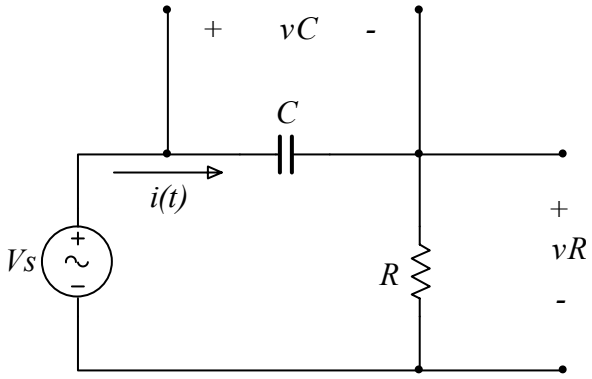
MASSACHUSETTS INSTITUTE OF TECHNOLOGY

22.071/6.071 Introduction to Electronics, Signals and Measurement

Spring 2006

Laboratory 11. Sinusoidal Steady State Response of RC and RL circuits.

We started looking at the circuit below last time but now that we have studied the Sinusoidal Steady State problem we will investigate it in more detail.



We will apply various forms for the voltage *Vs* and measure the response (i.e. look at the voltages *vR* and *vC*.)

Build the circuit with $C = 47\text{nF}$ and $R = 1.5\text{k}\Omega$.

First we will investigate the natural response of the system in order to measure the time constant RC which represents the natural response of the circuit.

To do this we will use a square wave signal for *Vs* of amplitude 5Volts and a frequency of 1kHz. Look at the output *vR* and draw the signal below.

Calculate the RC time constant for the components you use and identify it in the plot you just drew above.

Next we will use the sinusoidal signal $Vs = V_o \cos(2\pi f t)$ and observe the signals *vC* and *vR* for $V_o = 5$ Volts and *f*=1kHz.

Compare the frequency and the phase of the voltages *vR* and *vC* to the source voltage V_s. At these values ($V_o = 5$ Volts and *f*=1kHz) what is the amplitude of the voltage *vC* and *vR*? (use the oscilloscope to try and read the phase by comparing *vC* and *vR* to *Vs*)

Select a frequency ω such that the quantity ωRC=1. At this condition what is the amplitude of the voltage *vC* and *vR* compared to the amplitude of the voltage V_s.

Now change the frequency (while keeping the amplitude constant) of the voltage *Vs* and observe the signals *vR* and *vC* with your oscilloscope. Draw the amplitude of *vR* and *vC* as a function of ωRC

For extra credit: replace the 47nF capacitor with a 47mH inductor and repeat the experiments in this page.