

ECSE 2010
Electric Circuits
Final Exam
Spring 2006

Name _____

Section (please circle one)

MR MR MR
10-12 2-4 4-6

Please Note:

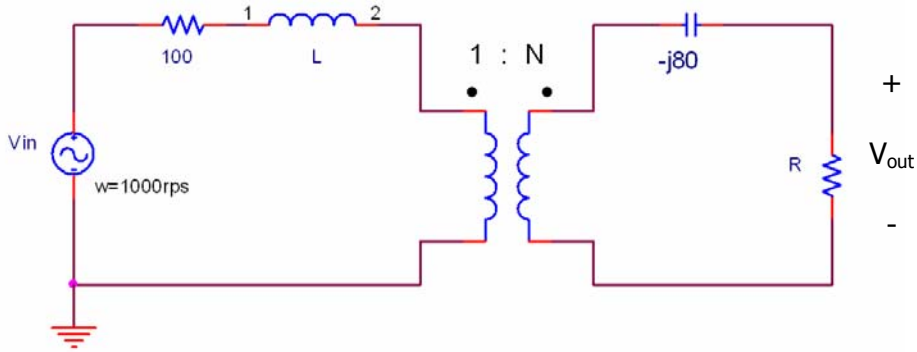
- Place all your answers in the spaces provided.
- You MUST show your work to receive any credit.
- Assume all resistances are in ohms, if not otherwise indicated.

Problem No.	Pts.	Score
1	20pts	
2	25pts	
3	25pts	
4	20pts	
5	20pts	
6	20pts	
7	20pts	
Total	150pts	

Problem 1 (20pts)

Name _____

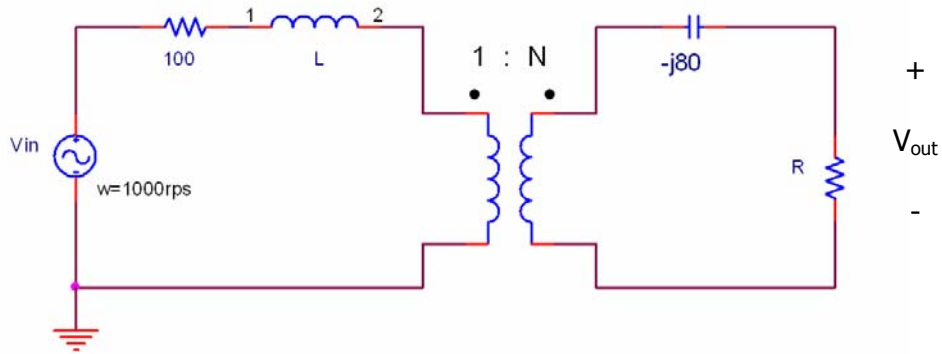
- a) Refer the secondary of the circuit to the primary side using $\omega = 1000\text{rps}$. Redraw the circuit without the transformer and leave the impedances in terms of the turns ratio, N . (6pts)



Problem 1 (cont)

Name _____

b) Find the value of L that will result in series resonance, assuming $\omega_0 = 1000\text{rps}$ and $N = 2$. (6pts)

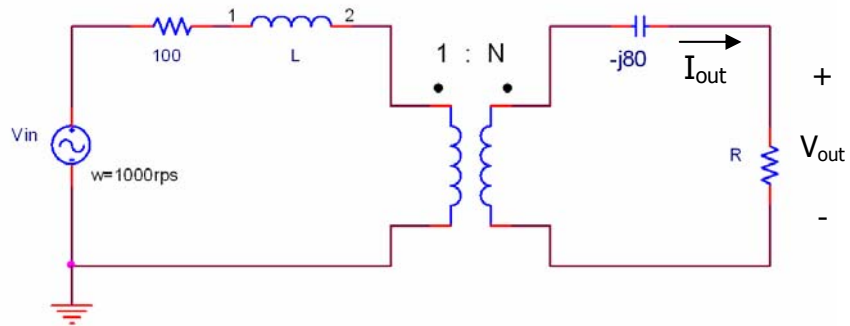


L	
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Problem 1 (cont)

Name _____

c) Find the power dissipated in R (with $R=800$) and the values of $|V_{out}(t)|$ and $|I_{out}(t)|$ on the secondary side, assuming the circuit is in resonance (at $\omega_0 = 1000\text{rps}$). (6pts)



