EE40 Midterm 2
Spring 2006
Professor Chang-Hasnain

Total Time Allotted: 80 minutes
Total Points: 100

1. (20 pts) Match the transfer function to the Bode plot. Each transfer function matches to exactly one Bode plot. Also there is no partial credit for this question

a. $H(f)=\dfrac{1}{\left(\dfrac{jf}{100}\right)^2+0.5\left(\dfrac{jf}{100}\right)+1}$	b. $H(f)=\dfrac{1}{\left(\dfrac{jf}{100}+1\right)^2}$	b. $H(f)=\dfrac{1}{\left(\dfrac{jf}{1000}+1\right)}$
d. $H(f)=\dfrac{1}{\left(\dfrac{jf}{100}+1\right)}$	e. $H(f)=\dfrac{1}{\left(\dfrac{jf}{100}\right)^2+1}$	

<u>Mark your answer here Magnitude Plot(dB)</u>

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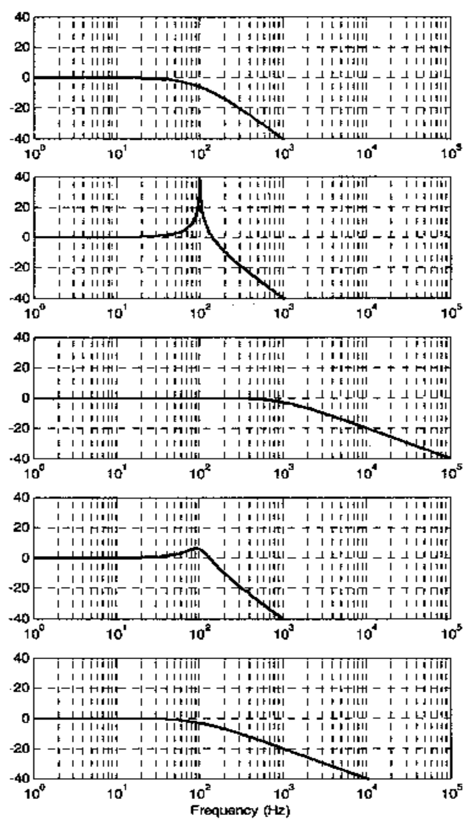

Mark your answer here Phase Plot(degrees)

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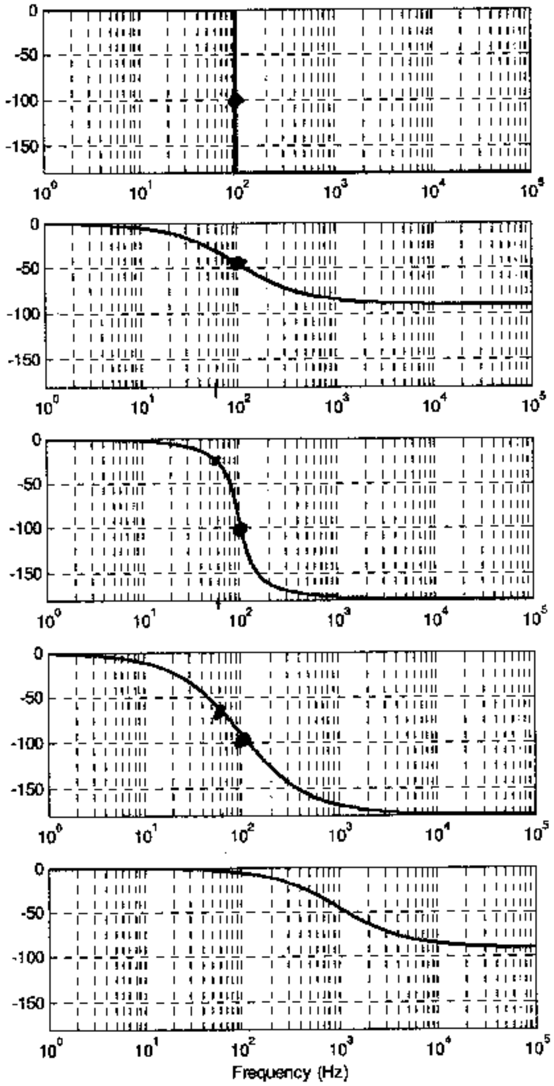
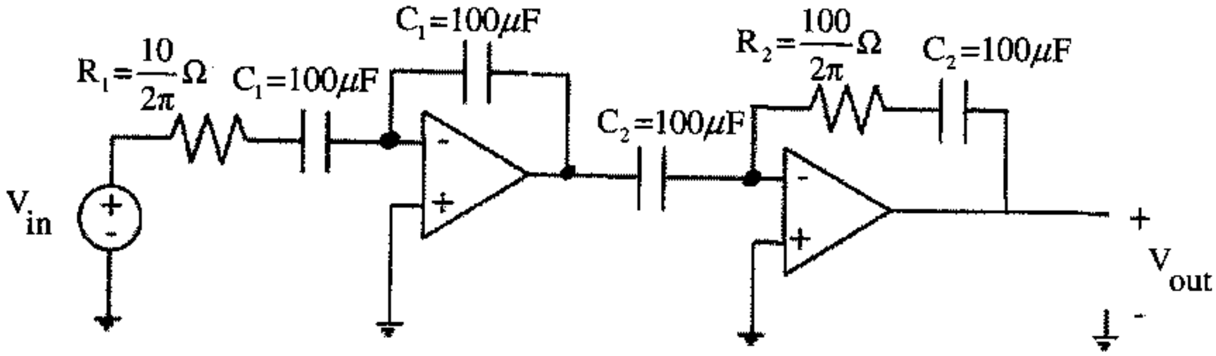


