GEORGIA INSTITUTE OF TECHNOLOGY
School of Electrical and Computer Engineering

Course EE 2250

Electric Circuit Analysis

Assigned: May 20, 1999

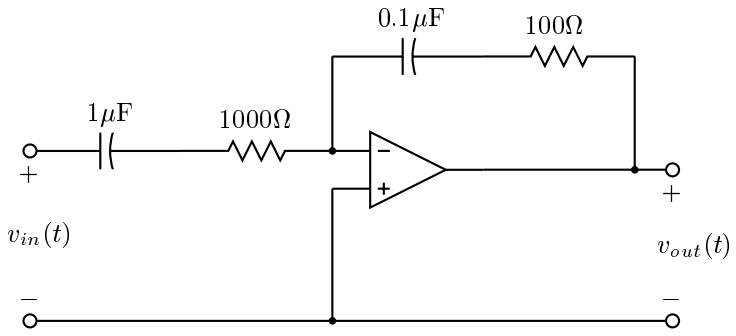
Due: May 27, 1999

Problem Set #8

Reading: Read the following sections from Dorf and Svoboda:
Chapter 10, Sections 10.10–10.11, 10.14; (Node and Mesh Methods)
Chapter 13, Sections 13.3, 13.5 (Frequency Responses of Circuits)

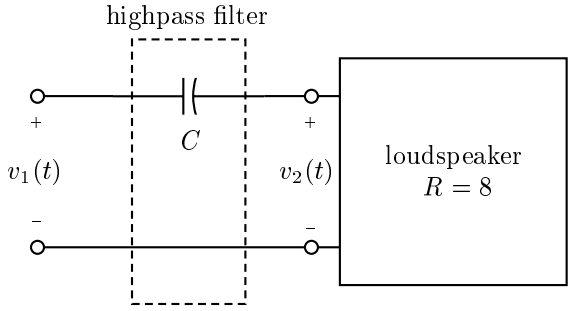
Announcement: Quiz #3 will be held on Thursday, May 27, 1999 during the class hour. Coverage will include that material contained on Problem Sets 5, 6, and 7. This will be a *closed book, closed notes* exam, but you are permitted to use one two-sided 8.5×11 inch handwritten sheet of notes. Calculators are also permitted.

Problem 8.1:



Plot the magnitude of the frequency response of the above circuit.

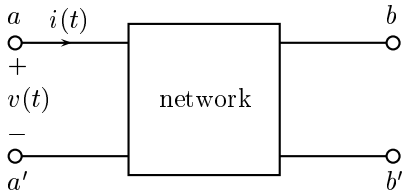
Problem 8.2: Many loudspeaker systems consist of two loudspeakers: the woofer, which reproduces the low frequency part of the signal, and the tweeter, which reproduces the high frequency part of the signal. A crossover network is used to select the high frequency part of the signal and feed it into the tweeter. Such a network functions as a highpass filter. The entire audio signal is applied at the terminals $a - a'$.



(a) Assuming that the equivalent circuit for the tweeter consists of just a resistor with a resistance of R, plot the pole-zero pattern of the system function that relates $v_2(t)$ to $v_1(t)$ and sketch the frequency response curves (magnitude and angle).

(b) If $R = 8\Omega$, find the value of the capacitance C so that the half-power frequency of the highpass filter is 5 kHz ($= 2\pi(5000)$ rad/s).

Problem 8.3:



For the two-terminal pair circuit shown above the relation between $v(t)$ and $i(t)$ is

$$v(t) = i(t) + 3\frac{di(t)}{dt}$$

when the terminals b and b' are open-circuited and

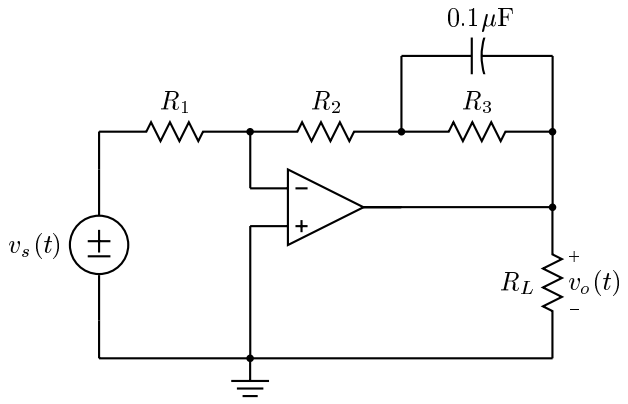
$$v(t) = \frac{di(t)}{dt}$$

when the terminals b and b' are short-circuited. Determine a possible circuit having these properties.

Problem 8.4: In the circuit below the value of R_1 is 10kΩ.

(a) Determine the values of R_2 and R_3 so that the gain (magnitude of the frequency response) at low frequencies is 5 and the gain at high frequencies is 2.

(b) Determine the frequency at which the gain is midway between these two values, i.e. the frequency at which the gain is 3.5.



Problem 8.5: An oscillator is a circuit whose system function has a pair of complex conjugate poles located on the $j\omega$-axis in the s-plane. It is capable of supporting a sustained oscillation, i.e., once started it will continue to produce a sinusoidal output $v_{out}(t)$. In the network below determine the value of K for which the system will oscillate and determine the frequency of oscillation.