Physics 320 - Fall 2017
LAB 5 - The Series and Tank LRC Circuit

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Objectives: Understand the frequency dependence of LRC circuits. Get more practice using the equipment.

To Turn In: The lab sheets with the specified information, the answers to the questions, and any graphs asked for in the lab.

As always, you should do the lab in your notebook and only transfer final data and answers to your data sheet when you are happy with it.

Part 1 - LRC Series Circuit

Write down the complex transfer function, $\mathbf{H}(j\omega)$, for the circuit shown below and sketch its magnitude, $|\mathbf{H}(j\omega)|$, as a function of ω in your lab notebook.

Construct the circuit below and measure its characteristics as a function of frequency (starting from 10 Hz, if possible, and ranging to at least 1 MHz). As before, do a quick scan of frequencies (10 Hz, 100 Hz, 1000 Hz, etc.) and then fill in the details. Make a rough plot of the amplitude ratio ($V_{\text{out}}/V_{\text{in}}$) versus frequency in your lab notebook. The amplitude and the frequency should be plotted on logarithmic axes. Pay particular attention to and identify if the phase is leading or lagging, i.e. $\pm\phi$. In the second and third steps you will repeat the experiment with different component values.

Make plenty and good and plenty good measurements near the resonance peak.

A. Construct and measure the circuit as described in the paragraph above, use the following values for the components: $L = 10$ mH, $C = 0.1\mu$F, $R = 330\Omega$. **Carefully measure the phase difference between the input and output signals.** It should be a smooth, continuous function.

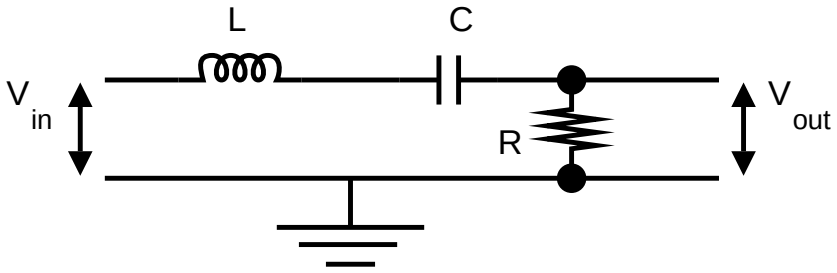

Figure 1: LRC Series Circuit

B. Construct the circuit using the following values for the components: $L = 10$ mH, $C = 2$ nF, $R = 330\Omega$. Measure only $V_{\text{out}}/V_{\text{in}}$ (not phase).

C. Construct the circuit using the following values for the components: $L = 10$ mH, $C = 2$ nF, $R = 10,000\Omega$. Measure only $V_{\text{out}}/V_{\text{in}}$ (not phase).

D. Using your favorite plotting program, plot $|\mathbf{H}(j\omega)|$ vs. ω and ($V_{\text{out}}/V_{\text{in}}$) vs. ω from your data from part A on the same graph. If you can, plot the phase on the same graph. Otherwise, plot the phase on a separate graph. (I don't want you to spend a lot of time trying to get the phase on the same plot as the transfer function.)

Part 2 - The LRC Tank Circuit

Write down the transfer function, $\mathbf{H}(j\omega)$, for the circuit shown below and sketch $|\mathbf{H}(j\omega)|$ as a function of ω in your lab notebook.

Construct the tank circuit shown below. Again measure its amplitude and phase response as a function of frequency. Use $L = 10$ mH, $C = 2$ nF, $R = 10,000\Omega$ for the components.

Using your favorite plotting program, plot $|\mathbf{H}(j\omega)|$ vs. ω and $(V_{\text{out}}/V_{\text{in}})$ vs. ω from your data on the same graph. If you can, plot the phase on the same graph. Otherwise, plot the phase on a separate graph. At this point, I don't want you to spend a lot of time trying to get the phase on the same plot as the transfer function. You should learn how to plot more than one quantity on the same graph though. This is not the same as plotting two curves for the same quantity on a single graph; you should already know how to do that.

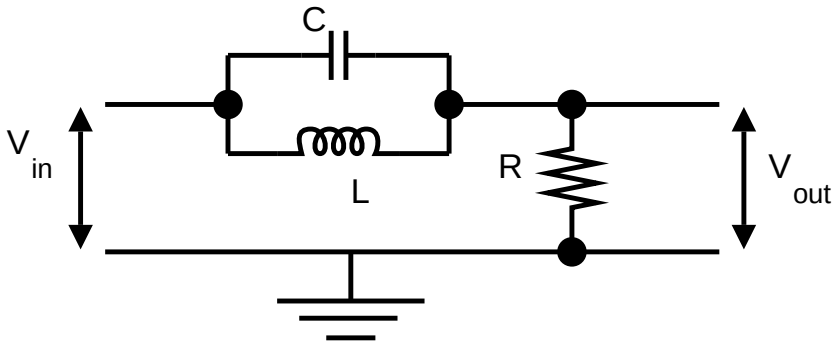

Figure 2: LRC Tank Circuit

Name_____

Date_____

Data Sheet for Electronics Lab 5 - The Series and Tank LRC Circuit

Part 1 - LRC Series Circuit

Circuit A
Component Values:

frequency ( )	V_{out} ( )	V_{in} ( )	V_{out}/V_{in}	phase ( )	Notes

Circuit B
Component Values:

frequency ( )	V_{out} ( )	V_{in} ( )	V_{out}/V_{in}	Notes

Name_____

Date_____

Data Sheet for Electronics Lab 5 - The Series and Tank LRC Circuit

Circuit C
Component Values:

frequency ( )	V_{out} ( )	V_{in} ( )	V_{out}/V_{in}	Notes

Part 2 - The LRC Tank Circuit
Component Values:

frequency ( )	V_{out} ( )	V_{in} ( )	V_{out}/V_{in}	phase ( )	Notes