ECE 3455: Electronics

Section 12071
Spring 2011

Exam 1

Version A

March 5, 2011

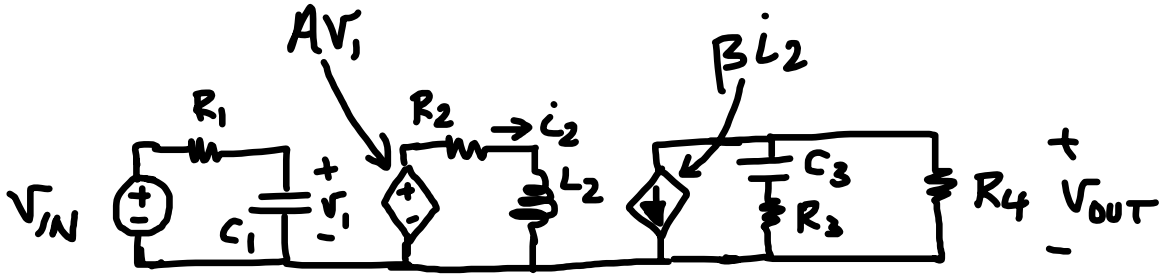
Do *not* open the exam until instructed to do so. Answer the questions in the spaces provided on the question sheets. If you run out of room for an answer, continue on the back of the page. This is a closed-book/notes exam and you may *not* use a calculator. You may use a crib-sheet as described in the syllabus and discussed in class. **You will have 1-¾ hours to finish the exam.**

Student's Name: _____

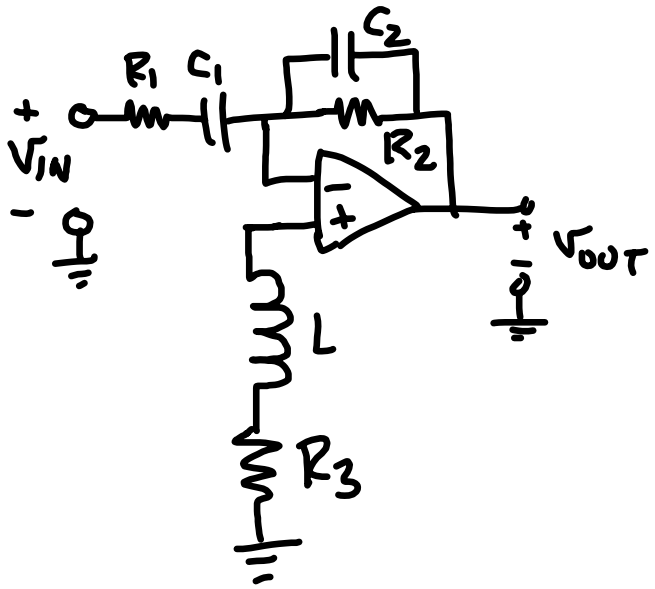
Question	Points	Score
1	25	
2	25	
3	20	
4	30	
Total:	100	

1. For the following circuits, find the transfer function $H(j\omega) = {}^{V_{out}}/_{V_{in}}$ in terms of the resistor, capacitor, and inductor variables. Write your solution in a form where the poles and zeros can be easily identified, just like we did in class.

   (a) (10 points)

