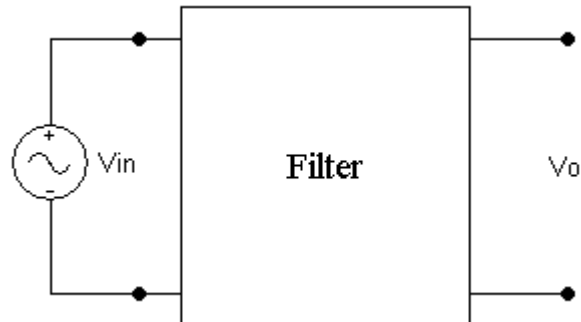


EE 206 Simulation 8

Simple ac Circuits

Background Information

In many circuits involving ac sources, either the frequency of the source may vary or the source is composed of several sinusoidal sources operating at different frequencies. An important type of circuit for working with sources with various frequencies is a *filter*. (See text pp. 672-677.) For a given magnitude of an input source V_{in} , the magnitude of the output V_o of the filter depends upon the frequency.



Filters usually are named based upon the range of frequencies which appear on the output with little change in the amplitude of the corresponding source. For example, a filter which passes low frequency sources relatively unchanged while reducing (attenuating) higher frequency sources is called a *low-pass* filter. Circuits which attenuate low frequency sources but pass higher frequency sources with relatively little change to the amplitude are called *high-pass* filters. Circuits which pass a range of adjacent frequencies (a band of frequencies) while attenuating frequencies both higher and lower than those in the desired band are called *band-pass* filters. Circuits which attenuate a range of adjacent frequencies (a band of frequencies) while passing frequencies outside the desired band are called *band-stop* filters.

An important frequency for a filter is its *cutoff frequency*, the frequency at which the power available at the filter's output is only one-half the power available from the source at frequencies which pass through the filter with relatively little amplitude change. (This frequency is the frequency at which the output voltage is $1 / \sqrt{2}$ of the output voltage of the source at frequencies that have little or no attenuation.) For a band-pass filter or a band-stop filter the difference between the upper and lower cutoff frequencies is called the *bandwidth* of the circuit.

Part I: Low-Pass Filter

Draw the low-pass filter circuit shown in Figure 1 using PSpice Schematics. Set the ACMAG parameter of V1 to 3.3 V. Set the values of R1 and C1 as shown on the figure. Go to "Setup Analysis"->"AC Sweep" and set "AC Sweep Type" to octave, "Total Points" to 1001, "Start Frequency" to 1.0 Hz and "End Frequency" to 10 kHz. Run the simulation. Print out the curve. Find the *cutoff frequency* of this low-pass filter from the curve. Then calculate the *cutoff frequency* by hand. Show that your calculation agrees with the simulation result. Explain how this simple circuit performs as a low-pass filter.

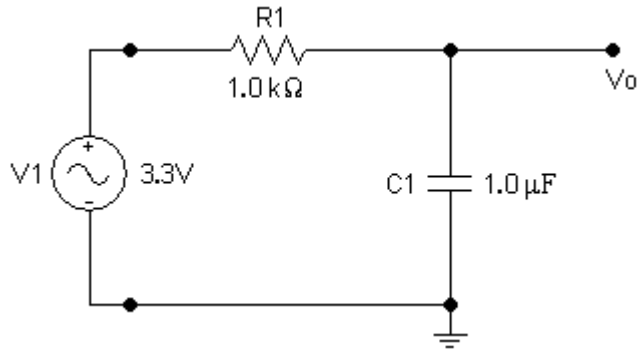


Figure 1. Low-Pass Filter

Part II: High-Pass Filter

Draw the high-pass filter circuit shown in Figure 2 using PSpice Schematics. Set the ACMAG parameter of V1 to 3.3 V. Set the values of R1 and L1 as shown on the figure. Retain the “AC Sweep” setting from before. Run the simulation. Print out the curve. Find the *cutoff frequency* of this high-pass filter from the curve. Then calculate the *cutoff frequency* by hand. Show that your calculation agrees with the simulation result. Explain how this simple circuit performs as a high-pass filter.

