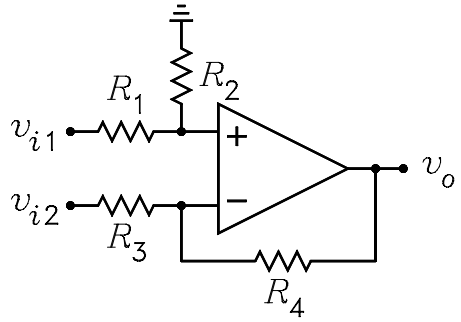
ECE 3040 Quiz 10 – July 27, 2005

Professor Leach Name_____

Instructions. Print your name in the space above. The quiz is closed-book and closed-notes. The quiz consists of two problems. Draw a box around all answers. **Honor Code Statement:** *I have neither given nor received help on this quiz.* Initials _____

1. Use superposition of v_{i1} and v_{i2} to solve for v_o as a function of v_{i1} and v_{i2}.



$$v_o = \frac{R_2}{R_1 + R_2}\left(1 + \frac{R_4}{R_3}\right) v_{i1} - \frac{R_4}{R_3} v_{i2}$$

2. (a) What is the gain of the circuit at very low frequencies?

$$\frac{V_o}{V_i} = -\frac{R_2}{R_1}$$

(b) What is the gain of the circuit at very high frequencies?

$$\frac{V_o}{V_i} = -\frac{R_2 \| R_3}{R_1}$$

(c) Sketch the *expected* Bode magnitude plot using log-log scales: (i) First sketch the straight-line asymptotes and label the slopes in decades per decade. (ii) Label the gains on any straight-line asymptotes that have a zero slope. (iii) Label any pole and zero frequencies, respectively, with the labels ω_{pn} and ω_{zm}, where n and m are index integers. It is a low-pass shelving transfer function with $\omega_p < \omega_z$.

(d) Finally, use the inverting op-amp gain formula to solve for the transfer function for V_o/V_i: (i) Express the transfer function as a gain constant K multiplied by terms of the form $1 + s/\omega_z$ and/or divided by terms of the form $1 + s/\omega_p$. (ii) Give the expressions for K, the ω_z, and the ω_p.

$$\frac{V_o}{V_i} = -\frac{R_2 \| \left(R_3 + 1/Cs\right)}{R_1} = K\,\frac{1 + s/\omega_z}{1 + s/\omega_p}$$

$$K = -\frac{R_2}{R_1} \qquad \omega_p = \frac{1}{\left(R_2 + R_3\right) C} \qquad \omega_z = \frac{1}{R_3 C}$$