GEORGIA INSTITUTE OF TECHNOLOGY
School of Electrical and Computer Engineering

Course ECE 2040

Circuit Analysis

Assigned: April 20, 2001
Due: April 27, 2001

Problem Set #13

Reading: There are no new readings from the class notes. The following sections of Dorf and Svoboda cover some topics of the course that are not treated in the class notes:

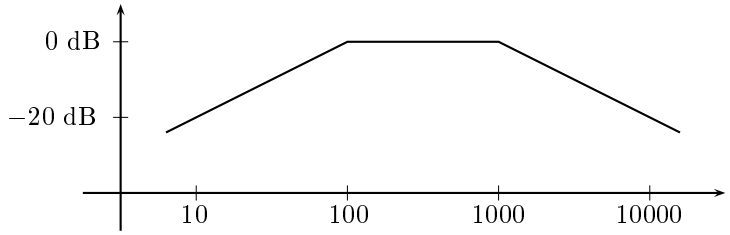
Chapter 16, Section 16.3–16.5

Announcement: The Final Exam will be held on Tuesday, May 1, 2001 from 2:50–5:40 (Period 6). It will be a closed book exam, although calculators are permitted. You may also bring one 8.5 by 11.0 inch sheet of *handwritten* notes. It will cover the entire course.

Problem 13.1: A circuit with the system function

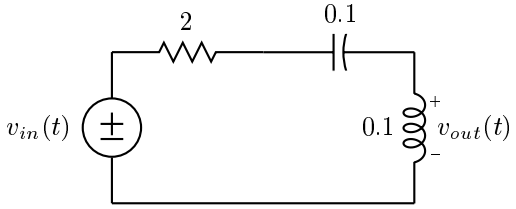
$$H(s) = \frac{ks}{(s+a)(s+b)}$$

has the Bode magnitude plot shown below.



Determine the values of k, a, and b.

Problem 13.2:



(a) Calculate the system function of the above circuit.

(b) Draw the Bode magnitude plot for the circuit.

Problem 13.3:

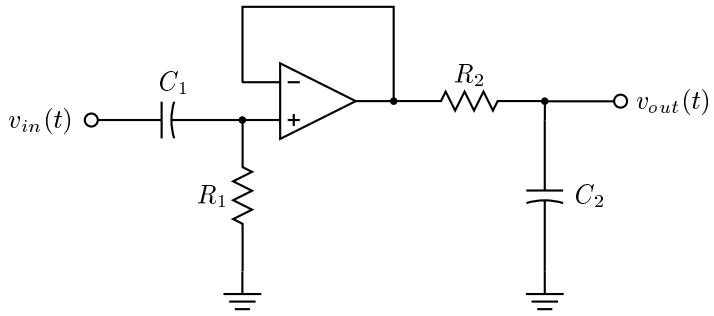


Figure 1: Circuit for Problem 13.3.

(a) Find the frequency response, $H(j\omega)$, of the circuit in Figure 1.

(b) Find values of R_1, R_2, C_1, and C_2 so that the asymptotes of the Bode magnitude plot for this circuit will resemble the one in Figure 2.

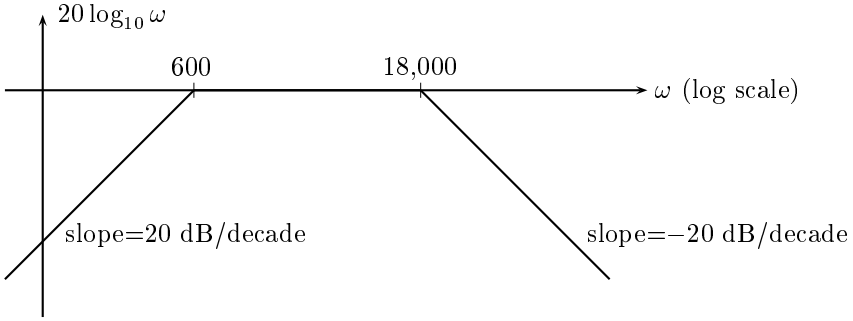
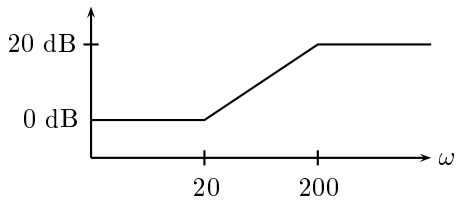
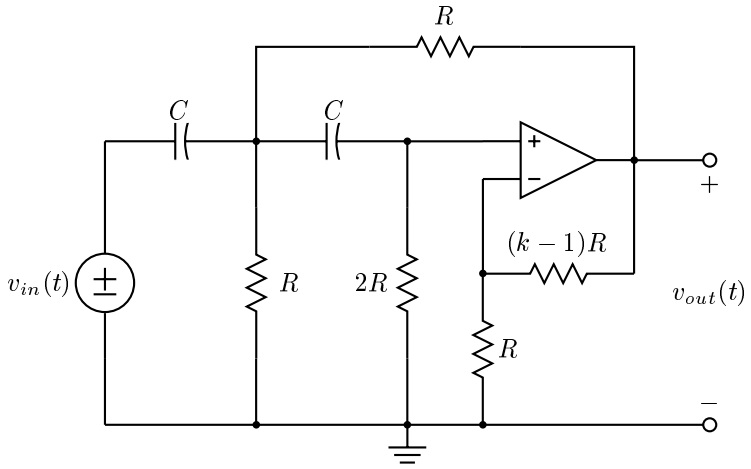


Figure 2: Bode magnitude plot for Problem 13.3.

Problem 13.4: The Bode magnitude plot for a circuit is shown below. We are told that all of the poles of the system and all of its zeros have negative real parts (i.e., they lie in the left-half of the s-plane). Determine the system function of the circuit.



Problem 13.5:



The circuit above implements a second-order highpass filter with the system function

$$H(s) = \frac{ks^2}{s^2 + \frac{3-k}{RC}s + \frac{1}{R^2C^2}}.$$

When $k = 1.586$, the filter is a Butterworth highpass filter.

(a) Select values for R and C so that the cutoff frequency of the filter will be 10kHz. (The cutoff frequency is also the break frequency on the Bode plot. It is also sometimes called the half-power frequency.)

(b) For these values of R and C, what is the high frequency gain of the filter?