

UNIVERSITY OF CALIFORNIA  
College of Engineering  
Department of Electrical Engineering and Computer Sciences

EE 105  
Spring 2010

Prof. Pister

**Prelab for Lab #10**

Due before your lab section, week 13

**Problem 1:** Assuming that you want to make a 100 $\mu$ H inductor by winding 24 gauge wire around a circle. The wire has a radius of 0.25mm, and a resistance of around 0.1 Ohms/meter.

Calculate the number of turns you need to get  $L=100\mu\text{H}$  if  $R=5\text{cm}$ ,  $a=0.5\text{mm}$ , and calculate the corresponding resistance of that much wire.

Plot the magnitude of the impedance of your inductor (with wire resistance) over the frequency range from 1 to 100 Mrad/sec.

On the same plot, plot the magnitude of the impedance of a 100pF capacitor.

**Problem 2** If you connect the inductor and capacitor in parallel to form an LC tank, what is the resonant frequency in radians/sec and Hz?

What is the impedance of the inductor at the resonant frequency of the tank? What is the impedance of the capacitor at the resonant frequency of the tank?

What is the Q of the inductor (the impedance at resonant frequency divided by the wire resistance)?

What impedance do you expect for the tank at resonance?

**Problem 3:** When you build your inductor, it will not be exactly the magnitude you expect. Plot the magnitude and phase of a high-pass LR filter with a 100 $\mu$ H inductor and a 1kOhm resistor. Thinking about this plot, how would you make measurements in the lab to estimate the inductance of a coil that you built?

**Problem 4:** Similarly, your LC tank will not be at the exact frequency you expect. Plot the magnitude and phase of a band-pass filter using your tank in series with a 1kOhm resistor. Thinking about this plot, how would you make measurements in the lab to estimate the center frequency of your tank? Is 1kOhm the right resistance to use?