AMERICAN INTERNATIONAL UNIVERSITY–BANGLADESH (AIUB)

FACULTY OF SCIENCE & TECHNOLOGY

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

ELECTRICAL CIRCUIT LAB - 1

SUMMER 2022-2023

Section: W, Group: 2

LAB REPORT ON

Familiarizing with the basic DC circuit terms & concepts: Introduction to laboratory equipment.

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Submitted By

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1. Abstract:

To gain experience in building DC circuits and making measurements of current and voltage. Also, strengthen the ability to reason about how adding or removing resistors will affect the current & potential at different locations in a DC circuit. Introduction: This lab is designed to review, solidify & improve your understanding of DC circuits & ohms law. Research has shown that even after students have completed their study of DC circuits, they often have difficulty with some specific concepts and ideas. The exercises here are designed to address these difficulties in a step-by-step fashion and help you learn to reason more easily & correctly about circuits. In each part of the lab, you will be given a circuit diagram, involving a power supply. You will be asked to make some predictions about the behavior of the circuit before you construct the circuit and make any necessary measurements. Hopefully, some of the circuits will surprise you with behavior.

2. Theory and Methodology:

Ohm's Law: Ohm's Law deals with the relationship between voltage and current in an ideal conductor.

This relationship states that:

At fixed temperature in an electrical circuit, the current passing through a conductor between two points is proportional to the potential difference (i.e. voltage drop or voltage) across the two points, and inversely proportional to the resistance between them. In mathematical terms, this is written as:

$$V = IR$$

Where I is the current in amperes (A), V is the potential difference in volts (V), and R is the resistance measured in ohms (Ω) which is constant here. The potential difference is also known as the voltage drop and is sometimes denoted by E or U instead of V.

Current: The amount of electric current (measured in amperes) that passes through a surface, e.g., a section through a copper conductor, is defined as the amount of electric charge (measured in coulombs) flowing through that surface over time. If Q is the amount of charge that passed through the surface in the time T, then the average current I is:

$$I = Q/T$$

Voltage: Voltage (sometimes also called electric or electrical tension) is the electrical potential difference between two points of an electrical conductor, expressed in volts. It measures the potential energy of an electric field that causes the flow of electric current through a conductor. Depending on the difference in the electrical potential it is called extra-low voltage, low voltage, high voltage, or extra-high voltage.

Between two points in an electric field, such as exists in an electrical circuit, the difference in their electrical potentials is known as the electrical potential difference. This difference is proportional to the electrostatic force that tends to push electrons or other charge carriers from one point to the other. Electrical potential difference can be thought of as the ability to move electrical charge through a resistance. At a time in physics when the word *force* was used loosely, the potential difference was named the electromotive force or **EMF**—a term that is still used in certain contexts.

Voltmeter: A voltmeter is a device that is used to measure the voltage difference between two points of an electronic component. The potential difference can be measured by simply connecting the leads across the two points of a load.

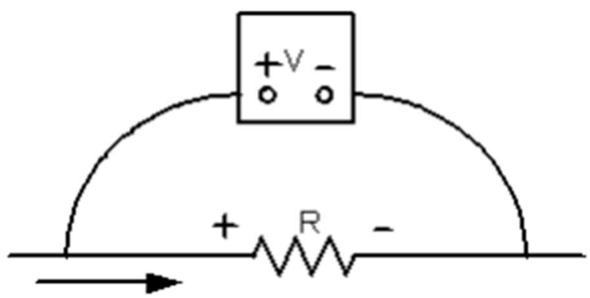


Figure 1: Voltage measurement across the two points/ends of a resistor

Ammeter: The ammeter is a device that is used to measure the current level of the circuit. Since ammeters measure the flow of charge, the meter must be placed in the network such that the charge will flow through the meter. Mistakenly placing the ammeter in parallel with a circuit will blow the fuse, possibly damaging the meter and causing injury.

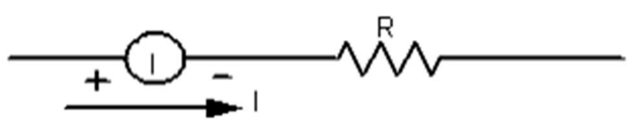


Figure 2: Demonstration of measuring current using an Ammeter

Wattmeter: The wattmeter measures the power delivered by a source and to a dissipative element.

