

## ELEC ENG 2E15

### Lab 2

Lab 2 explores the behavior and applications of zener diodes.

#### Objectives

1. Learn about the characteristics of zener diodes.
2. Learn about the use of zener diodes as shunt regulators.

#### Safety

The 10mF capacitor in your parts kit is a polarized capacitor. It MUST be connected in the correct polarity whenever you use it. Do NOT use it if the polarity across it is going to change. Do NOT connect it the wrong way around.

Other than the capacitor you should be sure to check the ratings of any device before using it. Supplying current or applying voltage in excess of device ratings could destroy the device and/or cause minor burns if you touch a device that is “running hot.”

#### Lab Requirements

##### *The Minimum (30 points)*

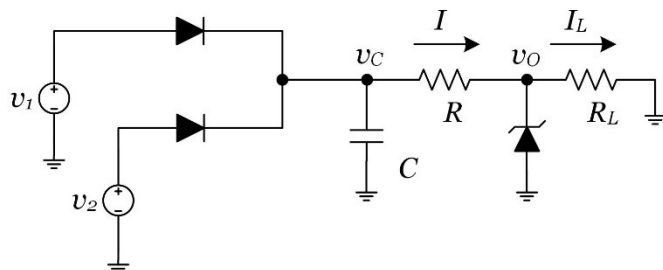
You need to accomplish all the tasks in this section to get a non-zero mark for the lab.

1. Using the setup that you used in Lab 1 or any alternate setup, measure the iv-characteristics of the Zener diode in your parts kit.
2. Take a photograph of your setup. Ensure that your circuit setup is neat and easy to understand from the photo. Include in the photo a label with you name and the date the photo was taken.
3. Look up the data sheet for the Zener diode in your parts kit. From your measurements, determine each of the following quantities and compare with the specifications on the data sheet:
  - a. The Zener breakdown voltage
  - b. The minimum current required to put the diode in Zener breakdown

##### *The Bulk (60 points)*

Do as many of these steps as you wish to get points. Points for each step are specified.

1. (10 points) Simulate the circuit shown here. Set  $v_1$  and  $v_2$  to be 1kHz sinusoids with amplitude 5V with a  $180^\circ$  phase difference between them. Set  $R_L = 340\Omega$ ,  $R = 20\Omega$ , and  $C = 20\mu\text{F}$ . Plot  $v_C$  and  $v_O$ .



2. (20 points) Experiment with changing the values of  $R$  and  $C$ . Explain the changes to the waveforms.
3. (30 points) Build the circuit with  $R_L = 340\Omega$  and with values for  $R$  and  $C$  chosen to produce a working dc power supply. **It is very important that you think and simulate before you build and measure, otherwise you are likely to destroy some devices and may run into safety issues.**

### ***The Max (10 points)***

Redo the simulation with a single source. How do the results change? Increase the amplitude of the source to 8V. How do the results change?

### ***The Bonus (10 points)***

Go back to your measurement of the Zener iv-characteristics. Determine the Zener resistance ( $Z_Z$ ) at the current levels specified in the data sheet and compare with the values given on the datasheet.

### **Report Requirements**

Your report should be submitted in the Avenue Dropbox for Lab 1. Your submission has to be a single pdf file containing:

1. The photograph of your hardware setup.
2. Tabulated or graphed data for part A step 1 (15 points).
3. The values and comparisons for part A step 3 (15 points).
4. Results for part B as follows:
  - a. Step 1: simulation results as graphs
  - b. Step 2: a clear and concise summary of the change in circuit behavior for different values of  $R$  &  $C$
  - c. Step 3: pictures of the graphs of the waveforms measured on the AD2
5. Answers for part C should be given as two clear and concise statements. Pictures for the changed waveforms would help.
6. For part D a summary of the values measured.

### **Deadline**

All deadlines are listed on the course schedule and in the "Labs and Projects" page in the Handbook.