Physics 4700 Experiment 3
Diodes

A sine wave has **no** voltage offset, i.e. the average of $V_0 \sin\omega t$ is 0. The sine wave from the signal generator might have a voltage offset which should be set to **zero** for the experiments below. Similarly the trigular wave from the generator might have an offset which should be **zeroed**. Apply a 1 kHz sine wave for parts 2-4.

1) Measure and graph the current through a diode vs. the voltage applied across it for both forward and reserve biasing voltage. Use a DC power supply, zener diode, resistor(s) and multimeter. The forward current in the diode should not exceed 300 mA. What are the turn-on and breakdown voltages?

2) Build a clipping circuit that limits the voltage swing from -0.6 V to 5.6 V. Use a 1 kΩ input resistor. Derive the 5 V reference from a 5 V source (power supply). Vary the amplitude of the input voltage and capture pictures of the input and output waveforms (3 pictures, 2 waveforms/picture, with time stamp) to **demonstrate** that the circuit satisfies the above spec. Repeat for a triangular input waveform.

3) Build a full wave rectifier. Capture a picture of the input and output waveforms (2 waveforms/picture, with time stamp). Modify the circuit by adding a capacitor so that the output voltage approximates DC and retake the picture. Use your signal generator for the voltage source. Use a transformer to couple the input voltage to your circuit. A transformer has a small serial resistor, resulting in large current flow from the signal generator which could distort the sine wave. You might need to add a resistor (~ 1KΩ) in series between the signal generator and the transformer. If the output waveform is small, swap the input/output of the trannsformer. The lecture note contains an example of the circuit. Almost every electronics book contains example circuit, e.g. Simpson (P187 and P857, experiment 10) and Hayes and Horwitz Student Manual (P76).

Ripple factor may be defined as the ratio of the RMS of the ripple voltage to the absolute value of the dc component of the output voltage. Measure the ripple factor of your circuit and compare it to that expected for an ideal circuit.

4) The following circuit is called a voltage doubler. Build it and find out why it has earned this name. The output is across C1. Pick C such that the output is a constant that double the input voltage and $RC >>$ the period of the input voltage V1, where $R = 1$ MΩ, the input impedenace of the scope. Capture a picture of the input and output waveforms, with time stamp. How could you modify the circuit to make it a voltage quadrupler? Show the circuit diagram and explain how it works.