University of Michigan
EECS 311: Electronic Circuits
Fall 2008

PROBLEM SET 2

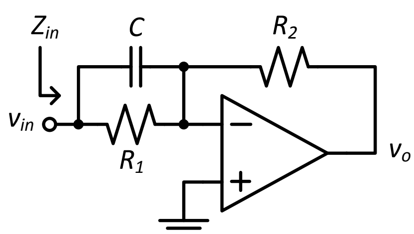
Issued 9/17/2008
Due in Lecture 9/24/2008

J&B refers to the course text: "Microelectronic Circuit Design (3rd Edition)," by Richard Jaeger and Travis Blalock.

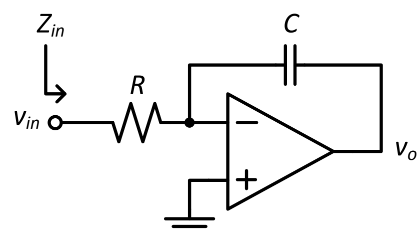
P2.1 Do problems J&B 11.38 and 11.39 assuming the opamps are ideal ($A_0 = \infty$, $R_{IN} = \infty$, $R_{OUT} = 0$).

P2.2 Find the transfer function $A_v = v_o/v_{in}$ and input impedance Z_{in} for the circuits below. Assume the opamps are ideal ($A_0 = \infty$, $R_{IN} = \infty$, $R_{OUT} = 0$).

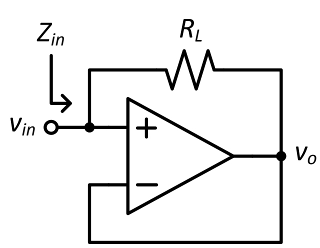
a)



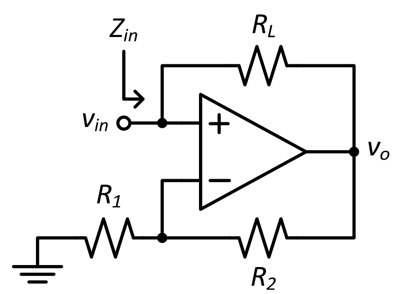
b)



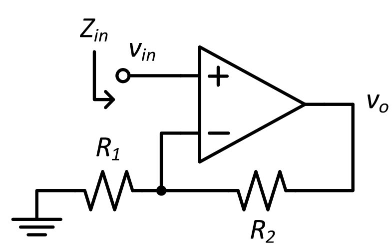
c)



d)

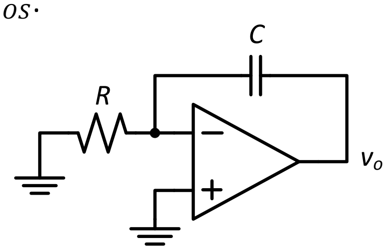


P2.3 Derive an expression for the input impedance Z_{IN} of the non-inverting amplifier below. Assume a non-ideal opamp with finite gain A_0 and input resistance R_{IN}. All other opamp parameters are ideal. Assume that $R_{IN} \gg R_1,\ R_2$ and use this to simplify your expression.



P2.4 For the circuit below, assume the opamp is non-ideal with finite gain A_0 and offset voltage V_{OS}. All other opamp parameters are ideal.

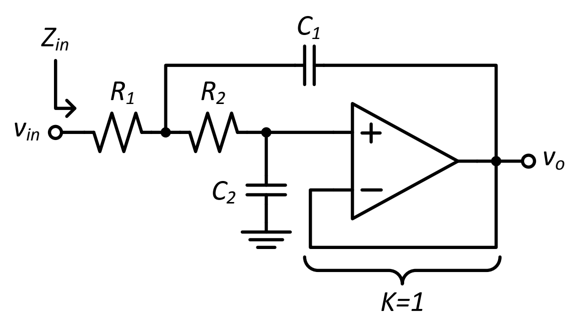
a) Derive an expression for v_o/V_{OS}.



b) Find an expression for the final value of v_o due to the offset voltage. Hint: assume V_{OS} is a step input from 0 to V_{OS} and find the final value of the step response at v_o.

P2.5 This problem analyzes one of the Sallen-Key filter topologies. Assume the opamp is ideal ($A_0 = \infty$, $R_{IN} = \infty$, $R_{OUT} = 0$).

a) Derive expressions for the transfer function $A_v = v_o/v_{in}$ and input impedance Z_{in} when $K = 1$ as shown in the circuit below.



b) Given that $\omega_n = \sqrt{R_1 R_2 C_1 C_2}$, find an expression for d that fits the form of the 2nd-order expression from the Sallen & Key paper:

$$A_v = \frac{K}{\left(\frac{s}{\omega_n}\right)^2 + d\left(\frac{s}{\omega_n}\right) + 1}$$