2. (35 pts) The circuit schematic for a functional block known as a lead compensator is:



a. (15 pts) Let $R_1 = 10/(2\pi)$ ohms, $R_2 = 100/(2\pi)$ ohms, $C_1 = 100$ uF, and $C_2 = 100$ uF. Show that the transfer function of the circuit shown above is:

$$H(f)=\frac{\frac{jf}{100}+1}{\frac{jf}{1000}+1}$$

b. (12 pts) In the following table, write the magnitude and phase values for H(f) for f=100Hz, f=1000Hz, very low f values (f →0 Hz) and very high f values (f →infinity Hz). These answers only need to be within 1.5 times the correct answer (but only because of rounding errors or sketching inaccuracies that you might have. Do not use the "straight line" approximation if it will cause your answer to be off from the exact value by more than 1.5 times).

f value (Hz)	$10\log\|H(w)\|^2$	ang H(w)
Very low f		
f = 100 Hz		
f = 1000 Hz		
Very high f		

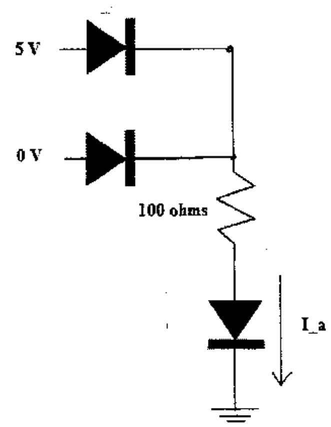
c. (8 pts) Sketch the bode plot of this transfer function. Sketch BOTH the magnitude and phase plot. Make sure to label the slopes of segments, the two break points of the transfer function, the low frequency magnitude, the nigh frequency magnitude, and the highest value on the phase plot. Be as accurate as you can, i.e., do not use the “straight line” approximation except as a starting guide if you wish for plotting the actual transfer function.

3. (15 pts) Find the unknown values in the circuits below. For the diodes, use the "0.8V On-Off" model:

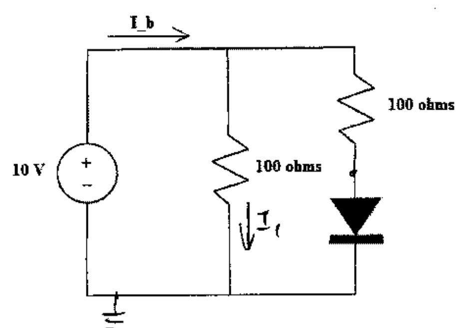
If I_d <0, then the diode is open or OFF

