Fall 2021

EEE/ETE 141L

Electrical Circuits-I Lab(Sec-5)

Faculty : Md. Abu Obaidah (AbO)

Instructor: Farhana Atuyar Saleh

Lab No. : 01

Date of Performance : 3/11/2021 Date of Submission : 10/11/2021	**Name:** **1. Tahsin Tabassum Ali** **2. Tabassoom Rahman** **3. Kanta Saha** **ID:** **1. 2011059642** **2. 2011062642** **3. 2011731642**

Experiment 1:

Experiment name: Verification of Ohm’s Law

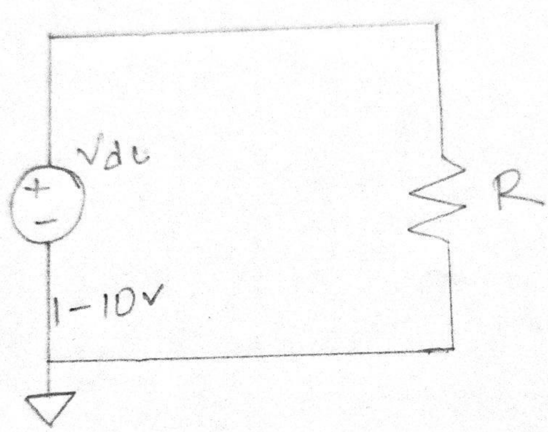
Objectives:

- We have to find the resistance of a resistor from its color code.
- We have to measure voltage, current and resistance values using a digital multimeter.
- We have to verify the validity of Ohm’s Law.
- We have to test the voltage divider rule in a series circuit.

List of equipment:

- Trainer board
- Resistors (3.3 KΩ, 5.6 KΩ)
- Digital Multimeter (DMM)
- Connecting Wire
- Multisim

Circuit diagram:



Circuit 1

Data table:

Table 1:

Resistance using colour coding					Resistance using DMM	% Error
Band 1	Band 2	Band 3	Band 4	Resistance ±tol		
Orange	Orange	Red	Gold	3.3k+-5%	3.3k	0%
Green	Blue	Red	Gold	5.6k+-5%	5.6k	0%

Table 2:

3.3 KΩ Voltage	Experimental readings		
	Current, I	Voltage, I R	Power, I^2R (mW)
2	.606 mA	2 V	1.212
4	1.212 mA	4V	4.818
6	1.818 mA	6 V	10.908
8	2.424 mA	8 V	19.392
10	3.03 mA	10 V	30.3

Table 3

5.6 KΩ Voltage	Experimental readings		
	Current, I	Voltage, I R	Power, I^2R(mW)
2	.357 mA	2V	.714
4	.714 mA	4V	2.856

6	1.071 mA	6V	6.426
8	1.429 mA	8V	11.432
10	1.786 mA	10V	17.86

Results:

