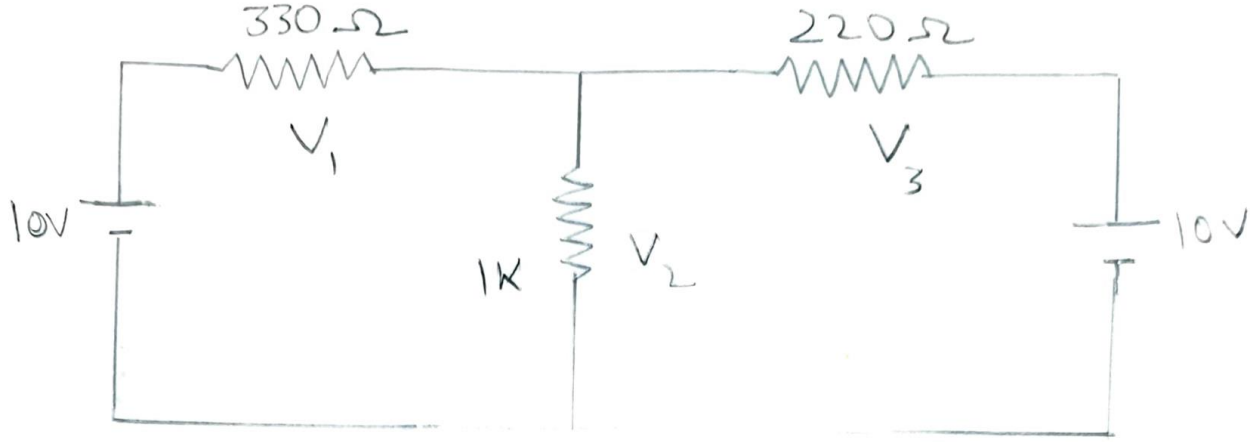
$-1000I_a + 2220I_b = 0$

Solving the equation

$I_a = 11.36\,mA$ (I_1) $\quad I_b = 5.12\,mA$ (I_3)

$I_2 = I_a - I_b = 11.36 - 5.12 = 6.24\,mA$

KVL:



$$\frac{V-10}{330} + \frac{V-0}{1000} + \frac{V}{220} - \frac{10}{330} - \frac{10}{220} = 0$$

$$V\left(\frac{1}{330} + \frac{1}{1000} + \frac{1}{220}\right) - \frac{10}{330} - \frac{10}{220} = 0$$

