Lab 1
Amplifiers, input/output resistance, cascades, and frequency response

Pre-Lab

1. Design the amplifier in question 1.
2. Design the amplifiers in question 5, derive an expression for A_{vo} of the cascade, and compute the expected value.
3. Design the amplifiers in question 6.

Input and Output Resistance

1. Using a LM 741 op-amp, build an inverting voltage amplifier with a gain of approximately 100, and input and output resistances of 1 kΩ (Hint: the circuit is a regular inverting amplifier followed by a series resistor). Measure the resistors and compute an actual theoretical gain, A_{vo}.
2. Attach the function generator directly to the input, and the output directly to a voltagemeter or the oscilloscope input. What are the source and load resistances? Use the DC offset of the function generator to provide an input signal. Measure and plot the output voltage for several values of the input voltage. It should be a linear relationship with a slope of 100. What is the output for zero input? A non-zero output for zero input is related to a DC imperfection in the op-amp which we will discuss in class.
3. Sketch and carry out an experiment to measure the input and output resistances of the amplifier using DC signals. You can use the function generator's DC offset with several suitable series resistors at the input. On the output, attach several suitable load resistors. Compare the results to the actual resistor values.

Frequency Response

4. Next, measure the frequency response of the amplifier. Use a small-amplitude sinusoidal input, gradually increasing the frequency until the gain has dropped significantly. Plot the gain and phase difference between input and output as a function of frequency.

   NOTE: At high frequency you must use a small amplitude input signal. If you notice any distortion of the output causing it to look triangular, reduce the input signal amplitude.

Amplifier cascades

5. Build a two-stage amplifier cascade consisting of two inverting amplifiers, each with a gain of 10 and each with input and output resistances of 1 kΩ. Measure A_{vo} of the cascade.

6. Modify the gains of the individual amplifiers (keeping them identical) to produce an A_{vo} of approximately 100. Measure the new gain.

7. Measure the frequency response of this cascade. Compare the results with the single-stage amplifier and discuss.