THE DIGITAL MULTIMETER AND THE BREADBOARD

The goal of these laboratory experiences is for students to become familiar with the Digital Multimeter to measure Resistance, Voltage and Current. In addition, students will become familiar with the solderless breadboard used for prototyping.

1.- Digital Multimeter as an Ohmeter: Measure Resistance

The picture to the left depicts a Digital Multimeter (DMM) similar to those that we will use in the labs in this course. The central rotary knob is used to select the variable to measure: Ohms, AC Volts, DC Volts, AC Amps, DC Amps, Temperature and Gain of Transistors among other variables.
**Procedure for measuring Resistance:**

1a.- Ensure that the power in the circuit under measure is OFF
Ohmeter applies external current. It can interact with the power in the circuit and damage it

or

1b.- Remove the component from the circuit

2.- Connect Black lead to COM
3.- Connect Red lead to terminal with symbol Ω
4.- Move Rotary selector to Ω
5.- Value of display is Resistance
6.- If display shows “OL”: Overload. Select higher range

**Example:** Short circuiting leads should result in a very low value of Resistance

**2.- Effect of tolerances**

- Take 15 resistors with the same nominal value
- Measure and record the resistance of each one
- Return all the resistors to their proper place
- What is the highest value of resistance? Lowest?
- Calculate the error in % between the nominal value and the value further apart
- Is this error within range? Explain

**3.- Measuring human resistance**

- Configure the DMM to measure resistance
- Grab each lead with a different hand
- If you cannot get a reading, you can by licking your fingers
- The DMM puts 2.8 V between its leads when measuring resistance. Calculate the current that flew through your body when doing this experiment.
- Explain your results
3.- Creating circuits in the solderless breadboard

The figure below shows a picture of a solderless breadboard.

Each pin is interconnected to other pins as shown in the next picture:

In some breadboards, the right and left side of the horizontal pins of rows are not connected together. If this is the case, you must create small jumping wires to connect them.

The horizontal lines are typically reserved for power supply voltages, grounds, etc. The vertical lines are typically used for interconnecting components.
3.a. **Measuring circuits (I).** For the circuit in the figure below:

<table>
<thead>
<tr>
<th>1k</th>
<th>1k</th>
<th>220 Ohm</th>
</tr>
</thead>
<tbody>
<tr>
<td>100 Ohm</td>
<td>1k</td>
<td></td>
</tr>
</tbody>
</table>

- Calculate the resistance between the two open terminals.  \( R_{\text{calculated}} = \)
- Build the circuit in your breadboard
- Measure the resistance between the two open terminals.  \( R_{\text{measured}} = \)
- Calculate the difference in % between the measured and calculated resistance values
- Is this error acceptable? Explain
- Return the resistors to their proper place

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3.b **Measuring circuits (II).** For the circuit in the figure below:

<table>
<thead>
<tr>
<th>10 k</th>
<th>4.7k</th>
<th>22 k</th>
</tr>
</thead>
<tbody>
<tr>
<td>22 k</td>
<td>4.7k</td>
<td></td>
</tr>
</tbody>
</table>

- Calculate the resistance between the two open terminals.  \( R_{\text{calculated}} = \)
- Build the circuit in your breadboard
- Measure the resistance between the two open terminals.  \( R_{\text{measured}} = \)
- Calculate the difference in % between the measured and calculated resistance values
- Is this error acceptable? Explain
- Return the resistors to their proper place
3.c Measuring circuits (III). For the circuit in the figure below:

- Calculate the resistance between the two open terminals. \( R_{\text{calculated}} = \)
- Build the circuit in your breadboard
- Measure the resistance between the two open terminals. \( R_{\text{measured}} = \)
- Calculate the difference in % between the measured and calculated resistance values
- Is this error acceptable? Explain
- Return the resistors to their proper place

4.- Write an individual laboratory report for this activity. Follow the guidelines and examples that are available in the EET 105’s website.