$$V(0.085) = 0.075$$

$$V = 8.83$$

$$i_1 = \frac{10 - 8.82}{330} = 0.0035$$

$$V_1 = i_1 \times 330 = 1.17$$

$$i_2 = V/1000 = 0.0083$$

$$V_2 = i_2 \times 1000 = 8.83$$

$$i_3 = \frac{8.82 - 10}{220}$$

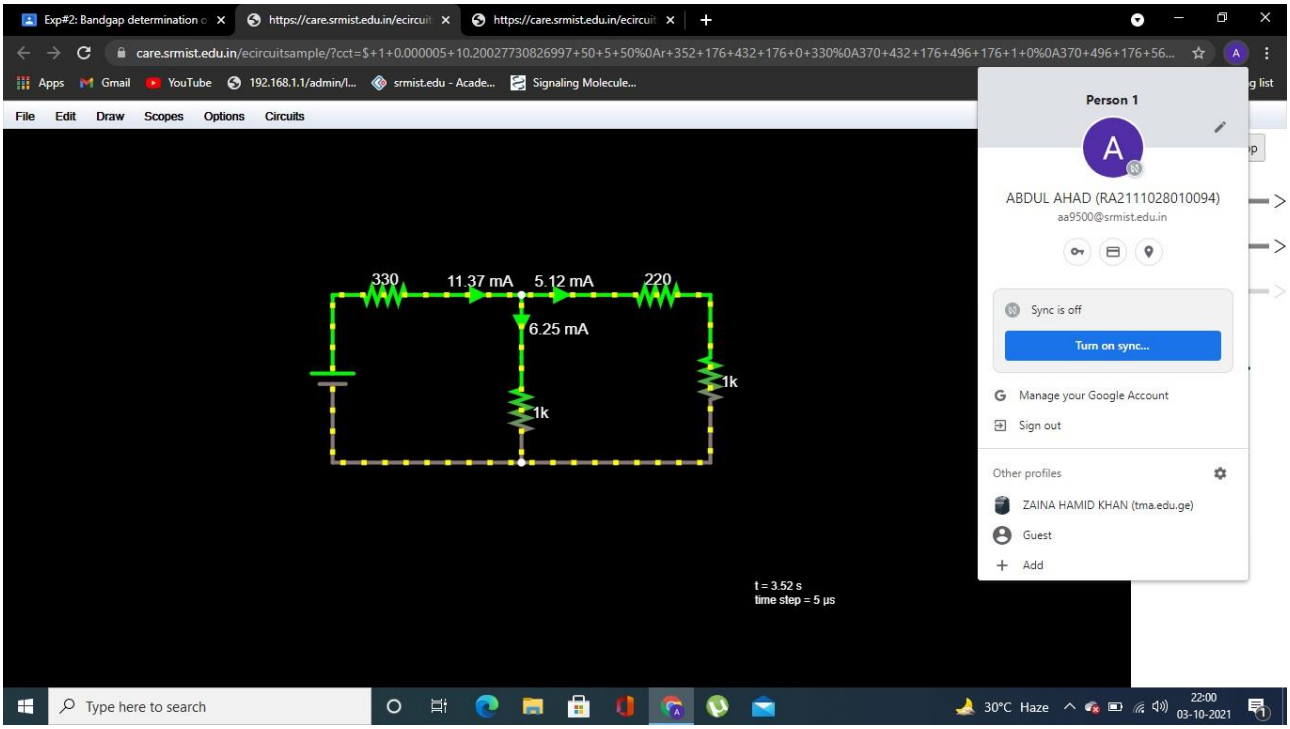
$$= -0.005$$

$$V_3 = i_3 \times 220$$

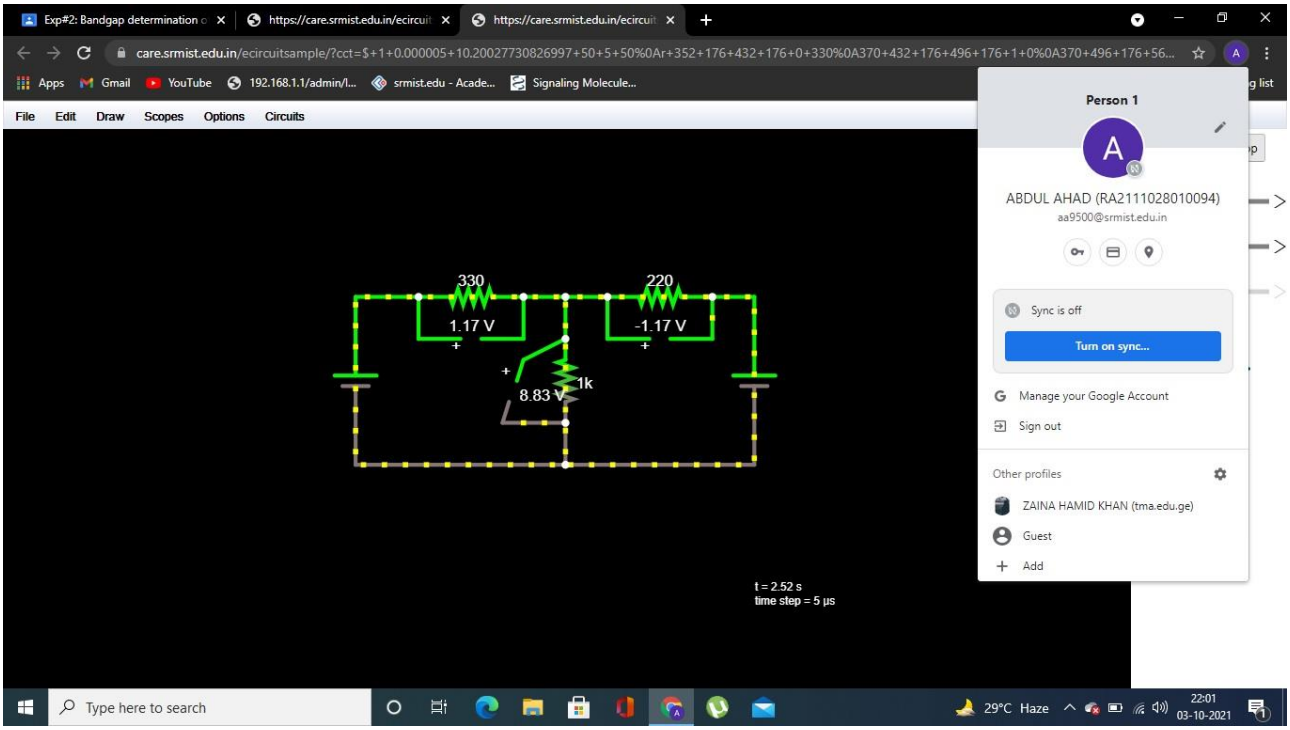
$$= -1.16$$

E circuit Results:

KCL:



KVL:

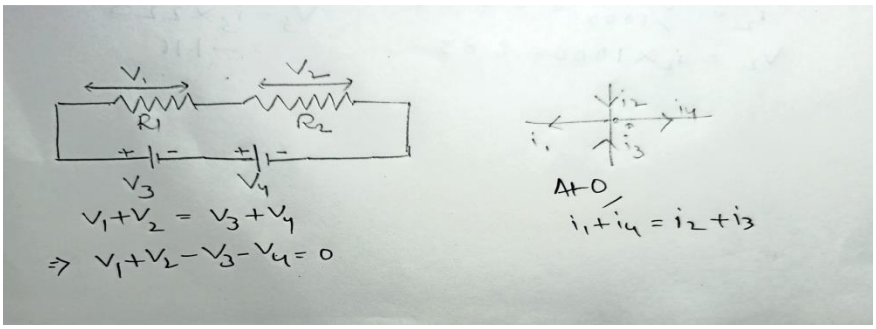


POST LAB QUESTIONS

1) **Illustrate KCL and KVL.**

KCL: It states that in a closed circuit, the entering current at node is equal to the current leaving at the node.

KVL: It states that the algebraic sum of the voltage at node in a closed circuit is equal to zero.



2) **Express the limitations of Ohm's law?**

Limitations of ohm's law are as follows:

- The law cannot be applied to unilateral networks. Unilateral networks permit the current to flow only in one direction. Example of such network includes diodes, transistors, etc.
- Ohm's law is ineffectual in the case of non-linear objects. In these components, the current is not proportional to the voltage applied. The reason is for each value of voltage and current, these components have different resistance values. Example is thyristor.
- Ohm's law will not work in case of non-metallic conductors.

3) **What is the practical application of Kirchhoff's law?**

The current distribution in various branches of a circuit can easily be found out by applying kirchoff's current law at different nodes or junction points in a circuit.

4) **Compare series and parallel circuits**

SERIES-CIRCUIT	PARALLEL-CIRCUIT
In series circuit, components are connected along a single conductive path. So the same current flows through the entire component but the voltage is dropped across each of the resistance.	In parallel circuit, components are connected parallel to each other and the voltage drop is same across each component.

5) What is the difference between series and parallel connection of batteries?

SERIES	PARALLEL
* In an electric circuit, components are arranged in a line.	* In an electric circuit, components are arranged parallel to each other.
* The same amount of current flows through all the components.	* The current flowing through each component combines to form the current flow through the source.
* When resistors are put in a series circuit, the voltage across each resistor is different even though the current flow is same through them.	* When resistors are put in parallel circuit, the voltage across each of the resistors are same. Even the polarities are same.
* If one component breaks down, the whole circuit wont work.	* Other components will function, if one component breaks down.
* If V is total voltage then, V = V1 + V2 + V3	* If V is total voltage then. V1 = V2 = V3