

ECSE 2010  
Electric Circuits  
Exam 3  
Spring 2006

Name \_\_\_\_\_

Section Number (please circle one)

1	2	3
MR	MR	MR
10-12	2-4	4-6

Problem No.	Pts.	Score
1	20pts	
2	30pts	
3	20pts	
4	10pts	
5	20pts	
Total	100pts	

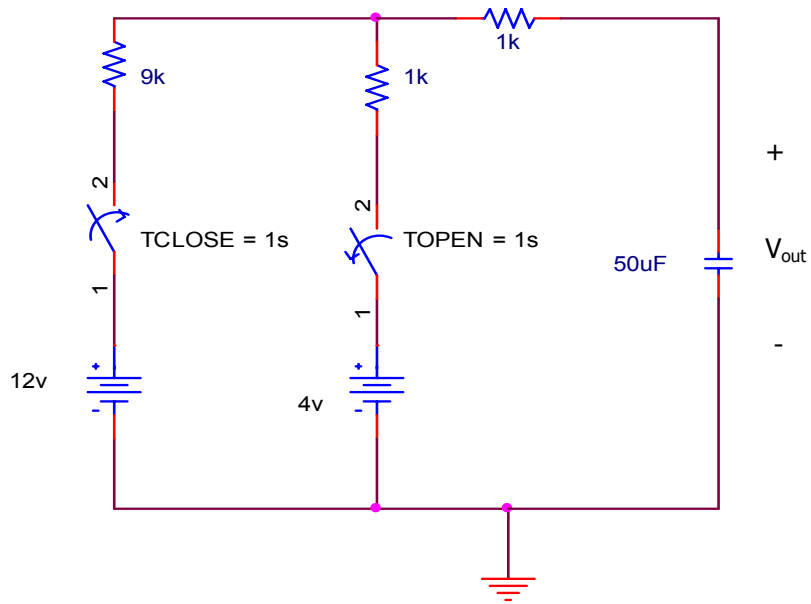
Please Note:

- \* Place all your answers in the spaces provided.
- \* You MUST show ALL your work or thoroughly describe your solution process to receive any credit.
- \* The Laplace transform of  $1u(t) = 1/s$ .

Problem 1 (20pts)

Name \_\_\_\_\_

a.) Find  $V_{out}(s)$  for  $t < 1s$ .



$V_{out}(s)$	
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Problem 1 (cont)

Name \_\_\_\_\_

b.) Sketch  $V_{out}(t)$  for  $t \geq 0$  using the circuit shown in part (a). Show ALL pertinent time constants and their associated values (of  $V_{out}$ ).

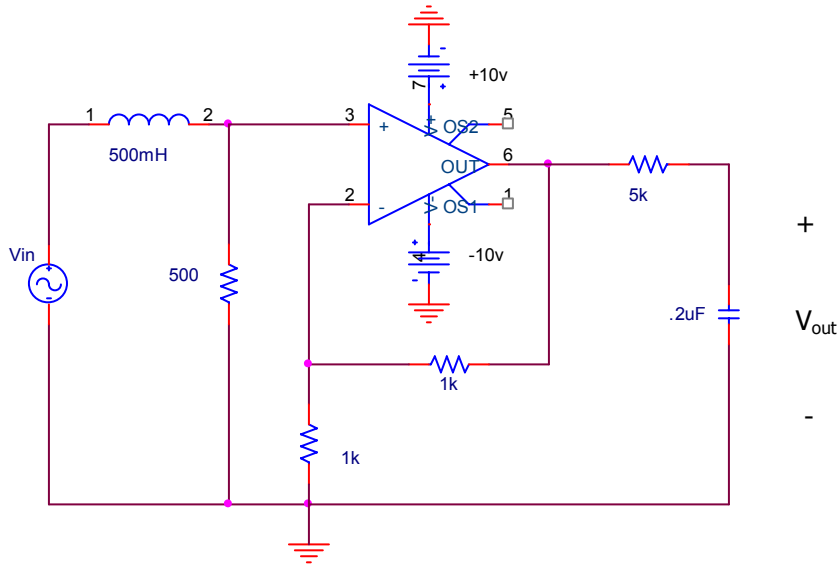


c.) Find  $V_{out}(t)$  for  $t \geq 1\text{sec}$  given the circuit shown in part(a).

$V_{out}(t)$	
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Problem 2 (30pts)

Name \_\_\_\_\_



a.) Find  $H(s) = \frac{V_{out}(s)}{V_{in}(s)}$  for the above circuit.

