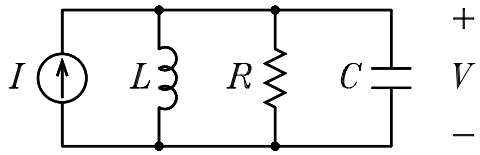
ECE 3050 Analog Electronics Quiz 7

July 1, 2009

Professor Leach Last Name:_____ First Name:_____

Instructions. Print your name in the spaces above. Place a box around any answer. **Honor Code Statement:** *I have neither given nor received help on this quiz.* Initials _____ For credit, you must give all equations that you use to calculate your answers. Credit will not be given for any answer without full supporting work.

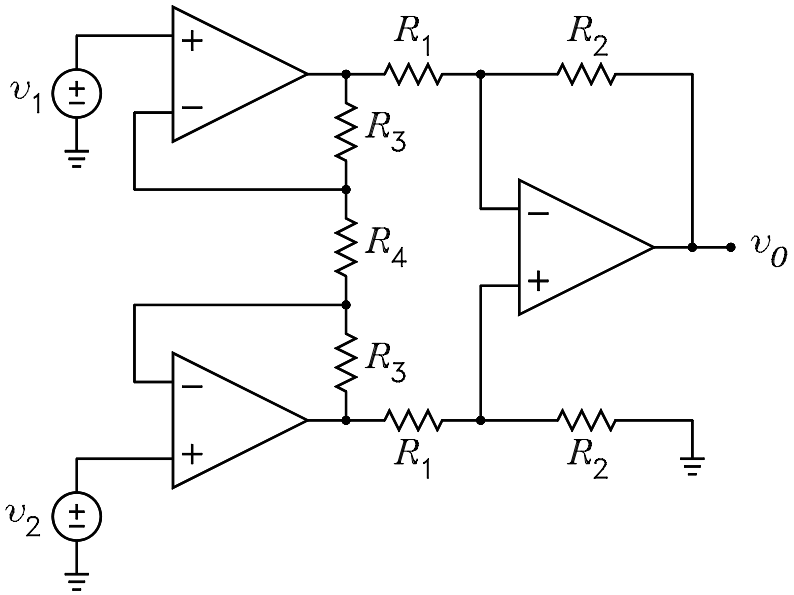
1 of 2. (a) Solve for the differential equation for the voltage V. Consider the current I to be an independent source. (b) Convert the differential equation into the transfer function $T(s) = V/I$.



$$i = \frac{1}{L}\int v dt + \frac{1}{R}v + C\frac{dv}{dt} \qquad \frac{di}{dt} = \frac{1}{L}v + \frac{1}{R}\frac{dv}{dt} + C\frac{d^2v}{dt^2}$$

$$sI = \frac{1}{L}V + \frac{1}{R}sV + Cs^2V \qquad Z = \frac{V}{I} = \frac{s}{\frac{1}{L} + \frac{s}{R} + Cs^2} = R\frac{\frac{L}{R}s}{LCs^2 + \frac{L}{R}s + 1}$$

2 of 2. For $R_1 = 10\,\text{k}\Omega$, $R_2 = 20\,\text{k}\Omega$, $R_3 = 2\,\text{k}\Omega$, and $R_4 = 100\,\Omega$, $v_1 = 0.03\,\text{V}$, and $v_2 = -0.02\,\text{V}$, solve for and label the voltage at each node in the circuit. (There are 7 node voltages to solve for.)



$$v_{N1} = v_1 = 0.03\,\text{V} \qquad v_{N2} = v_2 = -0.02\,\text{V}$$

$$v_{O1} = \left(1 + \frac{R_3}{R_4}\right)v_1 - \frac{R_3}{R_4}v_2 = 21 \times 0.03 - 20 \times (-0.02) = 1.03\,\text{V}$$

$$v_{O2} = \left(1 + \frac{R_3}{R_4}\right)v_2 - \frac{R_3}{R_4}v_1 = 21 \times (-0.02) - 20 \times 0.03 = -1.02\,\text{V}$$

$$v_O = \frac{R_2}{R_1}(v_{O1} - v_{O2}) = 2 \times (1.03 + 1.02) = 4.1\,\text{V}$$