# Phys 223

**Preliminary:**

You will need 1 power amplifier, 1 computer (to control the power amplifier and make measurements), a circuit board, electric components (R = 10 , L, C = 100 F), wires, and 2 voltage sensors.

* Connect R, C and the power amplifier in series. Set the power amplifier to generate a sine wave. Make sure that the amplitude doesn’t go beyond 6 V. Take measurements and draw a phasor diagram for VC, I, and VR. Is it as expected? Does it change with frequency? Try at least 3 different values of f, e.g. 20 Hz, 40Hz, and 60 Hz.  
  To make your measurements use a scope within DataStudio. Select time along the horizontal axis, and the voltages VR, and VC along the vertical axis.
* Connect R, L (without the iron core) and the power amplifier in series. Take measurements and draw a phasor diagram for VL, I, and VR. Is it as expected? Does it change with frequency? Again try with 20 Hz, 40 Hz, and 60 Hz.

**RLC forced oscillations:**

* Connect R, C and L(initially without the iron core) in series as shown below.

Power amplifier

I= Iocos(t - )

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V = V0cos(t)

L

R = 10 

C = 100 F

**Experiment**

* Select a frequency (e.g. 100 Hz). Measure the voltages VR and VC. Record the phase difference between VR and VC. Make it clear which signal is ahead of the other. Does the value of the phase depend on the frequency (i.e. vary the frequency and see what happens)?
* Repeat the above procedure with R and L.
* You will now take measurements to find the value of L in two cases: L without and with a core.  
  + For each case, as you vary the frequency, measure the amplitudes of V and VR. Make sure that you go through the resonance bump (maximum amplitude of VR). Try to find the exact resonance frequency (where the curves VR and V are exactly in phase). Record your measurements in data tables.  
    Note: increase the frequency in increments of 5 to 10 Hz. For L without a core, start at about 50 Hz. For L with a core, start at about 10 Hz.
  + Another way to find the resonance frequency is to plot VR versus V on the scope. At resonance frequency, the display is a straight line. Find the two resonance frequencies using this approach.

**Theory.**

* Draw a phasor diagram for the circuit at t = T/6, where T = 2/ is the period. Indicate the length of each phasor in terms of V0, Io, L, R, C and . Assume that LC
* Mark the angle  between V and VR on your diagram. Why is this angle the angle  that appears in the expression of the current?   
    
   is positive if V is ahead of VR. What is the sign of ?   
    
  Give its tangent in terms of L, R, C and .
* Find Io in terms of V0, R, L, C and .
* Find the value of  that makes the current maximum. Draw the phasor diagram in that case. Indicate the angle  on your diagram. Use this formula to find L(fresonance).
* Show that at resonance the plot VR versus V is a straight line.

**Data analysis:**

For the two cases (L without and with a core), plot the ratio . versus the frequency. What are the resonance frequencies? Do they match what you find by measuring directly the resonance frequencies (i.e. by getting the graph of VR versus V to be a straight line)? What are the values of L?

**Write up:**

## Abstract

## Preliminary

Data:

1. Give the measurements that you found for the phase differences.
2. Organize your measurements of VR and V0 and f in two tables.
3. Plot the two graphs.
4. Give your direct measurements of the resonance frequencies.

Theory:

Write your answers to the questions listed in the theory section above.

Results:

Give the two resonance frequencies from your graphs. Compare them with your direct measurements. Give the two values of L that you found.