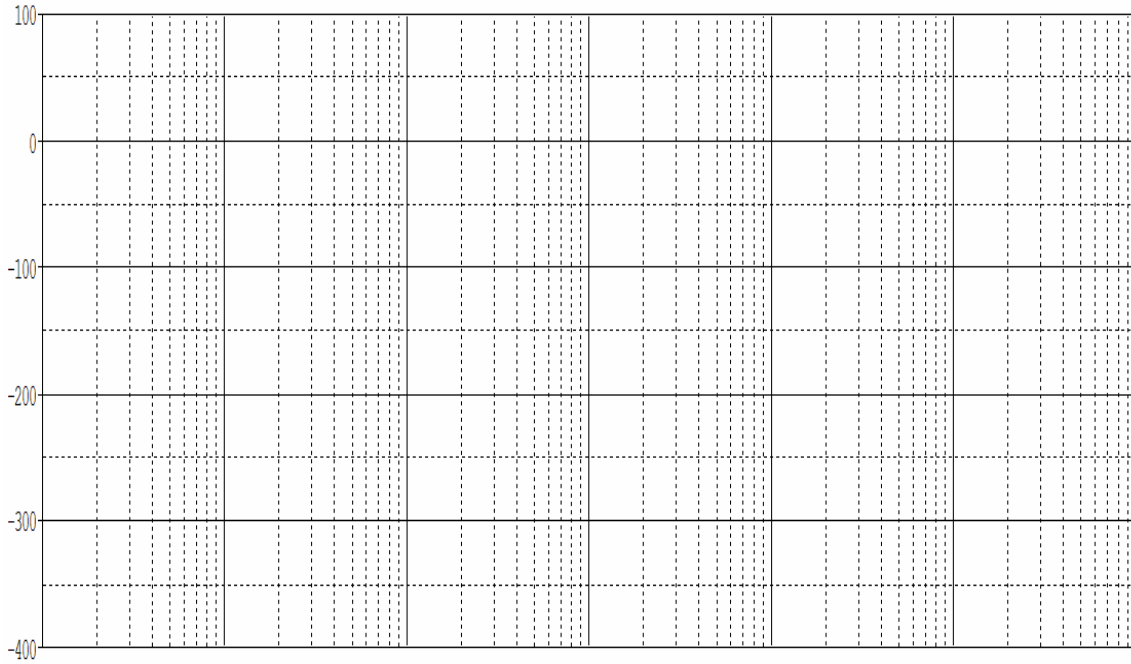
H(s)	
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Problem 2 (cont)

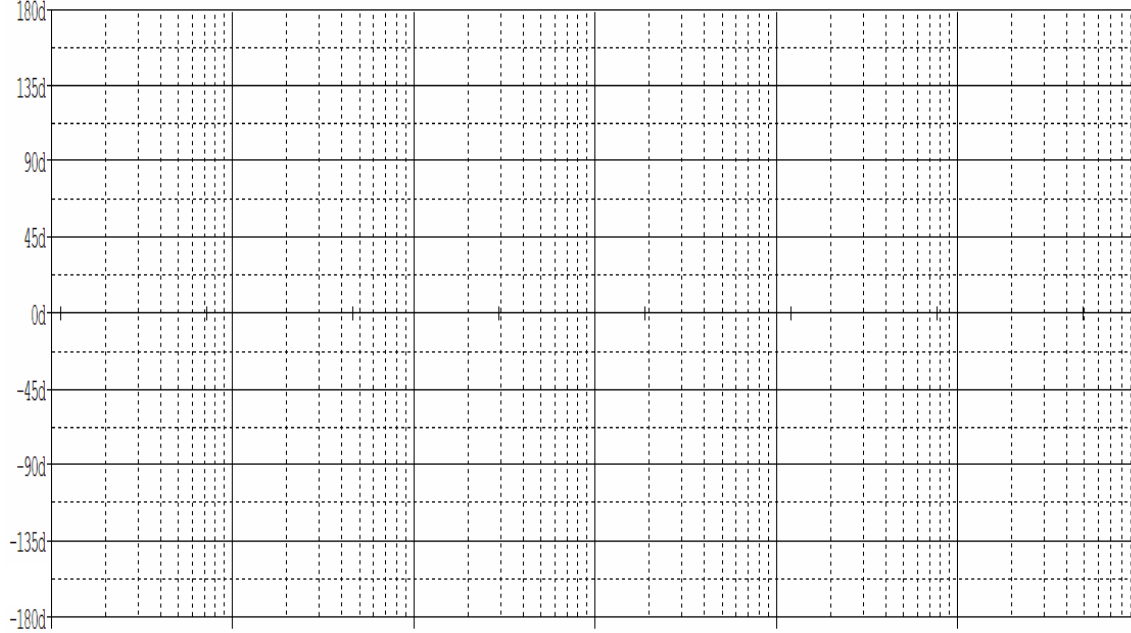
Name \_\_\_\_\_

b.) Sketch the asymptotic Bode plot  $|H(j\omega)|$  and  $\Phi H(j\omega)$  for the circuit shown in part (a). Please label your axes and critical values.

