

**Adama Science and Technology University**

**School of Electrical Engineering and Computing**

**Course Title:** Fundamentals of Electrical Engineering

**Course Number:** PCE2101

**Lab:** Laboratory Experiment No - 1

**Title:** Basic Electric Measurements and Measuring Resistance

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**Acknowledgement**

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**Theoretical Background**

**Resistance** is the opposition to conductance and is the property of a material to hold back, or restrict, the flow of current. It is encountered in every electrical circuit. Metals generally are good conductors, having many free electrons and, therefore, they exhibit low resistance.Insulators, on the other hand, have few free electrons making them poor conductors, exhibiting very high resistance. The resistance (R) of a material depends upon four factors:

* + - * It’s specific resistance.
			* Its length
			* It’s cross-sectional area.
			* Its temperature.

There are two common types of resistors. These are the *composition resistor,* which contains carbon, and the *wire-wound resistor,* which consists of a coil of wire. Values of resistors in ohms are normally indicated by color coding as shown in the table below. The first two colors on a resistor give the first two digits in the resistance value, with the decimal place to the right of the second digit. The third color represents the power of 10 for the multiplier of the resistance value. The last color is the tolerance of the resistance value.

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Table: Color Coding for Resistors

When a current flows through a resistance, a voltage or pressure drop is created. This loss of voltage, known as “**Voltage Drop” (V),** is equal to the product of the current and resistance.An individual voltage drop is expressed as **V = I x R**, where V is measured in Volts, I in amps and R in Ohms.

The relationship of resistance, current and voltage is given by **Ohm’s LAW** which states that the current in an electrical circuit is directly proportional to the voltage and inversely proportional to the resistance: **I = V/R**.

**Lab – 1: Basic Electric Measurements and Measuring Resistance**

**Objectives:**

* To be able to identify types of resistors and determining the resistance using color coding.
* To determine the operation of the instruments and Basic Measurements.

**Apparatus Used:**

* Carbon Resistors (Fixed Resistors)
* Variable Resistors (Rheostat)
* Digital Multimeter (DMM)
* Connectors
* DC power supply

**Procedures**

1. **Measuring Resistance with a Digital Multimeter (DMM)**
2. Firstly we brought and putted the resistor to be measured in a suitable and appropriate position.
3. Then we plugged the probes of the DMM in the right position. Meaning that the black cable goes into the “COM” port. And the remaining port goes in to the port that measures resistance.
4. Then we adjusted the meter to resistance measuring and adjust the region.
5. Following this we connected the probes to the two ends of the resistor. Here it does not matter which probe is assigned to which end if the resistor.
6. Then we attentively watched the reading that the DMM gives. Here the following may occur:
	1. The reading maybe “1”. This simply means either we haven’t connected the probes to the resistor or the resistor does not work.
	2. We may get a reading that is very small or very large. Here we must adjust the range we have set for measuring. If the reading is small then we have to increase our range and decrease it if the reading is very large.
	3. We may get a good reading.
7. **Measuring Voltage with a DMM**
	1. First we formed a complete circuit containing a DC source and a resistor.
	2. Just like we did while measuring resistance, here also we plugged the probes in the correct ports of the DMM. And adjusted the meter in the region of measuring voltage.
	3. Then we putted the two ends of the probes at the two ends of the resistor connecting the meter in parallel to the resistor. This is because the meter measures the voltage across the resistor and thus should be parallel.
	4. Then we watched the reading of the DMM. During this step the following may occur:
		1. We may see a reading that displays “1”. This simply means that we haven’t connected the probes to the resistor or we didn’t form a complete circuit or the resistor doesn’t work.
		2. We may see a reading that is negative. Here that mistake we have done is connecting the DMM in the wrong polarity to the voltage source. This mistake doesn’t affect our reading, it just makes it negative.
		3. Just like in the experiment involving the resistor, here also we may get a reading that is very small or very large. This can be corrected by adjusting the region of measuring on the DMM.
		4. We may get a good reading.
8. **Measuring Current with a DMM**
	1. At the beginning we brought a DC source, a resistor and a DMM.
	2. Then we connected the positive part of the source to the positive probe of the meter. Then the negative probe of the DMM was connected to the resistor. Following this we connected the resistor to the negative part of the source. This was done because an ammeter (DMM) measures a current through the conductor so the meter doing the measurement should be a part of the circuit being measured.
	3. Then we checked whether we are in the region of measuring current on the DMM. And we also checked if the probes were attached to the right port on the DMM.
	4. After this we carefully watched as the DMM displays the reading. The reading may be one of the following:
		1. The reading might be “1”. This simply means that either our circuit is not complete or the resistor does not work.
		2. Just like the previous experiments the reading might be either very large or small. To solve this we simply have to adjust the range of measuring in the DMM.
		3. We may get a good reading.

**Result and Discussion**

From the experiments we have done we have obtained the following measurements.

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| --- |
| Measuring the Resistance of given resistors |
| Resistance | R1 ($Ω$) | R2 ($Ω$) | R3 ($Ω$) |
| Calculated value | 680 $\pm $ 34 | 330 $\pm $ 16.5 | 470 $\pm $ 23.5 |
| Measured value | 691 | 324 | 465 |

|  |
| --- |
| Measuring Resistance of a Rheostat by varying length |
| Length | Measured Value ($Ω$) |
| 0 | 0.00 |
| L1 | 5.41 |
| L2 | 1.136 $×$ 103 |

Also the following results were obtained from our experiments.

* By using a 10 V DC power supply, we read **11.19 V**on a resistor connected to the power supply. The upset on the reading was due to errors that occurred when adjusting the DC power supply to 10 V.
* Also by using the same power supply (10V) and resistor we read a current of **16.4 mA**.

**Questions**

1. What’s wrong with holding the leads and probes between your fingers?

If there is a current or voltage source this will create a current that will pass through us. The danger of such event depends on the amount of the current. However, it is not advisable to have any amount of current flow through our body.

1. Measure the resistance value of the rheostat by varying the position what do you observe and does the resistance value vary? What is the relationship between the length of the coil and resistor value?

When we varied the position, the resistance of the rheostat also becomes varied. When the length taken becomes larger the resistance also goes higher. Meaning the increasing the length results in an increase of the resistance. So the length and resistance have a direct relationship.

1. Measure the resistance value by varying the knob. Does the resistance vary? What is the maximum value?

As mentioned in question number 2, when we varied the knob of the rheostat, the resistance also changes. The maximum resistance is acquired at maximum length. And the maximum resistance is 2850$Ω$.

1. What is your conclusion about today’s lab experiment?

After gaining the experience of working with a Digital Multimeter and various electronic components we have observed the following:

1. Never connect an Ammeter in parallel with an element being measured. The Ammeter will become damaged.
2. Always check and regulate the power source before connecting it to the circuit we are working on. This is to avoid any damages that may result from an unregulated power source.
3. Always come prepared for the laboratory sessions. This includes wearing appropriate cloth and shoes, not touching elements that we are unfamiliar with,
4. Being cautious when plugging in power source and ports. This include the probes we use to measure resistance, current or voltage. Here we must be careful of which ports of the Multimeter we are using when doing measurements.
5. When we get a reading of “1”, this means that either our circuit is not complete or the element we are currently working on is not functional.
6. After finishing up our experiments, we are expected to turn off any power supplies and return the apparatus we used to their places.

**References**

* Physics for Scientists and Engineers with Modern Physics, R. A. Serway and J. W. Jewett
* Module – 3: Electrical Fundamentals, Aviation Maintenance Technicians’ School (AMTS)

***“We have neither received nor provided any help on the writing of this lab report.”***

**Thank you!**