From table 2,

Where V=2 V, I = .606 mA

Power, I^2R = 2*0.606 = 1.212 mW

From table 3,

Where V=8 V, I = 1.429 mA

Power, I^2R = 8*1.429 = 11.432 mW

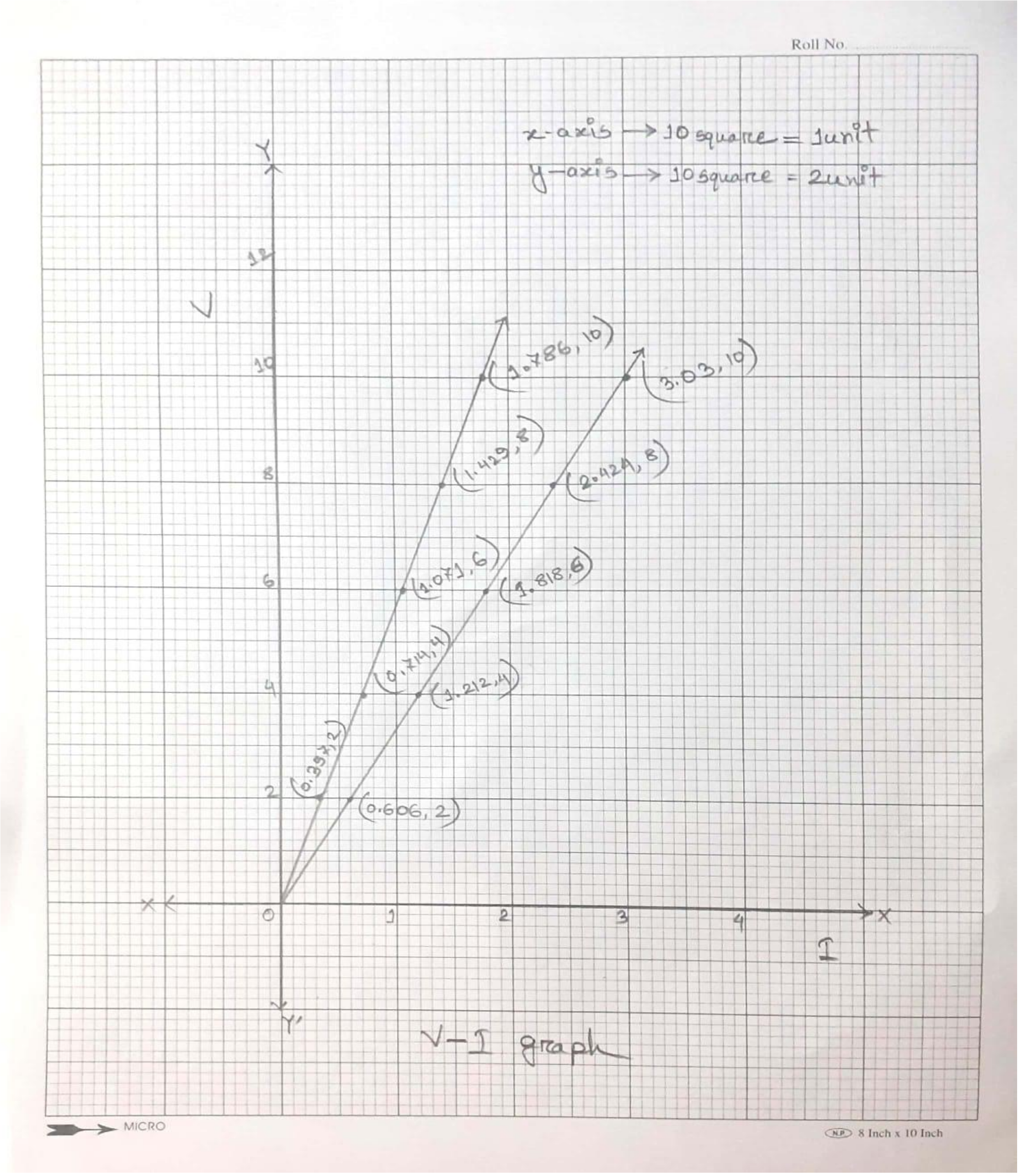
Question/Answer:

1. State Ohm's law.
Ans:
Ohm's law states that the voltage v across a resistor is directly proportional to the current (I) flowing through the resistor.

That is, V α I

Ohm defined the constant of proportionality for a resistor to be the resistance, R. (The resistance is a material property which can change if the internal or external conditions of the element are altered, if there are changes in the temperature.).
So, the equation is V = IR.

2. Plot V vs I graph for each resistor value in same graph.
Ans:



3.Does your experimental circuit follow ohm's law? Explain how you figured it out.
Ans:

Yes, my experimental circuit follow ohm's law.

Ohm's law states that the voltage v across a resistor is directly proportional to the current I flowing through the resistor. From. Data table 2, we can see that when voltage is 6 V, current passing through the resistor is 1.818 mA. When the voltage is decreasing to 4 V, current passing is decreasing to 1.212 mA. And when voltage is increasing to 8 V, current passing is also increasing to 2.424 mA.

From data table 3, we can see that when voltage is 6 V, current passing through the resistor is 1.071 mA. When the voltage is decreasing to 4 V, current passing is decreasing to 0.714 mA. And when voltage is increasing to 8 V, current passing is also increasing to 1.429 mA. So, it's following V α I.