Circuit Breaker and Fuses: The incoming power to any installation or house or machinery must be limited to ensure the current through the line is not above the rated value. Otherwise, the instrument may be damaged or serious hazards like fire or smoke may result. To limit the current level circuit breakers and fuses are used. Fuses have an internal metallic conductor through which the current will pass; a fuse will melt if the current through the system exceeds the rated value printed on the casing. Of course, if the fuse melts through, the current path is broken and the load in its path is broken and the load in its path is protected.

Fuses have now been replaced by circuit breakers. In a circuit breaker, when the current exceeds the rated value an electromagnet in the device will have sufficient strength to draw the connecting metallic link in the breaker out of the circuit and open the current path. When the conditions have been corrected the breaker can reset and be used again.

3. Apparatus

- Trainer Board
- Voltmeter
- Ammeter
- AVO meter or Multimeter
- DC source
- Resistors

4. Precautions:

- When measuring voltage, the multimeter must be connected to the two points of a circuit to obtain the desired value. Be careful not to touch the bare probe tips together while measuring voltage, as this will create a short-circuit!
- Never read the value of resistance or perform a continuity test with a multimeter in a circuit that is energized.
- When measuring current, the multimeter must be connected to the circuit so that the electrons flow through the meter.
- Multimeters have practically no resistance between their leads. This is intended to allow electrons to flow through the meter with the least possible difficulty. If this were not the case, the meter would add extra resistance to the circuit, thereby affecting the current reading.

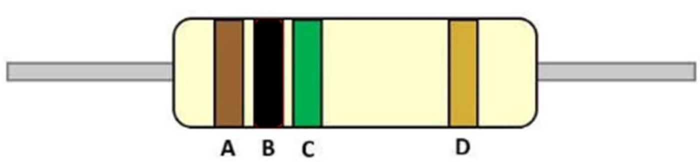
5. <u>Experimental Procedure and calculation</u>:

1. Firstly, we need to calculate the values of the supplied resistors using the color code chart theoretically. Then we have to measure the values using a multimeter and complete the table-1:

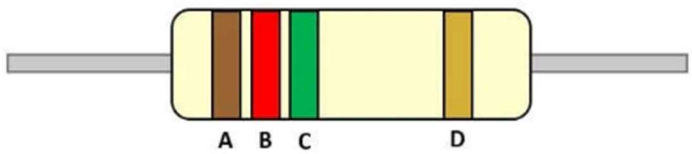
The Resistor Color Code Table

Color	1st Band (1st Digit)	2nd Band (2nd Digit)	3rd Band (3rd Digit)	Multiplier	Tolerance	Temperature Coefficient
Black	0	0	0	$\times 10^0\ \Omega$	N/A	250 ppm/K
Brown	1	1	1	$\times 10^1\ \Omega$	± 1% (F)	100 ppm/K
Red	2	2	2	$\times 10^2\ \Omega$	± 2% (G)	50 ppm/K
Orange	3	3	3	$\times 10^3\ \Omega$	N/A	15 ppm/K
Yellow	4	4	4	$\times 10^4\ \Omega$	N/A	25 ppm/K
Green	5	5	5	$\times 10^5\ \Omega$	± 0.50% (D)	20 ppm/K
Blue	6	6	6	$\times 10^6\ \Omega$	± 0.25% (C)	10 ppm/K
Violet	7	7	7	$\times 10^7\ \Omega$	± 0.10% (B)	5 ppm/K
Grey	8	8	8	$\times 10^8\ \Omega$	± 0.05%	1 ppm/K
White	9	9	9	$\times 10^9\ \Omega$	N/A	N/A
Gold	N/A	N/A	N/A	$\times 10^{-1}\ \Omega$	± 5% (J)	N/A
Silver	N/A	N/A	N/A	$\times 10^{-2}\ \Omega$	± 10% (K)	N/A

