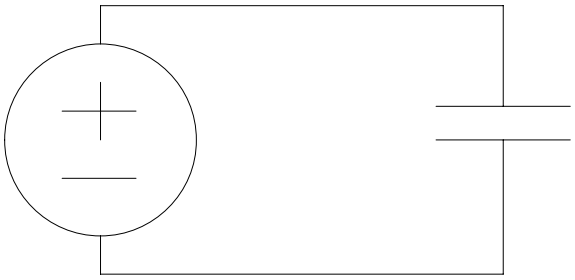
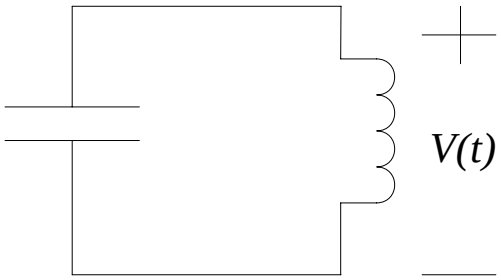
EECS 40
Pre-Lab: RLC Circuits

Name: _____
TA: _____Section: _____

For the first problem, imagine that a capacitor of capacitance C is attached to a voltage source, and fully charged to voltage A:



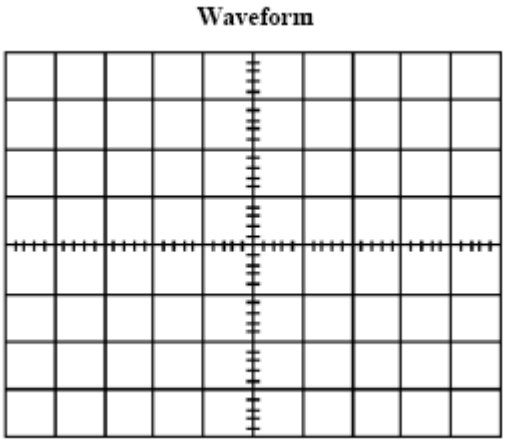
Now, imagine that the charged capacitor is disconnected from the voltage source, and connected to an inductor of inductance L at time t=0, as shown:



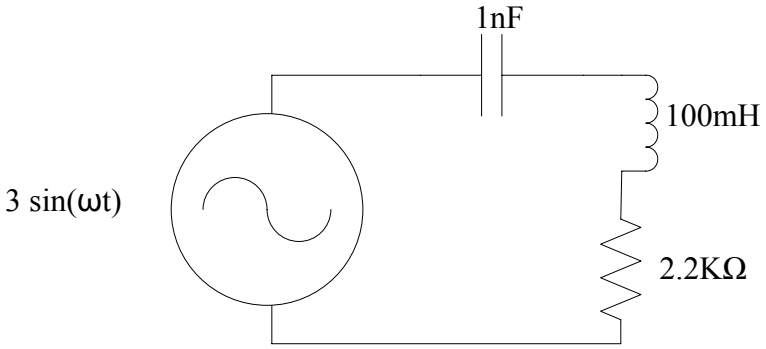
1.
a) Find an equation for *V(t)*.

b) Give the resonance frequency in radians/second and Hz.

c) Sketch *V(t)* on the graph provided.



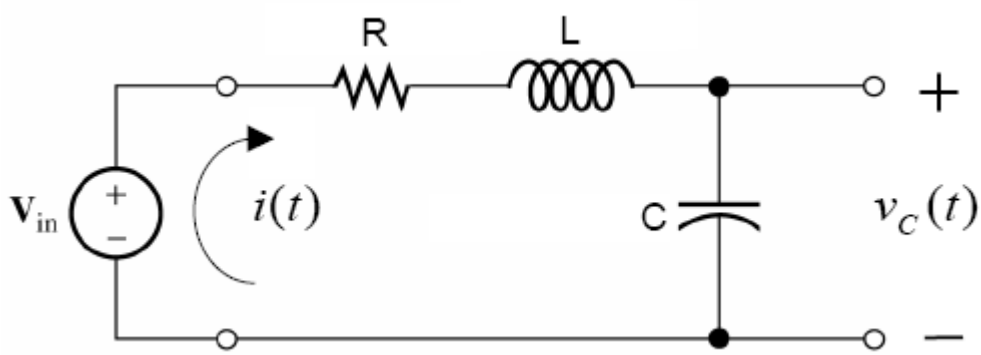
2. Consider the series RLC circuit shown below:



a) Using complex impedance and phasors, solve for the transfer function V_{out} / V_{in} with V_{out} being the voltage across the resister, and V_{in} being the sinusoidal voltage source. What kind of filter is this?

b) Find the resonance frequency in radians/second (ω_0) and Hz (f_0), quality factor (Q), and bandwidth (B) for the circuit. (copy these values onto your lab report)

5. Consider the following RLC (2^{nd} order) circuit.



a. Write the KVL equation for the above circuit. This will be an equation in terms of the components' values, $v_c(t)$, i(t), and their derivatives. Use what you know about capacitors to rewrite your expression as a differential equation in terms of solely $v_c(t)$ and its derivatives.

b. Divide your equation through by the necessary values so that the second-order (d^2/dt^2) term has coefficient 1 (This should now be in the general form from (Eq. 1 in the Lab Guide). What is the resonant frequency ω_0? What is the damping factor α?

c. Let L = 10 mH, C = 1 nF. What is the resonant frequency ω_0?

d. What value of R will result in critical damping? Calculate α. How does this compare to the resonant frequency ω_0?

e. Choose a value for R that will produce the underdamped solution, and calculate α. What is the resonant frequency ω_0? What is the natural frequency ω_n? How long is the period, T, of a wave oscillating at the natural frequency?

f. Repeat part d. for overdamping.