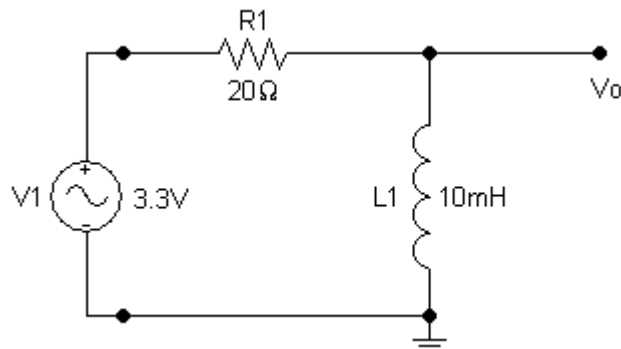


Figure 2. High-Pass Filter

Part III: Band-pass Filter

Draw the band-pass filter circuit shown in Figure 3 using PSpice Schematics. Set the ACMAG parameter of V1 to 3.3 V. Set the values of R1, C1 and L1 as shown on the figure. Retain the “AC Sweep” setting from before. Run the simulation. Print out the curve. Find the *bandwidth* of this band-pass filter from the curve. Explain how this simple circuit performs as a band-pass filter.

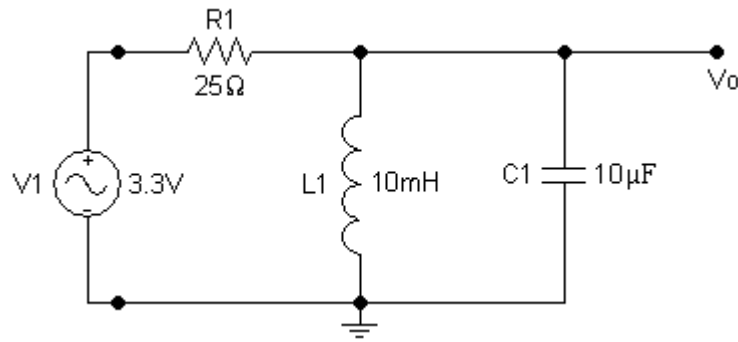


Figure 3. Band-pass Filter

Part IV: Band-stop Filter

Draw the band-stop filter circuit shown in Figure 4 using PSpice Schematics. Set the ACMAG parameter of V1 to 3.3 V. Set the values of R1, C1 and L1 as shown on the figure. Retain the “AC Sweep” setting from before. Run the simulation. Print out the curve. Find the *bandwidth* of this band-stop filter from the curve. Explain how this simple circuit performs as a band-stop filter.

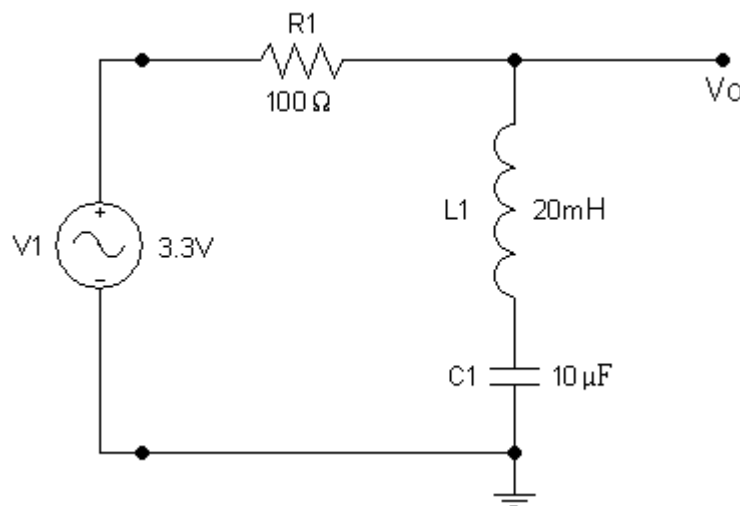


Figure 4. Band-stop Filter

Simulation Report: Your report should include the schematics and the four curves, as well as all your calculations, detailed analysis, and explanations. Your report is due at the beginning of the next lab session.