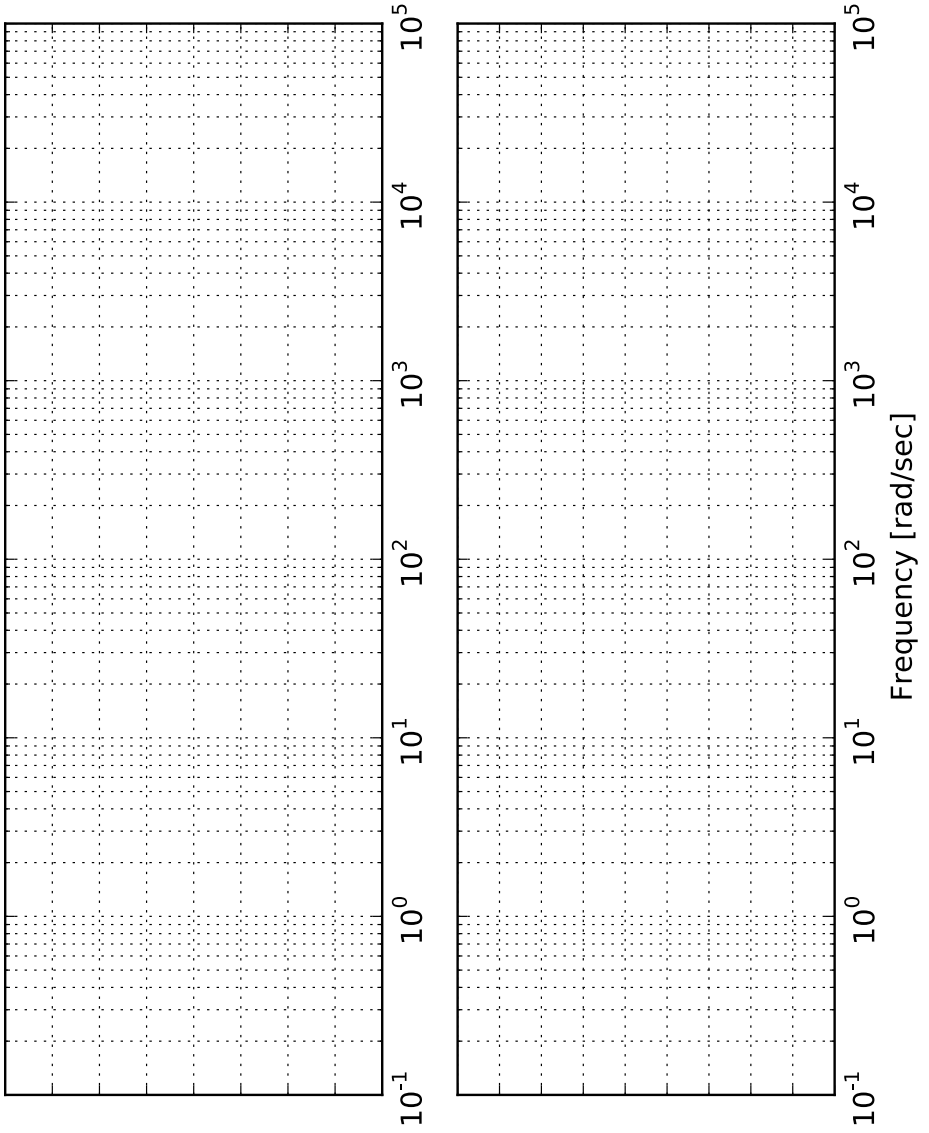


(b) (15 points) Assume you have an ideal op-amp

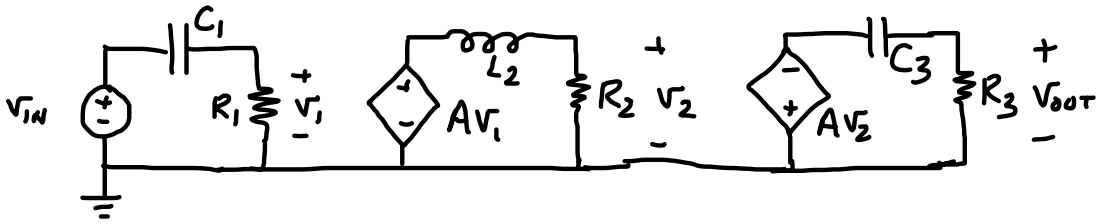


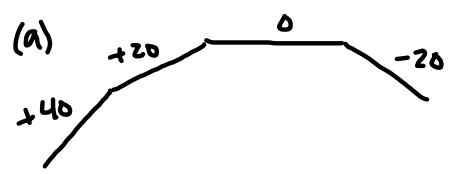
2. (a) (15 points) Using the graph paper below, sketch the magnitude and phase Bode straight-line approximation for the transfer function

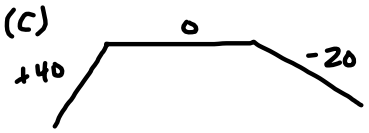
$$H(j\omega) = -\frac{100\left(1+\frac{j\omega}{10}\right)\left(1+\frac{j\omega}{20,000}\right)}{\left(1+\frac{j\omega}{100}\right)\left(1+\frac{j\omega}{1,000}\right)^2}.$$