4. Calculate the resistance of each circuit using the slope of your V vs I graphs. Compare these Rgraph values to the measured R values using DMM. Find the percentage difference.
Ans:
Slope = Rise/Run

For, the data table 2,
Using the slope of V vs I graphs,

Resistance, R = 2/.606 = 3.3kOhm

R = 4/1.212 = 3.3kOhm

R = 6/1.818 = 3.3kOhm

R = 8/2.424 = 3.3kOhm

R = 10/3.03 = 3.3kOhm

R value from DMM is 3.3kOhm.

So, Error = 0%

For, the data table 3,
Using the slope of V vs I graphs,

Resistance, R = 2/.357 = 35.6kOhm

R = 4/.714 = 5.6kOhm

R = 6/1.071 = 5.6kOhm

R = 8/1.429 = 5.6kOhm

R = 10/1.786 = 5.6kOhm

R value from DMM is 5.6kOhm.

So, Error = 0%

Experiment 2

Experiment name: Series Circuit

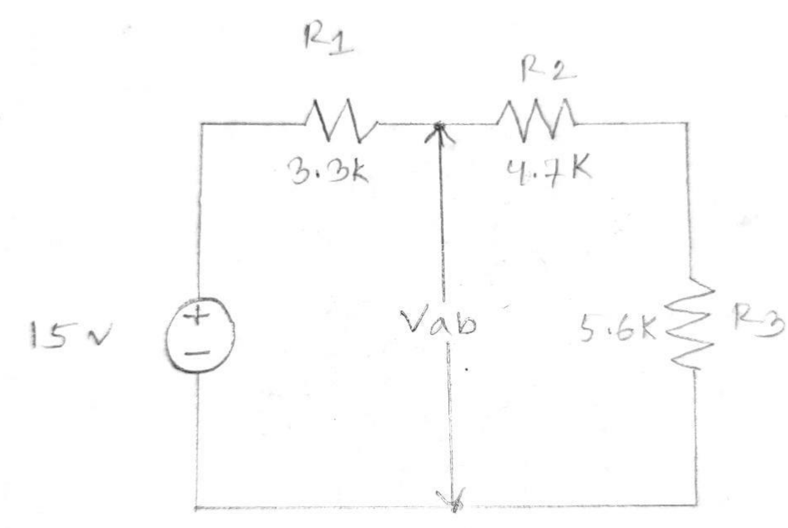
Objectives:

- We have to learn how to connect a series circuit on breadboard.
- We have to validate the voltage divider rules.
- We have to verify Kirchhoff's voltage law.

List of Components:

i. Trainer board
ii. Resistors (3.3 KΩ, 4.7 KΩ, 5.6K)
iii. Digital Multimeter (DMM)
iv. Connecting Wire
v. Multisim

Circuit Diagram:



Circuit 2

Data Table:

Table 1:

Resistance using colour coding					Resistance using DMM	% Error
Band 1	**Band 2**	**Band 3**	**Band 4**	**Resistance ±tol**		
Orange	Orange	Red	Gold	3.3k+-5%	3.3k	0%
Yellow	Violet	Red	Gold	4.7k+-5%	4.7k	0%
Green	Blue	Red	Gold	5.6k+-5%	5.6k	0%

Table2:

Experimental readings				Theoretical values			
V_S	**V_{R1}**	**V_{R2}**	**V_{R3}**	**V_S**	**V_{R1}**	**V_{R2}**	**V_{R3}**
15V	3.64V	5.184 V	6.176 V	15V	3.64V	5.18V	6.176

% Error			
V_S	**V_{R1}**	**V_{R2}**	**V_{R3}**
0%	0%	0.077%	0.065%

Table 3:

Potential rise V_S	15 V	**Are the voltage rises and drops equal?**
Potential drops (V_{R1} + V_{R1} + V_{R3})	(3.64+5.184+6.176)=15V	Yes

