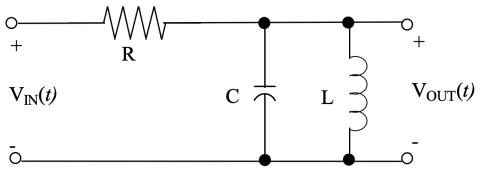
ELE 215 – Lab 6 – Bode Plot of an RLC Filter

Objectives

- More practice on generating a Bode plot, this time with an inductor in the circuit

Notes

- The circuit for today modifies that from Lab 5 by adding an inductor; the result tis a bandpass filter.



Procedure

1. Prelab completion:

   Show your theoretical Bode plot to the TA (each team needs only one plot).

2. Setup:

   a) Collect a resistor, inductor, and capacitor for your assigned values from the bins; measure and record the values for the resistor and capacitor and use the inductor value marked on your device. If the R or C value is far off that assigned to your pair, get a different circuit element and try again. I want you to see a good fit between this experiment and your theoretical Bode results!

   b) The setup is like that of Lab 5; the only difference is the addition of the inductor in parallel with the capacitor. Build the circuit shown above; connect the signal generator to provide a 4-volt (8 V peak-to-peak) sinusoid for the input; connect the scope to observe $v_{in}(t)$ on channel 1 and $v_{out}(t)$ on channel 2; configure the scope's measurement menu to show the frequency of channel 1, the two amplitudes, and the phase shift from channel 1 to channel 2 (CH2-CH1).

3. Take data:

   As part of your prelab exercise you were asked to use the theoretical transfer function to both locate and compute the value of the peak of the magnitude of $H(f)$ and to find those frequencies at which the magnitude response was 3 and 20 dB below the peak. Here you will take data to verify those calculations on a real circuit.

   a) Experimentally find the peak frequency, f_c, the point at which the ratio of the output to input amplitudes is a maximum (for this particular circuit this is 1 and is also the frequency for which the phase difference is zero). If your component

values closely match the desired values, the frequency should be close to your prelab value; if not, search around a little by slowly varying the frequency on the SigGen. Take some care to get as close as you can. Record the frequency as well as the two amplitudes and phase difference on your summary sheet. In your theoretical analysis this peak gain should have been one; with real components you should get something close, but slightly less than one.

b) Experimentally locate the two -3 dB frequencies (in general when the amplitude ratio is 0.707 and, for this circuit, when the phase shifts is $\pm 45°$), one below f_c and one above f_c. Record the amplitudes and phase data on your summary sheet. Repeat for the two -20 dB frequencies (amplitude ratio 0.1). All of these should be close to your prelab values.

c) Finally, fill in a few more data points for a comparison of theory to practice. Pick two frequencies between the -20 dB and -3 dB pairs below and above the peak and another pair between the two -3 dB points and f_c.

4. Reporting results:

a) You now have 9 pairs of magnitude and phase values; it's time to generate a nice Bode plot. Specific ally, modify your prelab script to do the following:
   - Regenerate the Bode plot from your prelab exercise using the measured R and C and provided value of L as a solid line.
   - Add your measured data using clearly visible symbols (NO connecting line).

   Your measured data and Bode plot using the measured R, L, and C should match pretty well; if not, go back to lab and redo the measurements.

   As from Lab 5 make this plot pretty and easy to read (axis labels, large font, etc.). Print your plot and attach it to the summary sheet as a single page.

b) In Recitation 8 I talked briefly about teamwork. Can you identify one thing you did well as a team? And don't give vague answers such as "we worked really well together"; I want one very specific thing that you did do well.

5. Submission:

a) Scan both sides of the summary sheet plus the Bode plot, producing a single 3-page pdf document. Upload this single document to the ELE 215 Brighspace site.

b) Please use the following convention for the filename, substituting your's and your teammate's HW ID numbers:

Lab_6_789_321.pdf