$|H(j\omega)|_{dB}$



$\Phi H(j\omega)$



Problem 2 (cont)

Name \_\_\_\_\_

c.) For an input  $V_{in}(t) = 10\cos(10t)$ , what is the output voltage  $V_{out}(t)$ ?

$V_{out}(t)$	
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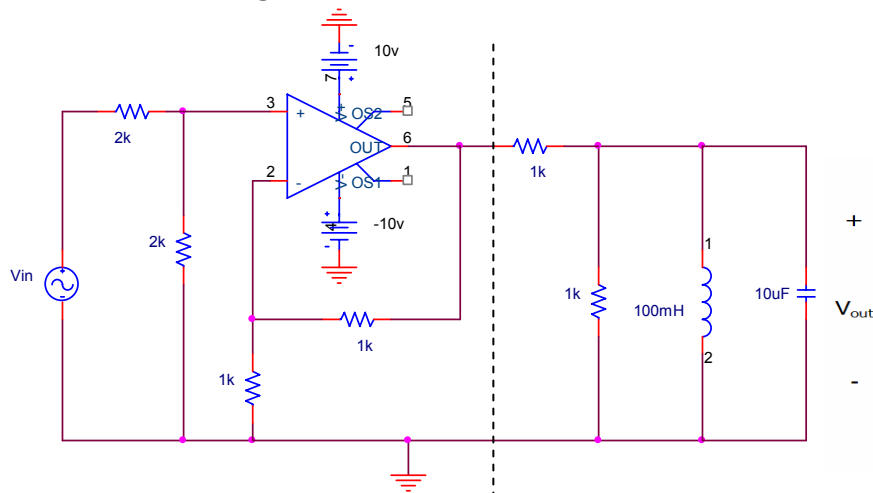
d.) For an input  $V_{in}(t) = 20\cos(500kt)$ , what is the output voltage  $V_{out}(t)$ ?

$V_{out}(t)$	
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**Problem 3 (10pts)**

Name \_\_\_\_\_

Given the following circuit:



a.) Determine the frequencies ( $\omega$ , in radians/sec) where  $Z_{eq}$ , the equivalent load impedance of the circuit above (to the RIGHT of the dashed line), is either at a minimum or at a maximum.

$\omega$ $Z_{eq}$ (min)	
$\omega$ $Z_{eq}$ (max)	