Table 4

Experimental readings		Theoretical values	
V_{ab}	**R_{eq}**	**V_{ab}**	**R_{eq}**
11.36V	13.6k	11.36 V	13.6k
% Error			

V_{ab}	R_{eq}
0%	0%

Results:

$V_x = (E*R_x)/R_T$

R_T = 3.3+4.7+5.6 = 13.6

V_{R1} = (3.3*15)/13.6 = 3.64

V_{R2} = (4.7*15)/13.6 = 5.18

V_{R3} = (5.6*15)/13.6 = 6.18

% Error = (Theoretical value – Experimental Value) / Theoretical Value

For Vs,

%Error= (15-15)/15*100% = 0%

For V_{R1} ,

%Error= (3.64-3.64)/3.64*100% = 0%

For V_{R2},

%Error= ((5.184-5.18)/5.18)*100% = 0.077%

For V_{R3},

%Error= ((|6.176-6.18|)/6.18)*100% = 0.065%

V_{ab} = 5.18 + 6.18 = 11.36 V

R_{eq} = 3.3k+4.7k+5.6k = 13.6k

Question/Answer:

1. State the voltage division rule.
Ans:

Voltage division rule states that the voltage is divided between two resistors which are connected in series in direct proportion to their resistance.

The equation is, $V_x = (E*R_X)/R_T$

2. State the Kirchhoff's voltage law (KVL).
Ans:

Kirchhoff's voltage law (KVL) states that the voltages around a closed path algebraically sum to zero. In other words, the sum of voltage rises equals the sum of voltage drops.

So, the equation is,

$$\sum_{M=0}^{m} Vm = 0$$

3. Showing all steps, calculate the theoretical values in Table 2. Compare theoretical values to your experimental values and explain whether your circuit follows KVL or not.
Ans:

$$Vx = (E*Rx)/R_T$$

$R_T = 3.3+4.7+5.6 = 13.6$

$V_{R1} = (3.3*15)/13.6 = 3.64$

$V_{R2} = (4.7*15)/13.6 = 5.18$

$V_{R3} = (5.6*15)/13.6 = 6.18$

% Error = (Theoretical value – Experimental Value) / Theoretical Value

For Vs,

%Error= (15-15)/15*100% = 0%

For V_{R1} ,

%Error= (3.64-3.64)/3.64*100% = 0%

For V_{R2},

%Error= ((5.184-5.18)/5.18)*100% = 0.077%

For V_{R3},

%Error= ((|6.176-6.18|)/6.18)*100% = 0.065%

Here, Voltage rise = 15 V

Voltage drop = $V_{R1} + V_{R2} + V_{R3}$ = (3.64+5.18+6.18) V = 15 V

So, Voltage rise = Voltage drop

Which follows KVL.

4.Showing all the calculations, theoretically calculate Vab. Compare with the experimental value and verify the voltage division rule at the terminal a-b.

Ans:

According to Voltage division rule,

$$V_X = (E*R_X)/R_T$$

Va = (15*4.7)/(3.3+4.7+5.6)

= 5.18 V

Vb = (15*5.6)/(3.3+4.7+5.6)

= 6.18 V

Vab = 5.18 + 6.18 = 11.36 V

From the experimental value of multisim we see that, Vab = 11.36 V.

Here, the error is 0%

So, Voltage division rule at the terminal a-b is verified.

5. Showing all the steps, calculate Req. Compare with the experimental value.

Ans:

By experimenting from multisim, Req = 13.6kOhm

$Resistance_{Total} = R_1+R_2+R_3$

= (3.3k + 4.7k + 5.6k)Ohm

= 13.6kOhm

So, Theoretical and experimental values for Req are the same.

So, there is 0% error.

Discussion:

From the lab 1, we learned about Ohm’s law, Kirchoff’s voltage law, and voltage divider rule using series circuit.

As, it was an online lab, we had to use multisim to do the experiments. So, we didn’t have to face many errors or faults. We could find the theoretical values easily.

If we would have done the lab offline, we could have faced many errors such human errors, environmental errors or mechanical errors. Also, we could have faces errors using DMM, cables, breadboard connection etc.