Name:

**KS16001 LABORATORY 1**

## LAB 1: INTRODUCTION TO THE LABORATORY BASIC ELECTRONICS TOOLS/INSTRUMENTS

**Objective:**
This laboratory exercises will introduce you to two of the laboratory workhorses: the dc power supply, and the digital multimeter.

**Learning Outcomes:**
1. The ability to use dc power supply as a source in electronic circuit.
2. The ability to use multimeter as a basic tool to measure resistance, dc voltage, and dc current.

**Instrument/Component:**
Power Supply
Multimeter
Bread Board
Resistors-different resistance values: 1kΩ, 4.7kΩ, 10kΩ, 10MΩ

**Introduction:**

**MULTIMETER**
Multimeter is a multipurpose device to measure voltage, current and resistance. Basically there are two types of multimeter: analog (VOM) and digital (DMM) meters. The DMM can be used to measure resistance (OHM-METER), voltage (VOLT-METER) and current (AM-METER) and other parameters as well.

***Resistance Measurement***:
Turn the knob to Resistance Symbol (Ω) and make sure the probe is inserted into the correct ports. Touch the probe to the resistor legs.

***Voltage Measurement***:
Turn the knob to Voltage Symbol (V) and make sure the probe is inserted into the correct ports. When measuring voltage levels, make sure the meter is connected in parallel with the element whose voltage is to be measured. Polarity is important because the reading will indicate up-scale or positive reading for correct connection and down-scale or negative reading if reverse connection of the meter test leads to the resistor's terminals.

***Current Measurement***:
Turn the knob to Current Symbol (A) and make sure the probe is inserted into the correct ports. When measuring current levels, make a series connection between the meter and the component whose current is to be measured. In other words, disconnect the particular branch and insert the ammeter. The ammeter also has polarity marking to indicate the manner they should be hooked-up in the circuit to obtain an up-scale or positive measurement. Always start with higher range going downwards to avoid damaging the instrument.

**Pre-Lab Preparation:**

Read the Electronic Color Code from the link
https://en.wikipedia.org/wiki/Electronic_color_code and answer the questions below:

1. What color code designates a 1Ω, 10% resistor?

2. What color code designates a 1k Ω, 5% resistor?

3. What color code designates a 10M Ω, 1% resistor?

Answer the following questions by referring to any reliable sources:

4. What is the ideal resistance of a voltmeter?

5. What is the ideal resistance of an ammeter?

6. How do you measure a voltage between two points in a circuit? (draw a diagram)

7. How do you measure a current between two points in a circuit? (draw a diagram)

8. How do you measure the resistance of a circuit element?

## Task 1: DC Power Supply and Multimeter

1.1 Locate the dc power supply. Examine the controls on its front panel. This is a relatively simple instrument to use. It is used to provide dc (constant) voltages and currents. It is important to prevent the leads of the dc power supply from touching each other. When the power supply leads touch, a short circuit is formed which can cause serious damage to the power supply. Consider what would happen if you shorted the wall socket, or a car battery! Short circuits can be dangerous, and special care should be taken to avoid them.

1.2 Locate the digital multimeter. Examine the controls on its front panel. This instrument is used to measure voltage, current and resistance. When configured to measure voltage, its function is a voltmeter. Likewise, it may function as an ammeter or as an ohmmeter.

## Task 2: Measuring Resistance

2.1 Select a (nominal) 1kΩ resistor. Record the complete color-code of the resistor you used (and particularly the tolerance of the resistance).

2.2 Set the multimeter to measure resistance. Determine the actual value of the resistor. The words “actual” and “measured” may be used interchangeably.

2.3 Compute the percent difference between the actual (measured) value of the resistor and the nominal value of 1kΩ as indicated by its color code. Record the actual and percent difference values.

2.4 Select 4 different value of resistors and apply steps 2.1 to 2.3. Record your result in Table 1.1.

**Table 1.1**

| Resistance Value | Color-code | Actual Value | Difference (%) |
|---|---|---|---|
| 1kΩ | | | |
| | | | |
| | | | |
| | | | |
| | | | |

## Task 3: Biologic Resistor.

3.1 Holding one probe between the thumb and forefinger of each hand, measure the resistance of your body between your hands. Squeeze the probes tightly so that good contact is established. Record the value of your body’s resistance.

