ELEC 225: Lab 5

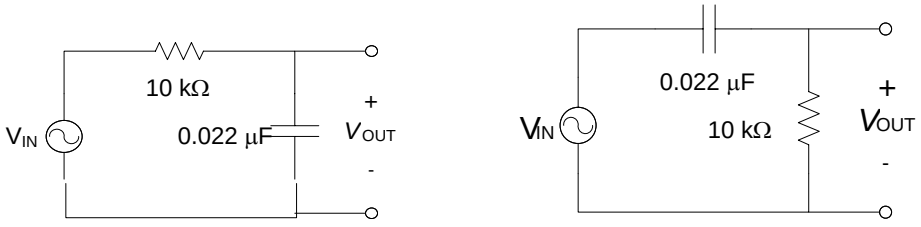
Low Pass Filters

The response of a circuit as a function of frequency may be classified by the way that it "passes" a signal. For example, a circuit that has a larger output at low frequencies than at high frequencies is a *low-pass* filter. A circuit that has a larger output at high frequencies is a *high-pass* filter. Would you please list other filter types?

1. Simulate the circuit shown in Figure 1 using Pspice. Plot the magnitude of the voltage ratio as a function of frequency on a semi-log scale, with the log of frequency on the *x*-axis. Print the plot for your lab notebook. Find the frequency at which the voltage V_{OUT} is 0.707 times V_{IN}.
2. Build the circuit shown in Figure 1a.
3. Using the oscilloscope, measure the magnitudes of V_{OUT} and V_{IN} at a number of different frequencies. (Set the function generator for sine-wave output with an amplitude of 2V peak-to-peak. Connect Channel 1 of the 'scope to measure the output of the function generator. Connect Channel 2 to measure the voltage across the capacitor. Set the 'scope to trigger from Channel 1. Determine the frequency range of interest from the cutoff frequency given by:

$$f = \frac{1}{2\pi RC}$$

Take enough data to graph a curve of the voltage ratio (V_{OUT}/V_{IN}) *vs.* frequency to validate your simulation results. Find the frequency at which the voltage V_{OUT} is 0.707 times V_{IN}. Compare it with the frequency predicted by R and C and your simulation.



(a) **(b)**

Figure 1 – (a) Low-Pass Filter Circuit (b) High-Pass Filter Circuit

Recall that RC is the *time constant* for this circuit. Its inverse turns out to be the (angular) *cutoff frequency* of this *low-pass filter* circuit, in radians/sec. The angular frequency divided by 2π gives you the frequency f in Hz. Is the prediction reasonably close to the frequency where the output/input voltage ratio is 0.707?

4. Build the circuit shown in Figure 1b, and measure the magnitudes of V_{OUT} and V_{IN}. What is the type of this filter?
5. For this circuit, find the frequency at which the voltage V_{OUT} is 0.707 times V_{IN}. Compare it with the frequency predicted by R and C. Is the prediction reasonably close to the frequency where the output/input ratio is 0.707?
6. Review Lab 4 and now test your filters using the soundcard, headphones, and speakers.