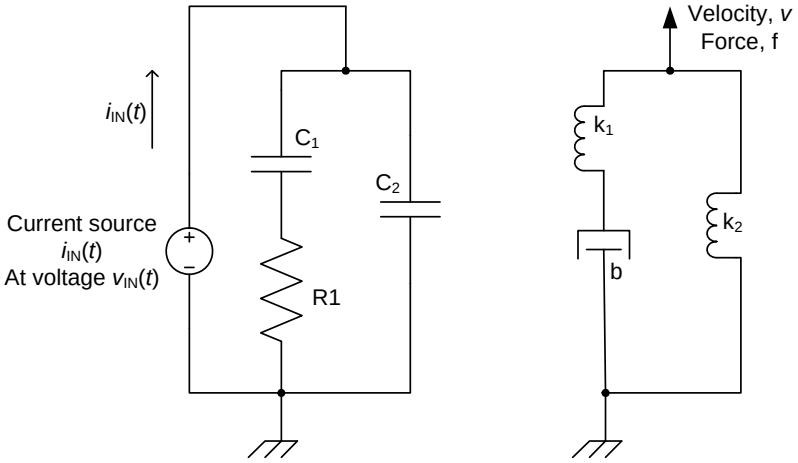
BIOEN 302 Name _____
Autumn 2009

Quiz 2 – Take home

You may leave your answers in terms of C and R, or you may use $R = 50\ \Omega$, $C_1 = 200\ \mu F$, $C_2 = 400\ \mu F$.

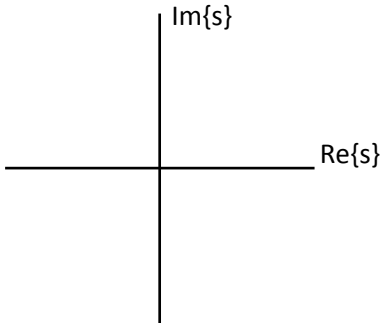
You saw in homework 1 that the unit impulse response of the Kelvin model of viscoelasticity is an exponential curve that decays from $k_1 + k_2$ to k_2 (see figure for spring labeling). The capacitor-resistor arrangement show below has a similar arrangement, capacitors are analogous to springs, and resistors are analogous to resistors. Therefore, one might expect this electric circuit and its mechanical counterpart to behave in the same way.



Schematic drawings of electric circuit (left) and mechanical system (right). Spring constants are represented by *k* and the ratio of force to velocity is *b*.

a) Using frequency-domain analysis, find the impedance of the electric circuit as seen by the current source. Provide the transfer function of the circuit, defining $v_{IN}(t)$ as the output and $i_{IN}(t)$ as the input.

b) Mark any poles or zeros on the complex plane, and state whether the integrator is BIBO stable, unstable, or conditionally stable. Use the circuit's response to a unit impulse or unit step to support your choice.



c) After a unit impulse of velocity has been applied to the mechanical system and transients have been allowed to die out…

· Does the system store any energy?

· In which component(s) is the energy stored?

· Which component(s) determine how much energy eventually stays in the system?

d) After a unit impulse of current has been applied to the electrical system and transients have been allowed to die out…

· Does the system store any energy?

· In which component(s) is the energy stored?

· Which component(s) determine how much energy eventually stays in the system?