If I_d >=0, then the diode is a 0.8V source or ON

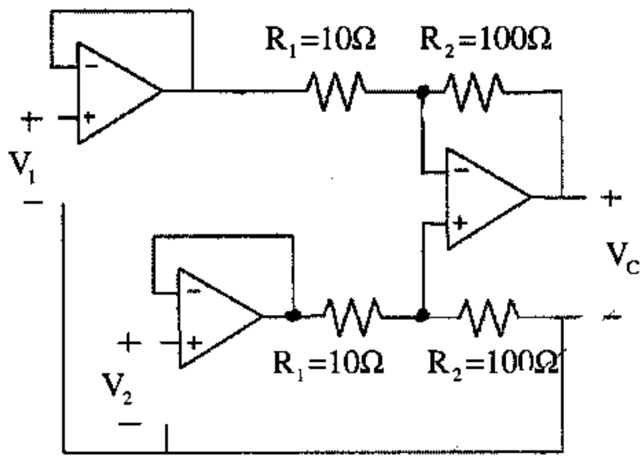
a. (5 pts) Find I_a in the circuit below:



b. (5 pts) Find I_b in the circuit below:



c. (5 pts) Let R_1 = 10 ohms and R_2 = 100 ohms. Find V_c in the circuit below, in terms of V_1 and V_2:

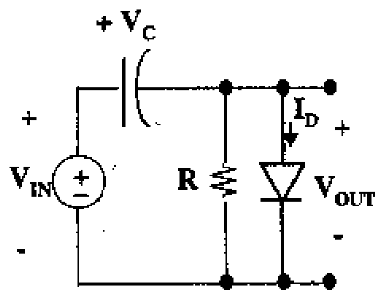


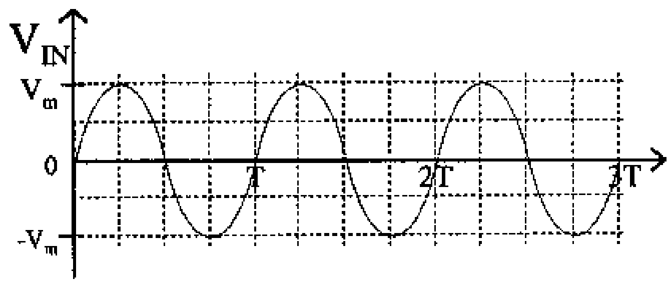
4. (30 pts) Consider the circuit shown below, in which <u>the RC time constant is very long compared to the period T of the input $V_{in}(t)$</u>. Use the Ideal Diode model:

If $V_D<0$, then the diode is OFF and does not pass current ($I_D=0$)

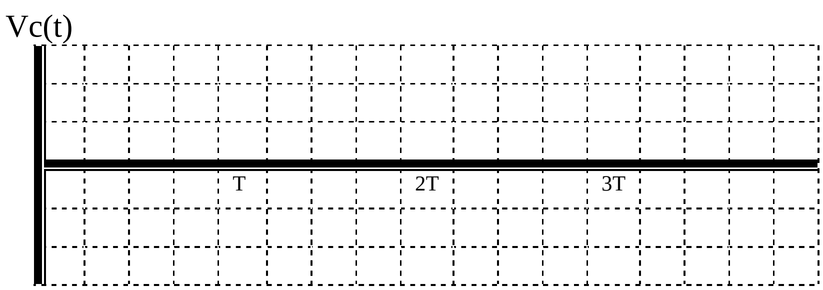
If $I_D>0$, then the diode is ON and $V_D=0$

V_D is the voltage drop across the diode and I_D is current through the diode. $V_D=V_{out}$ in this problem. Analyze the following circuit. Given $V_{in}(t)=V_m\sin(2\pi/T)$ for t>0 and $V_c(t=0^-)=0$.





a. (8 pts) sketch $V_c(t)$? Label all key values.



b. (8 pts) Sketch $V_{out}(t)$? Label all key values.

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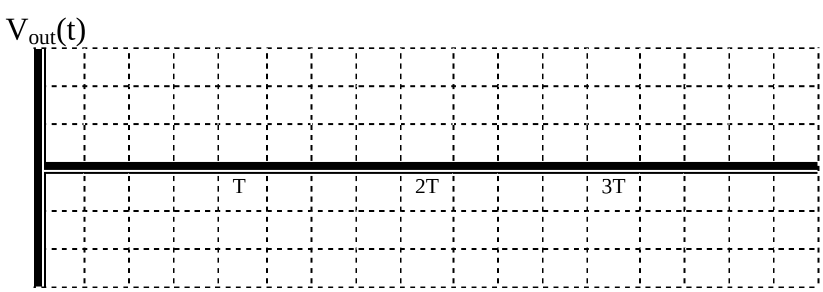

c. (8 pts) Explain what is happening for different time duration.

d. (6 pts) Sketch $I_D(t)$? Label all key values.

$I_D(t)$