R1 Resistor

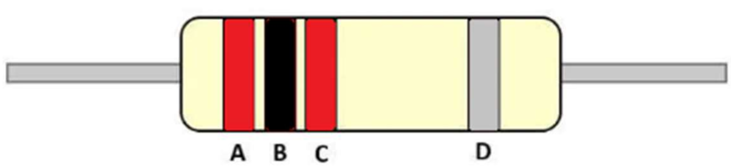


R2 Resistor



R3 Resistor

R4 Resistor



R5 Resistor

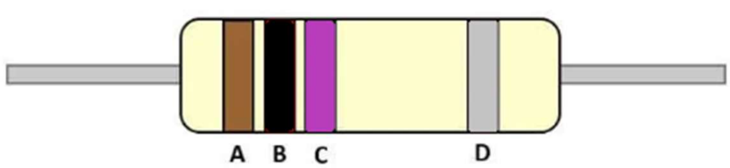


Table 1

Resistor	Value using color code chart	Value using multimeter
R1	$10 \times 10^5 \pm 5\%$	$10.02 \times 10^5 \pm 5\%$
R2	$12 \times 10^5 \pm 5\%$	$12.13 \times 10^5 \pm 5\%$
R3	$10 \times 10^2 \pm 5\%$	$10.07 \times 10^2 \pm 5\%$
R4	$20 \times 10^2 \pm 10\%$	$20.01 \times 10^2 \pm 10\%$
R5	$10 \times 10^7 \pm 10\%$	$10.05 \times 10^7 \pm 10\%$

2. Now, we need to construct the following circuit (Figure 3). Then we need to theoretically calculate R_T (total resistance), I (total Current), V_{ab}, V_{cd}, V_a, and V_b. Then we calculated the same quantities using the multimeter and complete the table Table-2 provided below.

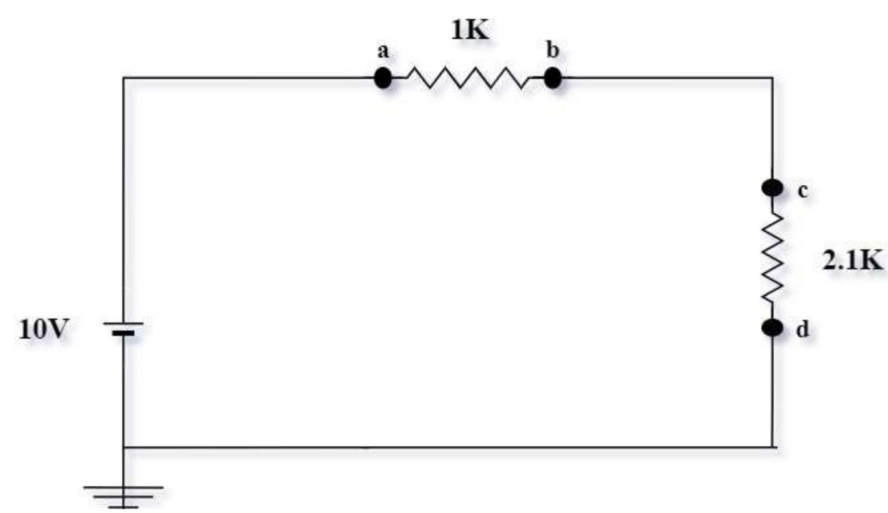


Figure 3: Circuit schematic to perform the 2nd step of the experimental procedure

Table 2

E	Theoretical Calculation						Multimeter readings				
	R_T	I	V_{ab}	V_{cd}	V_a	V_b	I	V_{ab}	V_{cd}	V_a	V_b
5 V	3.1 kΩ	1.61ma	1.61v	3.38v	5v	3.38v	1.6ma	1.61v	3.5v	5.12v	3.5v
10 V	3.1 kΩ	3.225ma	3.225v	6.45v	10v	6.77v	3.2ma	3.17v	6.91v	10.08v	6.95v

6.Discussion

1. The trainer board and the multimeter were checked before the start of the experiment.
2. The resistor was placed properly according to the figure.
3. The value of the voltage was increased gradually as applying a large voltage can damage the resistors.
4. During the experiment some error was taken place due to the fault of voltage source. It was solved with the help of the course instructor.
5. Finally, all the data was placed in the data table. For the given equation, a result was obtained.

7. Conclusions:

In this experiment, the basic idea of DC terms and circuits was observed and verified with a specific theory. Also, we come to know how to measure the voltages and currents using a multimeter. So, the experiment is successful.

8. References

1. [1]http://zebu.uoregon.edu/disted/ph162/lec04.html
2. [2] Robert L. Boylestad, " Introductory Circuit Analysis '', Pearson, Twelfth Edition, pp#101-109, ISBN 978-81-317-6476-3.