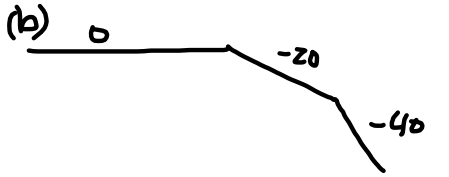


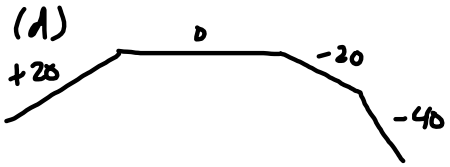
(b) (10 points) Indicate which of the following Bode magnitude sketches, if any, are possible for the following circuit. The slope is indicated for each segment on the sketches and more than one may apply. Briefly (in one sentence) justify your answer — you must do this to get credit for your choice.



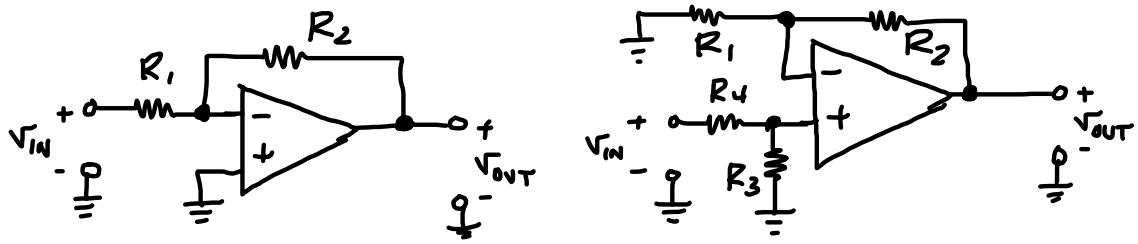




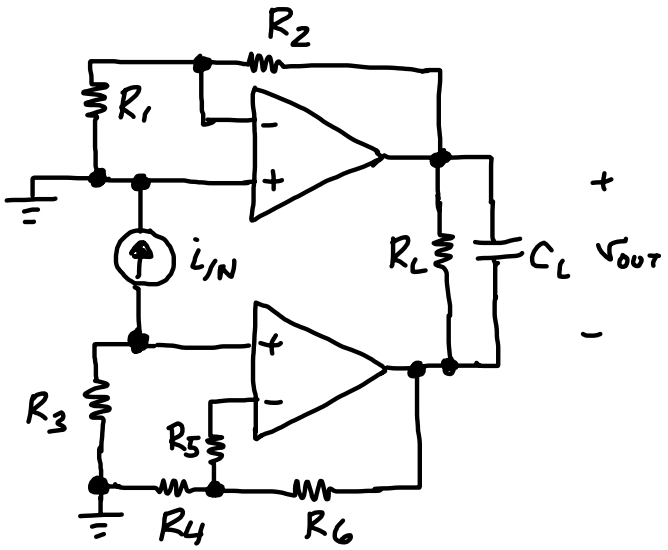




3. (a) (10 points) For the following two circuits, find $\frac{v_{OUT}}{v_{IN}}$ and R_{in}.



(b) (10 points) Find $\frac{v_{OUT}}{i_{IN}}$ for the following circuit.



4. Design a circuit that meets the following specifications using only parts from the list below (you do not have to use all of the parts).

   - Gain is 20 dB $\pm$6 dB for $100 \leq \omega \leq 10{,}000\,^{\text{rad}}/_{\text{sec}}$
   - Gain is $<$0 dB $\pm$6 dB for $\omega < 10\,^{\text{rad}}/_{\text{sec}}$
   - Gain is $<$-20 dB $\pm$6 dB for $\omega > 100{,}000\,^{\text{rad}}/_{\text{sec}}$
   - $R_{in} > 100\,\text{k}\Omega$

   Available parts:

   - (5) 10 kΩ and (5) 1 kΩ resistors;
   - (5) ideal op-amps; and
   - A magical bin containing any capacitor you would like.

   (a) (5 points) Sketch the straight-line approximation for the Bode plot.

   (b) (10 points) Write down the transfer function.

   (c) (15 points) Design your circuit.

   To receive full credit, you must indicate which part of the circuit corresponds to each pole/zero in your transfer function. *Hint:* No phase response has been specified for this circuit so need not deal with it (this time).