PHYS 102 EXPERIMENT 1. ELECTRICAL MEASUREMENTS

Objective:

Introduction to electrical circuit components, acquiring basic skills in electrical measurements and I-V (current-voltage) curves.

Introduction:

An electronic circuit is essentially a path which is formed by electrons that are flowing under the influence of a potential energy difference. In order to sustain a "load", electrons need to flow in a closed circuit. The load can be as simple as a lamp, or more complicated as various house appliances. The most basic elements in electrical circuits are passive elements, such as resistors, capacitors, and inductors. These elements can be used to achieve static or dynamic (time-dependent) voltage drops in circuits, which can be used for various useful functions. In this experiment we will evaluate the basic voltage-current behaviour of resistors.

Equipment:

The following equipment will be suppied:

- A 30 V power supply;
- Two identical resistors (100 – 1000 Ohm);
- An ammeter (or a multimeter in current measurement mode);

Procedure:

Your lab assistant will provide you with a resistor. This element has two ports formed with two metallic wires. The resistor is a symmetric element, which means that in practice you can flip the two ports without any change. Resistor simply resists the flow of electrical current due to collisions between its atoms and the electrons. While metals have very low resistance, the resistor material has a high collision rate, thus causing a voltage drop.

It can be shown that the voltage drop across a resistor is given by a simple formula, called the Ohm's Law. The law states that the voltage drop across a resistor is equal to current times resistance: V=I*R. The unit of voltage is "volt (V)", current is "Ampere (A)", and resistance is "ohm (Ω)". In this experiment, we will make use of Ohm's Law.

1. Connect the resistor (can be a 100 - 1000 Ohm labeled resistor) to a voltage source, and set up your multimeter in current measurement mode. The current to be measured needs to pass through the multimeter. Therefore, you will need to connect the multimeter in "series" to the circuit. Note that, if you wanted to measure the voltage, the multimeter would need to be in "parallel" to the resistor. Since the voltage source directly provides the voltage, you will only need to measure the current in the experiment.
2. Now, change the voltage difference from 5 V to 20 V, in 3 V steps. At each voltage value, measure the current. Fill in Table 1. Note the current may be at the milliampere (mA) level.
3. Draw the I-V graph, where the *y*-axis shows the voltage, and the *x*-axis shows the current. This

is also called the *current-voltage (I-V) characteristics* of the resistor. From Ohm's Law, you should expect the data to be best described by a linear curve. Go ahead and draw a line to your data. The slope of this curve should give you the *resistance* value. Report your resistance (Remember the "significant digits" section from the previous experiments).

4. In any experiment there are random errors. Assuming that your multimeter is calibrated to remove any systematic errors, estimate the uncertainty in your resistance measurement. Report it as percentage error, as well as absolute error.

5. Repeat the same measurement with another resistance with the same resistor label. Since the label on the resistance is the same, at least in principle, you should expect the same result. Do you get the same result? If not, what is the reason behind the discrepancy? Explain your reasoning.

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Data & Results: [25]

Voltage ( )						
Current ( )						

Table 1: Current-voltage relation across the resistor 1

$\boldsymbol{R1} =$	$\frac{\boldsymbol{\Delta R1}}{\boldsymbol{R1}} =$

Voltage ( )						
Current ( )						

Table 2: Current-voltage relation across the resistor 2

$\boldsymbol{R2} =$	$\frac{\boldsymbol{\Delta R2}}{\boldsymbol{R2}} =$

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Plot 1 [15]:

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Plot 2 [15]:

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Conclusion: [15]