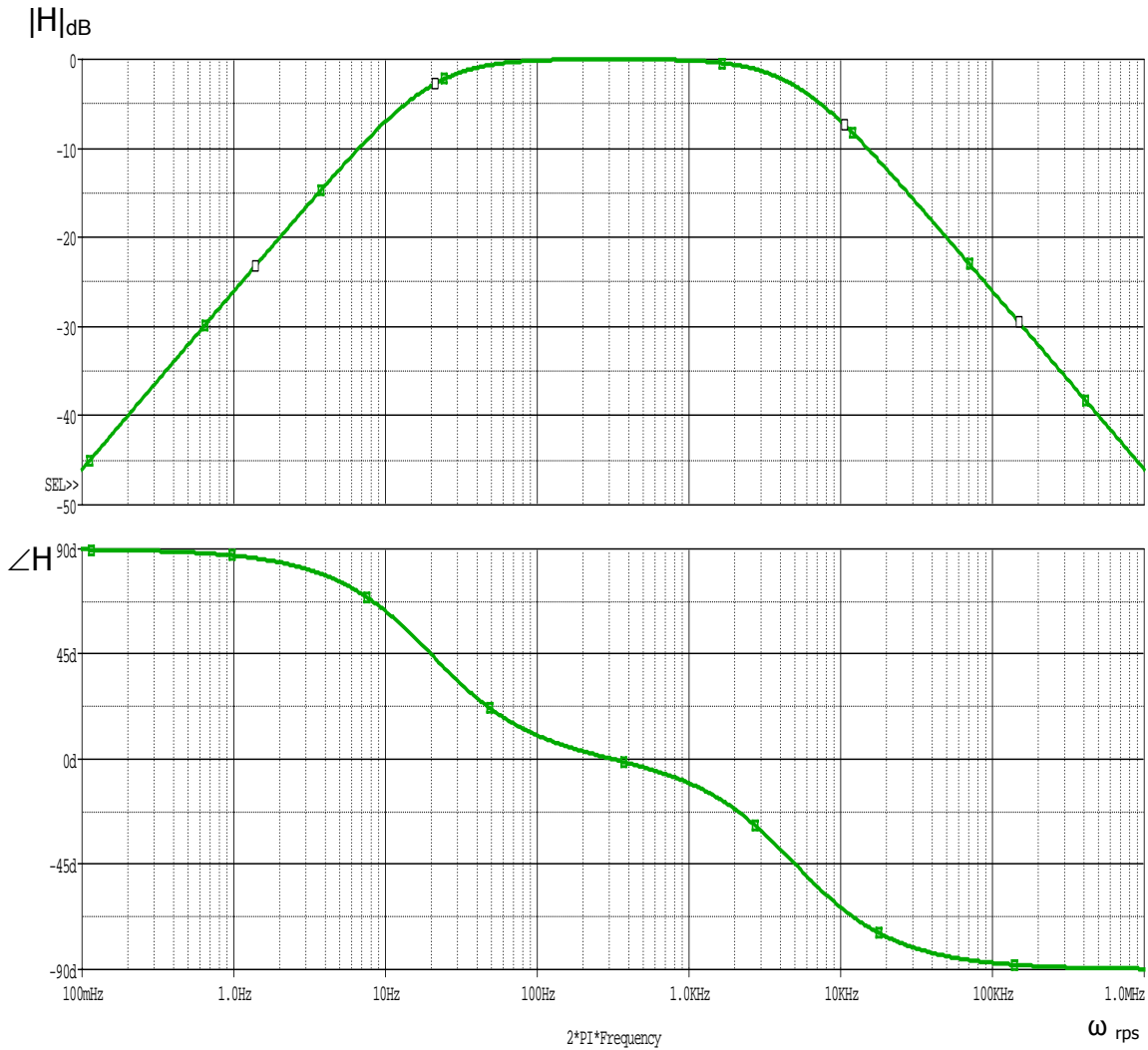
b.) What is  $V_{out}(t)$  for  $V_{in}(t) = 10\cos(\omega_0 t)$ , where  $\omega_0$  is the resonant frequency? Please justify your response.

$V_{out}(t)$	
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Problem 4 (20pts)

Name \_\_\_\_\_

Given the following frequency response:



a.) What kind of filter does this circuit represent? (Circle any/all that may apply and BRIEFLY explain your response in the space provided below.)

Lowpass	Bandpass	Highpass	Notch
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Problem 4 (cont.)

Name \_\_\_\_\_

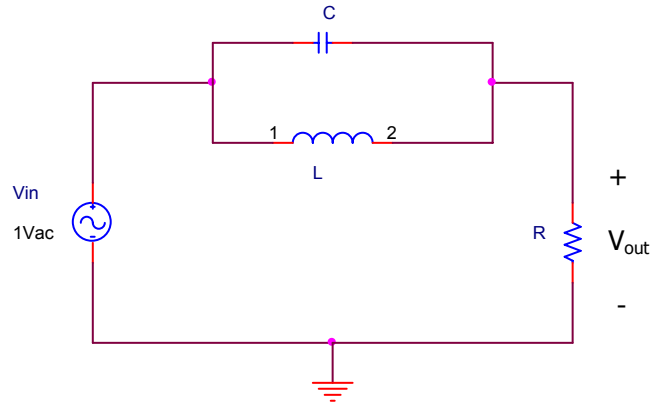
b.) Design a circuit that would produce the frequency response shown above, using ONLY one resistor, one inductor and one capacitor.

c.) Derive  $H(s)$  for your circuit and describe how the resulting  $H(s)$  verifies that your design would produce the frequency response provided in part (a).

Problem 5 (20pts)

Name \_\_\_\_\_

a.) Find  $H(s) = \frac{V_{out}(s)}{V_{in}(s)}$  for the circuit shown in terms of C, L and R and circle the most appropriate circuit response type below.



H(s)	
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2 <sup>nd</sup> order HPF	1 <sup>st</sup> order LPF	2 <sup>nd</sup> order BPF	None of these
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Problem 5 (cont.)

Name \_\_\_\_\_

b.) What value of L would produce a resonant frequency of 2,000rps if R = 10 ohms and C = 50uF?

L	
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c.) What would  $V_{out}$  be for a  $V_{in} = 10_v \cos(\omega_0 t)$ ; if L=100mH, C=200uF and R=10 ohms?

d.) What is the Q of the circuit?

Q	
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d.) What is the damping ratio of the circuit?

Damping ratio ( $\zeta$ )	
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Extra space (if needed)

Name \_\_\_\_\_

Extra space (if needed)

Name \_\_\_\_\_