Lab 3: AC signals, Complex Impedance, and Phase

Section 1: Impedance matching with a transformer

In this section, we explore AC impedance matching with a transformer.

1a. Measure the output impedance of a signal generator and the input impedance of a speaker. Remember you are using AC signals. What does an AC current from a DVM mean in terms of the waveform? How do you measure current with an oscilloscope? Check this with the oscilloscope.

1b. Then, connect the signal generator to a speaker. (If you turn the amplitude all the way up, you might be able to hear it.)

1c. Measure the signal amplitude with, and without connecting to the speaker. The voltage drops so much because of the impedance mismatch.

1d. Use a transformer to decrease the output voltage, while increasing the output current. Measure the new impedance of your signal generator plus transformer system.

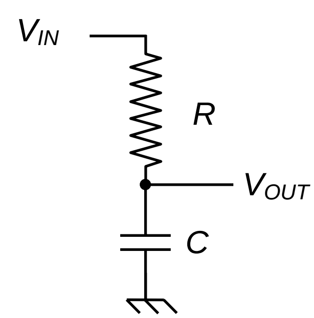
1e. (Same set-up) Connect the output to the speaker, and hear the difference in sound levels. Measure and describe the new output, with and without the speaker load.

1f. (Same set-up) Measure V_{out}, V_{in}, I_{in}, and I_{out}. How well does the transformer transmit power. Does $V_{out}/V_{in} = I_{in}/I_{out}$? What is the ratio of primary turns to secondary turns?

Section 2: The RC circuit

In this section, we take a first look at this important circuit and the concept of phase.

2a. Get two capacitors and measure their individual capacitances. Measure the total capacitance with a capacitance meter when they are in series, and when they are in parallel. Do you get good agreement with what you expect?



2b. Construct the RC circuit to the right, with component ranges R=1-10 kΩ and C=0.001-0.01 μF. Set the function generator at approximately ω=0.1/RC with a square wave and describe what you see. Measure the time constant of the exponential and use it to determine the capacitance of C (R should be determined with a multimeter). Does the oscilloscope affect the measurement?

2c. (Same set-up) Set the function generator to sinusoidal output at ω=1/RC and measure the magnitude of V_{in} and V_{out}. Do you get what you expect ?

2d. (Same set-up) How do you measure phase? Measure the phase of V_{out} with respect to V_{in} and make a Lissajou plot of V_{out} and V_{in}.

2e. (Same set-up) Measure the ratio V_{out}/V_{in} and the phase of V_{out} with respect to V_{in} for a range of different frequencies ω and make log plots for each – part (e) is long, so make sure to allot enough time for it.