EECS 40, Fall 2006
Prof. Chang-Hasnain
Midterm #2

October 25, 2006
Total Time Allotted: 50 minutes
Total Points: 100 / Bonus: 10 pts

1. This is a closed book exam. However, you are allowed to bring one page (8.5" x 11"), single-sided notes PLUS your 1-page notes from midterm 1.
2. No electronic devices, i.e. calculators, cell phones, computers, etc.
3. Slide rules are allowed.
4. SHOW all the steps on the exam. **Answers without steps will be given only a small percentage of credits.** Partial credits will be given if you have proper steps but no final answers.
5. **Remember to put down units.** Points will be taken off for answers without units.

Last (Family) Name:_____

First Name: _____

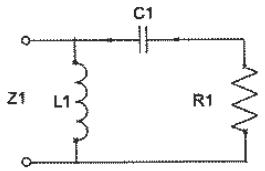
Student ID: _____Discussion Session: _____

Signature: _____

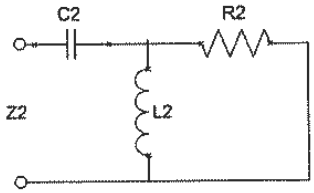
Score:	
Problem 1 (16 pts) Complex Impedances	
Problem 2 (54 pts): Bode Plots	
Bonus (10 pts):	
Problem 3 (30 pts): Second-order Circuits	
Total	

1. [16 points] Parallel and Series Complex Impedance

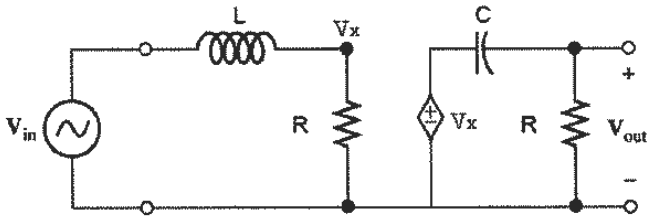
a) [8 pts] What is the complex impedance Z_1?



b) [8 pts] What is the complex impedance Z_2?



2. [54 points] Bode Plots:



(a) [10 points] For the above circuit, show $H(f) = \frac{1}{1+j\frac{f}{f_2}} \times \frac{1}{1-j\frac{f_1}{f}}$

Express f_1 and f_2 in terms of R, L, C. (Hint: Remember $\omega = 2\pi f$)

(b) [6 points] Now Let R = 1kΩ, L = 0.16 mH, C = 0.16 uF, what are f_1 and f_2? Remember to put down units.

(c) [22 pt] Bode Magnitude Plot. ***You must put down all the steps leading to your results.***
Hint: **You may consider** $f_1 \ll f_2$

[4 points] Write down the expression for $y = 10\log|H(f)|^2$

[4 points] As frequency goes to a very small value, what is the slope of y as a function of $\log f$?

[4 points] As frequency goes to a very large value, what is the slope of y as a function of $\log f$?

[4 points] What is y, $f_1 \ll f \ll f_2$?

[2 points] What is y at f_1 ?

[2 points] What is y at f_2 ?

[2 points] What filter is this?

Bonus [5 points] If the input $|V_{in}| = 1\ V$ and the frequency is 1 MHz, what is the output $|V_{out}|$?

Bonus [5 points] If the input $|V_{in}| = 1\ V$ and the frequency is 10 MHz, what is the output $|V_{out}|$?

(d) [16 pt total] Bode Phase Plot. ***You must put down all the steps leading to your results. Hint:*** **You may consider** $f_1 \ll f_2$

[4 points] Write down the expression for $\angle H(f)$

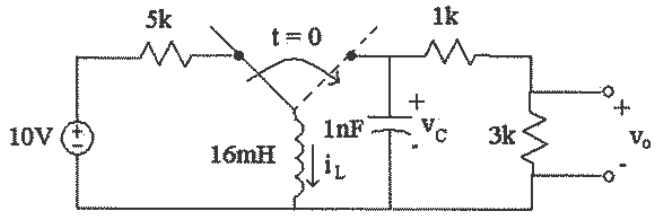
[4 points] What does the value of $\angle H(f)$ approaches to as $f \to 0$?

[4 points] What does the value of $\angle H(f)$ approaches to as $f \to \infty$?

[2 points] What is $\angle H(f)$ at $f = f_1$?

[2 points] What is $\angle H(f)$ at $f = f_2$?

3. [30 points] Second-order Circuits:



Assume the switch has been to the left for a long time before switching to the right at t = 0.

(a) Find the following values: [18 points] (Hint: What is $v_o(t)$ in terms of $v_C(t)$?)

$i_L(0+) =$	
$v_C(0+) =$	$v_C(\infty) =$
$v_o(0+) =$	$v_o(\infty) =$
$\frac{d}{dt} i_L(0+) =$	
$\frac{d}{dt} v_C(0+) =$	
$\frac{d}{dt} v_o(0+) =$	

(b) [6 points] Write the differential equation in terms of v_c.

(c) [6 points] What are the values of the natural frequency (ω_0) and the damping ratio (ζ)?