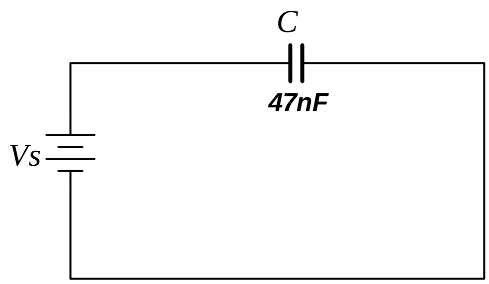
MASSACHUSETTS INSTITUTE OF TECHNOLOGY
22.071/6.071 Introduction to Electronics, Signals and Measurement
Spring 2006

Laboratory 10. Capacitors and Inductors

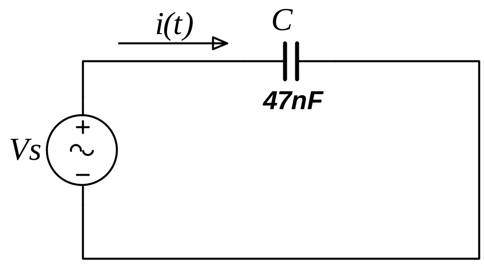
First let's investigate the DC characteristics of a capacitor.

Using a 0.047μF capacitor construct the following circuit. With your ampere-meter measure the current in this circuit for *Vs*=5V and *Vs*=15V.



Is the measured value of the current what you expected?
Why?

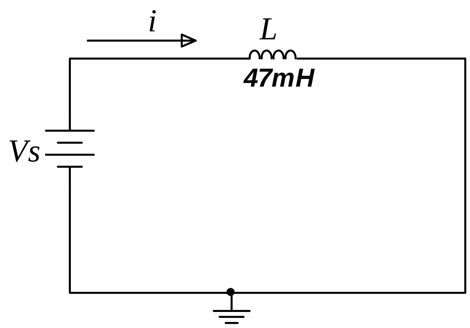
Now apply the sinusoidal voltage signal $Vs = 2\cos(1000\ 2\pi\ t)$



Determine the expression for the current *i(t)*

How would you measure this current *i(t)* using your laboratory instruments?

Next let's use a 47mH inductor to construct the following simple circuit



For *Vs*=5 V what do you expect the current *i* flowing in the circuit to be and why?

Now try to measure the current. What value to you measure?

Does it agree with your expectations?

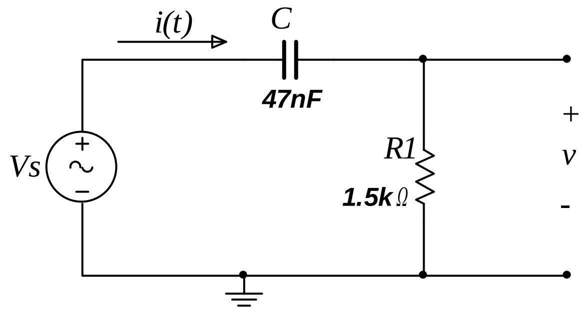
Why not?

Based on the measured value for the current construct a simple non-ideal circuit model for your inductor. Show your component values.

Now measure the resistance of your inductor.

Does it make sense now?

Now let's investigate the following circuit. Even though this is a new circuit for us we will investigate it as a motivation for the upcoming material and in order to enhance our current understanding of reactive elements.



Again apply the sinusoidal signal $Vs = 2\cos(1000\ 2\pi\ t)$.

As we learned in class, the current flowing through the capacitor and the voltage across it are out of phase.

We can look at the signal Vs with our scope, but in order to see the form of the current signal *i(t)* we will look at the voltage, *v*, generated across the resistor. As we will learn starting next class, the presence of the resistor alters the phase difference between the voltage and the current.

Apply the sinusoidal signal $Vs = 2\cos(2\pi\ f\ t)$ with a frequency of 1kHz and observe it along with the voltage *v* with your oscilloscope.

In the space below draw the general characteristics of the two signals.

Now look at the amplitude of the voltage *v*. After you account for all relevant parameters what is the corresponding amplitude of the current *i(t)*?

Compare this amplitude with that obtained by the application of the capacitor current-voltage relationship $i = c\frac{dv_c}{dt}$

Now let's change the frequency (while keeping the amplitude constant) of the voltage *Vs* and observe the results.

What happens to the amplitude of the signal *v* as the frequency changes?

What about the phase difference between *Vs* and *v* as the frequency changes?

Draw a plot of the signal amplitude as a function of frequency (just show the trend): keep this observation in mind as we move forward with the analysis of circuits containing reactive elements.