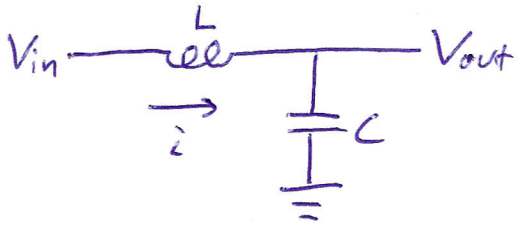
ECE100 Midterm Exam #2 Fall 2012

Question #1

a) Sketch a differentiator circuit using an op-amp, a resistor, and an inductor.
b) Assuming an ideal op-amp, derive the transfer function, and demonstrate that it is a differentiator.
c) Now assuming the op-amp has gain A=G/s, show that the transfer function is second-order.

Question #2

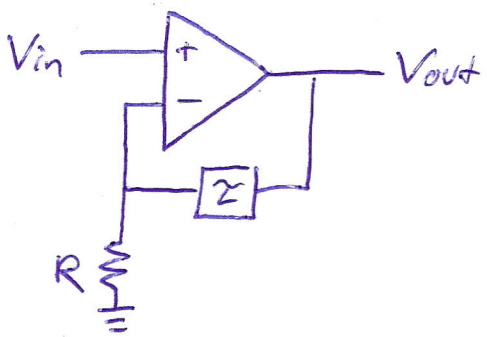
a) Write the current/voltage equations that govern the behavior of the circuit shown below.
b) Express the equations as a signal flow diagram where currents and voltages appear as node values.
c) Use Mason's gain equation to find the transfer function of the circuit from the signal flow diagram.




Question #3

The circuit below has a time delay of $\tau$ in the feedback path.

a) Find the transfer function using a 1st order Pade approximation for the time delay.
b) Now assuming that the op-amp has a gain of A=G/s, show that this is a second order system.
c) If $G=10^5$ rad/sec, what is the shortest time delay $\tau$ that will cause the circuit to be unstable?




Question #4

a) Convert the circuit diagram shown below to that of a simple amplifier with positive feedback.
b) Find an expression for the loop gain AB of your circuit as a function of circuit parameters.
c) What is the relationship between the resistor values for this circuit to work as an oscillator?