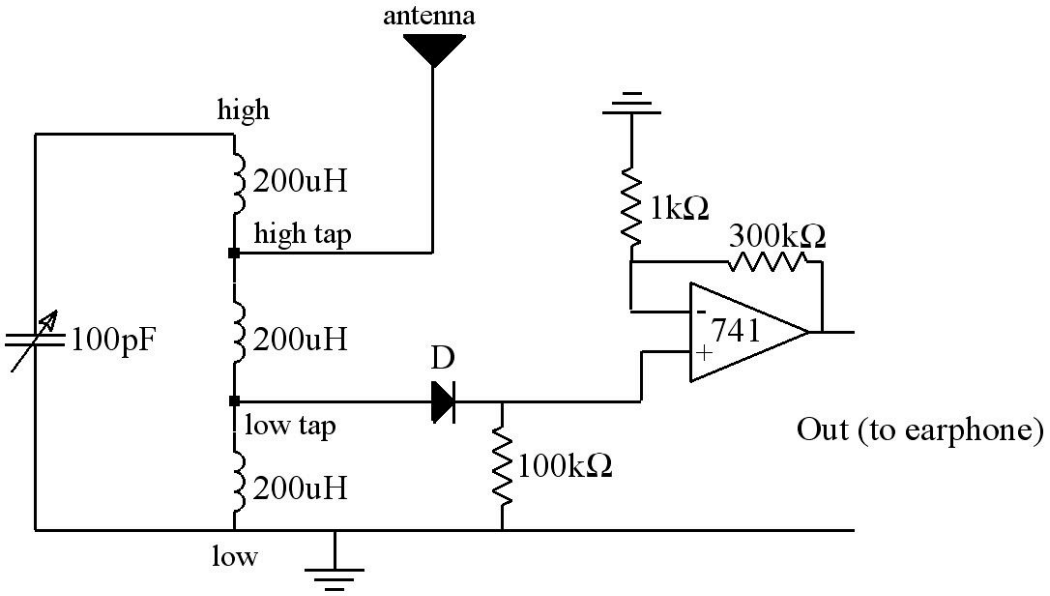
Physics 517/617 Experiment 5
Operational Amplifiers & AM Radio

Basic Experiment - Physics 517/617

1) Build and measure a summing amplifier. The input voltages can be AC or DC.

2) Build and measure an integrating circuit. Test it with sine waves of different frequencies, triangle waves and square waves.

3) The following circuit is an AM radio. Construct it. If you look closely you will also note that it's just an L-C circuit connected to a rectifying circuit amplified by an non-inverting op amp amplifier similar to the ones you designed and built in Experiment 3. The L-C circuit and tunable capacitor are mounted on a pc board available from the lab cabinets. Use a germanium of "Schottky" signal diode.



4) Our laboratory, being in the middle of the building, is in a very poor location for receiving AM signals. A master antenna has been set up by running a 90 ft wire along the outside of the building. Connect the high-tap lead of your coil to this master antenna. With this radio you will be able to receive several radio stations. Below is a procedure, which will help you analyze which station you are receiving.

5) When studying filters we learned that the frequency domain is important for understanding how circuits work. Fast Fourier Transforms is a numerical method for solving coefficients of a Fourier transform. To see how this works use your frequency generator to feed a 500 KHz sine wave into your scope. Using the Matlab ScopeGui program obtain a FFT frequency spectrum of this sine wave. How to the peak frequency and amplitude displayed on the FFT compare with what you measure with your oscilloscope. If a square wave is used what is the observed FFT spectrum and what do you expect it to be?

6) Back to the radio. Obtain a FFT frequency spectrum of the raw antenna wire attached to the oscilloscope. You identify several local radio stations. Local radio station frequencies are available on the FCC webpage linked on our class webpage.

7) With your radio tuned to an AM station (listen for FCC call letters e.g. WOSU) obtain frequency spectrums at the low tap point. Additionally obtain a frequency spectrum directly after the diode on the diagram above. Lastly obtain a frequency spectrum of the voltage driving the earphone. Explain these frequency spectra in terms of the workings of a radio.

8) When you write up this lab include the following:
· A description of the radio in terms of basic building blocks (e.g. detector, amplifier, demodulator).
· A description of demodulation.

You should compare the FFT spectrums with what you expect based on the function of each portion of the radio circuit.

Horowitz and Hill, *Art of Electronics* is a useful reference book for this.
No additional work is required for Physics 617