Physics 4700 Experiment 5
Transistors Radio

1) The following circuit is an AM radio. If you look closely at it you will note that is just an L-C circuit in series with three common emitter amplifiers. Complete the design by choosing R_1, R_2, R_3, R_4, R_5, and R_6. This circuit uses a different biasing scheme than the one described in the write-up "Designing the Common Emitter Amp". The resistors R_1, R_3, and R_5 are the bias resistors. Choose them such that at the operating point 1 to 10 μA flows into the base of each transistor. The other three resistors (R_2, R_4, R_6) determine the gain of each amplifier stage. Choose these resistors to give each stage (transistor) a gain of about 50. Assume the β of each transistor is 100.

There is a "master" antenna in the classroom that runs to the roof of the building. Connect the antenna to the "hi tap" of the printed circuit board (PCB) containing the inductor and variable capacitor.

The above guidelines are very rough and will need fine tuning (no pun) as you go along. If the radio does not work at first, check the DC voltages at the base, emitter, and collector of each transistor. Remember the base should be $\approx$ 0.6 Volts higher than the emitter. You should be able to receive several AM stations including WTVN (610 kHz) and WVKO (1600 kHz).

2) With your radio tuned to an AM station (record which one), capture a picture of the waveforms at the base and collector of each transistor (2 waveforms/picture). What is the gain of each stage (transistor)? Which stage performs amplitude demodulation (what is amplitude demodulation?)?

3) When you write up this section of the lab include the following:
a) A description of amplitude modulation and amplitude demodulation.
b) A description of the radio in terms of building blocks, i.e. detector, amplifier, demodulator.
c) What is the voltage at the base and collector of each transistor?
d) A comparison of your gain calculations with your gain measurements. Measure each gain by injecting a very small sine wave into each base and compare the signal to that at the collector.