GEORGIA INSTITUTE OF TECHNOLOGY
School of Electrical and Computer Engineering

Course EE 2250

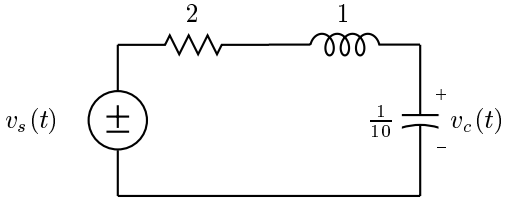
Electric Circuit Analysis

Assigned: February 26, 1999
Due: March 4, 1999

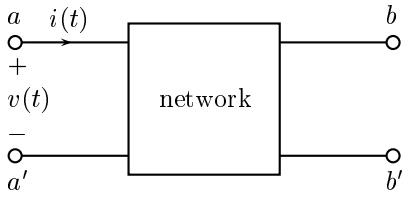
Problem Set #8

Reading: Reread the following sections from Dorf and Svoboda:
Chapter 13, Section 13.6–13.6

Problem 8.1: (a) For the network below determine the system function.
(b) Find $v_c(t)$ for all time if the network is at rest for $t < 0$ and $v_s(t) = u(t)$.
(c) Find $v_c(t)$ for all time if the network is at rest for $t < 0$ and $v_s(t) = 2\delta(t)$.



Problem 8.2:



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

$$v(t) = 3i(t) + 2\frac{di(t)}{dt}$$

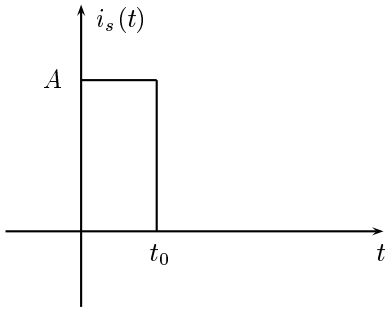
when the terminals b and b' are open-circuited and

$$v(t) = i(t)$$

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

Problem 8.3: In a particular communication problem, data in the form of a sequence of binary numbers "one" and "zero" are to be coded in such a way that a "one" is represented by three cycles of a sinusoid and a "zero" by the absence of a signal. As one part of the transmitter, a circuit with the following specifications is required:

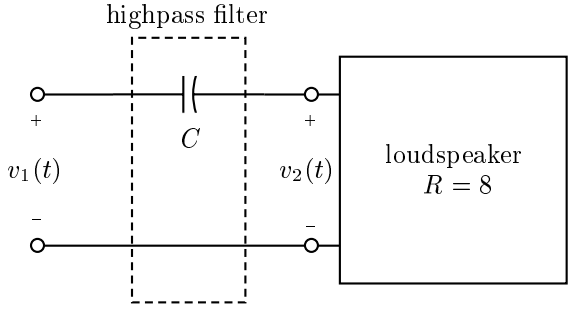
1. The excitation is a current source $i_s(t)$ that is a pulse of amplitude A starting at $t = 0$ and ending at $t = t_0$ as shown below.



2. The response is a voltage $v(t)$. It is two be zero for $t < 0$ and must be given by $v(t) = B \sin \omega_0 t$ for four complete cycles starting at $t = 0$ and be zero thereafter.

Design a circuit that meets the above specifications using only inductors and capacitors. Determine the width of the input current pulse t_0 and values of the inductors and capacitors in terms of ω_0, A, and B.

Problem 8.4: 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 8.5: For each of the pole-zero plots below, determine which, if any, of the sketches of magnitude versus frequency in Fig 8.1 and the sketches of phase versus frequency in Fig 8.2 could result. You should be able to solve this problem by visualizing the appropriate vectors in the s-plane.

Problem 8.6: Determine $H(j\omega)$ from the asymptotic Bode plot below.

Figure 1:

Figure 2: