Physics 334
Notes for Lab 1 – DC circuits/Intro to Capacitors

Lab manual sections **1-1, 1-2, 1-3, 1-4, 2-1, 2-3, 2-4**.

Review the material in the syllabus on making lab reports. Your TA will also offer suggestions. In particular, note that the report for this lab is due at the beginning of your lab period next week. Lab reports should be done on engineering paper and include your partner's name as well as your own. Each person should turn in their own lab report.

These notes are meant to be used along side the lab manual. They give clarifications to the procedure and extra hints about questions you need to answer. Each time you build a new circuit, you should make a diagram. Try to mimic the style in the manual: neat but not fussy (no need for rulers!).

1-1. You won't use an old fashioned VOM, but one of your DMMs as the ammeter.

   Measure I and V for a 20k (or two 10k's in series) and a 10k for five points each with the power supply set at about 1 volt intervals. Make a data table and then a plot (by hand is OK). Put values for both resistors on the same plot. From the slope of each line, you should get the corresonding resistance if you plotted it right.

   Think about all of the questions in "Effects of instruments on your readings", but answer the quantitative part in your lab report. Assume that you really do have a VOM in the circuit, with an internal resistance of 200,000 Ω (20,000 Ω/V on the 10 V scale).

1-2. Repeat the procedure in 1-1: measure 5 points spaced about 1 volt apart, and make a plot. You should see a definite curve to your plot.

   On the question of "resistance", think about the difference between the *static* resistance, defined as V/I and the dynamic resistance defined as dV/dI, each associated with a point on the V vs. I plot. What is the dynamic resistance (approximately) at $V = 1$ V? What is it at $V = 5$ V?

1-3. Again, you don't need more than about 5 points (in the forward direction) to see the curve. Since the current increases exponentially with the voltage across the diode, space you measurements out by *doubling* the current at each point. Note: what current does the 1k resistor limit you to? To make things easier, start with the variable resistance R equal to zero, and then add resistance into the circuit. If you make a plot on the computer, it is easy to switch axes to logarithmic to see the effect.

   Then reverse the diode, and see what happens for $R = 0$.

1-4. Show all calculations and measurements. You may only be able to make a resistance that is approximately the correct R_{Th}.

You may do section 1-6 if you have time; you already did 1-5 last week. Skip to Lab 2: Capacitors.

2-1. Use the same circuit for sections 2-1, 2-3, and 2-4. You may or may not have a yellow "mylar" cap. You are supposed to both measure and calculate RC. Follow the suggestion on using the scope in the box; you get better numbers that way.

NOTE: If you are using a 10x scope probe, *make sure that it has its compensation correctly set!* See pp. 62,63 in the manual for a discussion of this. If you don't have the probe set right, your numbers will be off.

When you vary the frequency of the square wave, note how it looks as if you are simply "chopping" the charge/discharge curves off, not changing their shape.

2-3. You may need to use a lower frequency than 100kHz to see much. Answer the impedance question without a calculation, but with a brief discussion. Assume no load on the output. Hint on the triangle wave question: it is *not* a sine wave. What is the integral of a line ($y = ax + b$)?

2-4. Even though the diagram calls for a 15k resistor, you can use the 10k already there.

Hint on measuring the $f_{3\mathrm{dB}}$ point: (a) Set the input of the scope to "GND" and park the trace on the 0% line. (b) Switch the input to "AC" (one of the few times you'll use this setting) and with the frequency well below $f_{3\mathrm{dB}}$ increase the amplitude of the generator so that the peaks reach 100%. (c) Increase the frequency slowly until the peaks drop to about 71%. That frequency is $f_{3\mathrm{dB}}$.

Don't spend too much time on measuring phase shifts; mainly look for the qualitative behavior. The box on triggering is helpful.

Make a table of the attenuation figures, with a column for the frequencies, a column for the *amplitude* relative that at $f_{3\mathrm{dB}}$, and then a column for the *dB attenuation* relative to that at $f_{3\mathrm{dB}}$.

Ignore the box on "Sweeping frequencies" unless you have enough time.