EGR 262

Fundamental Circuits Lab

File: N262L1

**Lab # 1**

**Breadboarding Circuits**

A. **Objectives**

The objectives of this laboratory are to introduce the student to:

1. basic breadboarding and wiring techniques
2. test equipment, including voltmeters, ammeters, ohmmeters, and power supplies
3. potentiometers and LEDs
4. diode modeling
5. circuit documentation and report writing

B. **Materials**

Breadboard

5V Power Supply

Agilent 33401A Digital Multimeter (Two)

100 Ω resistor

10 kΩ potentiometer

LED

C. **Introduction**

The LED circuit shown below (Circuit 1) will be analyzed and tested in lab. The circuit consists of a 5V DC independent voltage source, a 100 Ω resistor, a 10 kΩ potentiometer (R) that will be varied from 0 to 5000 ohms, and an LED. See the ***Presentation for Lab #1*** for more detailed background information.

100 Ω

R

LEDΩ

5 V

+

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Circuit 1

D. **Pre-Lab Tasks**

Include instructions with each step.

1. Use PSPICE to draw a schematic for Circuit 1 below.

* Use part R\_Var for the potentiometer.
* Use a general diode such as the 1N4001 in the Evaluation library, but rename it as LED once it has been placed in the schematic.

1. Use Fritzing to draw a breadboard layout for Circuit 1.
   * Reference: See the file ***FritzingEGR262*** on the course website.
   * Follow the **Basic Rules for Breadboards Produced for EGR 262 labs** listed in reference above.
   * Begin with the standard EGR 262 breadboard layout in the file ***EGR262Breadboard.fzz*** (available on the course website). Assume that 5V and ground are provided to the power rails on the breadboard by the Arduino as shown in the standard breadboard layout.
   * For the potentiometer use the part named ***Rotary Potentiometer (Small)*** in the Input section of the Core Parts library.
   * Save your breadboard layout for Lab 1 (.fzz file) and also export the breadboard as a jpg image to insert in your lab report.
2. Fritzing will have also produced a schematic to match the Lab 1 breadboard above. Rearrange the schematic so that it is neatly presented and all parts are clearly labeled. Again save the file (.fzz) and also export the schematic as a jpg image to insert in your lab report.
3. Also draw Circuit 2 by modifying the schematic above to replace the diode with a diode model consisting of an ideal diode, a resistor R, and a voltage source Vo (use values of Ro and Vo provided by the instructor). Label each component clearly. No breadboard layout is required for this schematic.
4. Derive an expression for the current through the diode in Circuit 2 as a function of the variable resistance, R.
5. Plot the current through the LED as a function of the variable resistance R for at least 10 values of R from 0 to 5000 ohms. Use Excel or MATLAB for all graphs in this course. Graphs must always be properly formatted. Include both the table of values used and the graph in your notebook. **Always** include sample formulas with tables of calculations in Excel or include the program used in MATLAB to generate the table and graph (with comments).

E. **In-Lab Tasks**

Ask the instructor to check your completed pre-lab analysis. If your answers are correct, then you can proceed to the In-lab task.

The In-Lab section should in general include measured data as well as notes regarding lessons you have learned in the lab (for example, if you connected a meter incorrectly, add a note explaning the problem and how it should have been connected.) Keep a detailed recored of what actually occurred in lab, not just your data.

1. Construct Circuit 1. Use the 5V power supply in lab to connect power to the power rails. Do not use the USB connection or the AC/DC adaptor for the Arduino. Use neat wiring practices. Quickly adjust the potentiometer back and forth to see that the circuit is working properly (the LED’s brightness should vary).
2. Measure the exact value of the 100 Ω resistor and record its value.
3. Use a table to record values of I, V, and R for each of the 10 or more values of R used in the Pre-Lab section. Also add a column to the table for LED brightness (this is subjective so you might use a scale of 1-10 for example). For each set of measurements you will need to:
   * Remove the potentiometer from the circuit and adjust its value using an ohmmeter. It may not be possible to adjust it to the exact value desired, so adjust it as closely as possible and record the exact value used.
   * Replace the potentiometer and measure the diode voltage and diode current. Remember that circuit must be broken in order to place the ammeter in series with the diode.
   * Be sure to record at least 3 significant digits for all values.
4. All labs require demonstration. Ask the instructor to check your table of values.

F. **Post-Lab Tasks**

1. Graph the the expected and measured current through the diode as a function of the variable resistance, *R* (on the same graph). Your expected values should be recalculated using the exact resistance values measured in lab. Show the table of values used to generate the graph and include % error between expected and measured current.
2. Discuss how well your in-lab measurements match your pre-lab predictions. Discuss possible reasons for error.
3. Graph diode current versus diode voltage. Discuss how well your diode model matches this graph. Show the table of values used to generate this graph as well. What values of Vo and Ro are implied by your graph?
4. Discuss the purpose of the 100 Ω resistor in Circuit 1.

F. **Report**

A lab report is due one week after the date of the experiment.

* The lab report must be your own work. Copying data, tables, graphs, circuits, etc., from other students is not allowed and will result in grades of 0 on the lab.
* Be sure to follow good practices for presenting all tables and graphs. See the Presentation for Lab #1 for examples.
* The lab report should consist of the following sections:

1. Title Page (include course number & title, lab number & title, date, and your name)
2. Pre-Lab Tasks
   * Include instructions or headings for all items to make the report easy to follow.
3. In-Lab Tasks

* Include instructions or headings for all items to make the report easy to follow.
* Be sure to include comments from lab as well as measured data.

1. Post-Lab Tasks

* Include instructions or headings for all items to make the report easy to follow.