3.2 Considering that a current of 100–200 mA through your heart will almost certainly kill you, how much voltage across your hands would be lethal? Show your calculation.

**Task 4: Measuring Current and Verifying Ohm's Law.**

4.1 Configure the multimeter to measure voltage. Adjust the voltage of the power supply to 5V. Measure the exact voltage using the multimeter (**Remember, always measure the voltage provided by the power supply with the voltmeter. Do not rely on the digital display on the front panel of the power supply**).

4.2 **Set the multimeter to measure dc <u>current</u>**. Assemble the circuit in Figure 1.3.

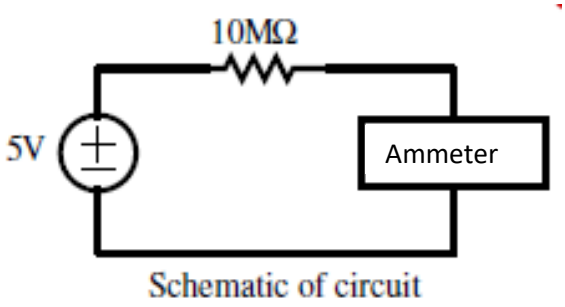


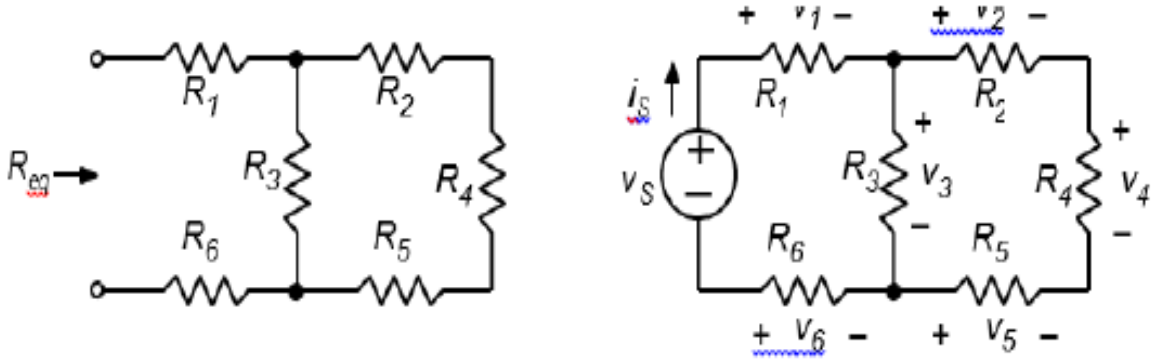

**Figure 1.3**

4.3 Measure the current flowing through the resistor. An ammeter measures the current flow from the red probe to the black probe within the meter. Does this value agree with Ohm's Law?

4.4 Measure the current flowing through the resistor in the opposite direction. This is done by reversing the leads of the ammeter. Does this value agree with Ohm's Law?

## Task 5: Measurements on resistive circuits

5.1 Build the resistor network as shown in the first part of Figure 1.4.




*$R_1$ = 1kΩ, $R_2$ = 4.7 kΩ, $R_3$ = 10 kΩ, $R_4$ = 1 kΩ, $R_5$ = 4.7 kΩ, $R_6$ = 1 kΩ, $V_S$ = 20V*

**Figure 1.4**

5.2 Calculate the equivalent resistance of the network with respect to the two terminals. Use the nominal values of the resistors.

5.3 Use the ohm-meter to measure the equivalent resistance at the two terminals.

5.4 Connect the voltage source to the resistor network as in second part of Figure 1.4, with the voltage set to 20V.

5.5 Calculate the expected voltages across each resistor, using the nominal values of the resistors.

5.6 Use the voltmeter to measure the source voltage, and then measure the voltage across each resistor.

5.7 Use Ohm's law to calculate the current in each resistor.

5.8 Break the connection between the positive source terminal and the first resistor. Insert the multi-meter (set up for current) and measure the current from the source.

**Task 6: Design and build a simple voltage divider circuit**

Using Vs =10 V, design a voltage divider to provide 2 V and 3 V as output voltages. Draw your design and show relevant calculations to prove it.