P	
$ V_{out}(t) $	
$ I_{out}(t) $	

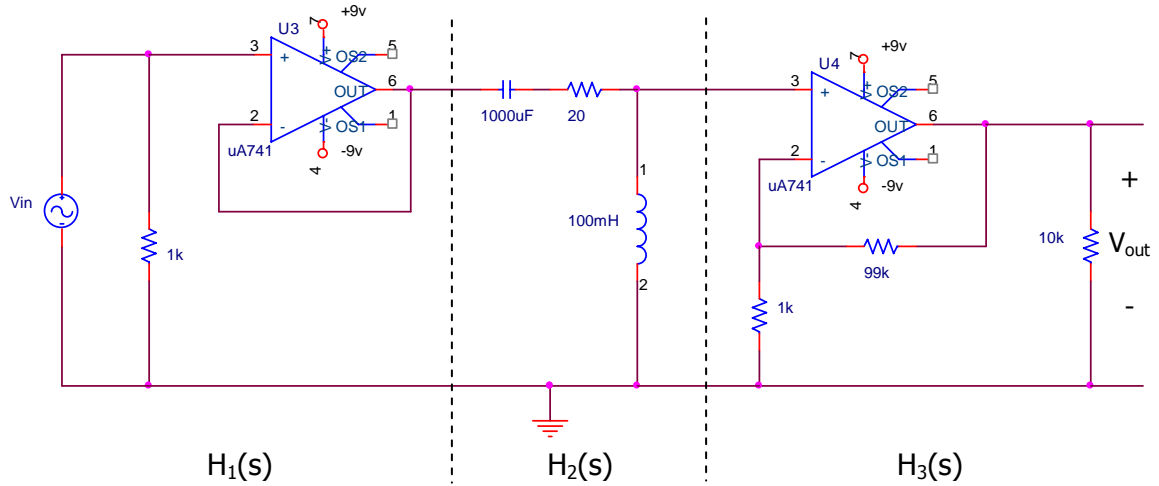
d) If it is desired to maximize the power delivered to R_L in the circuit, the value of R_L should be: (please circle one) (2pts)

DECREASED	UNCHANGED	INCREASED
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Problem 2 (25pts)

Name _____

a) Find $H_1(s)$, $H_2(s)$, $H_3(s)$, and the overall transfer function $V_{out}/V_{in} = H(s) = H_1(s)H_2(s)H_3(s)$ for the circuit shown below. (5pts)

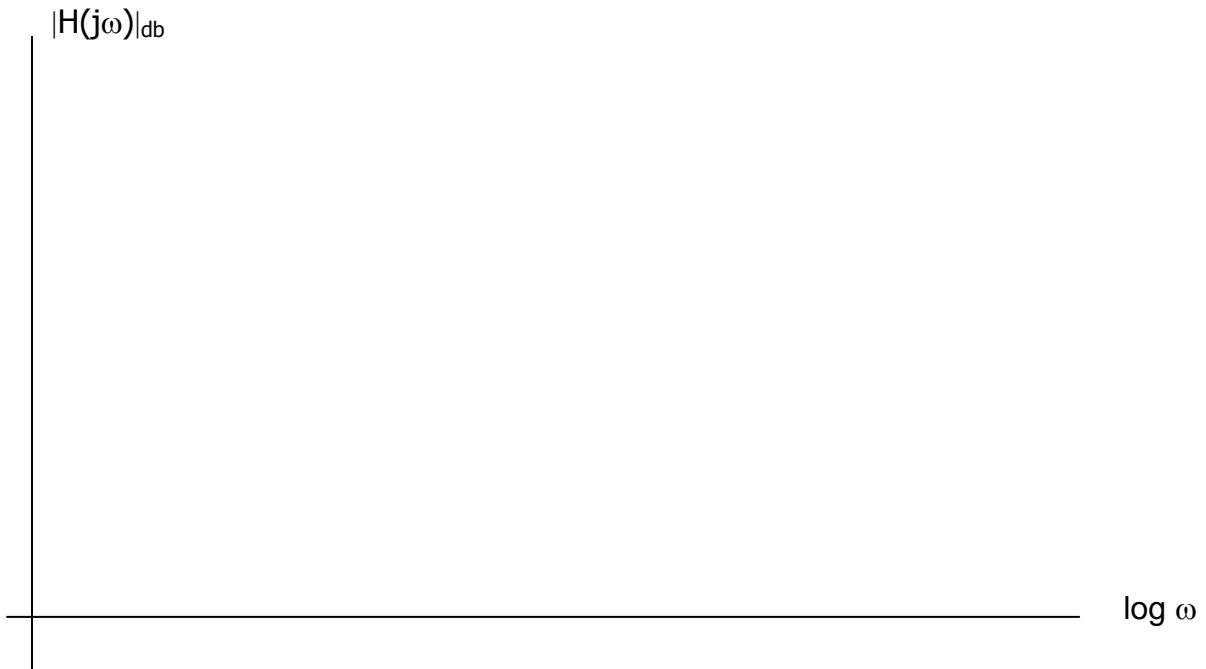


$H_1(s)$	
$H_2(s)$	
$H_3(s)$	
$H(s)$	

Problem 2 (cont)

Name _____

b) Sketch the asymptotic graphs of $|H(j\omega)|_{db} = |V_{out}/V_{in}|$ and $\angle H(j\omega)$ for the circuit shown in part a on the previous page. (10pts) (Please clearly label your axes appropriately)



Problem 2 (cont)

Name _____

c) It is desired to have an output sinusoid with an amplitude of 10v ($|v_{out}|=10v$) for an input $V_{in}(t) = A\cos(5000t)$ volts (for the circuit shown in part a). What must the value of A be? (5pts)

A	
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d) What frequency (ω) will change an input that is $= 1\cos(\omega t)$ and produce an output $= 70.7\sin(\omega t)$ (using the circuit shown in part a)? Explain and justify your response. (5pts)

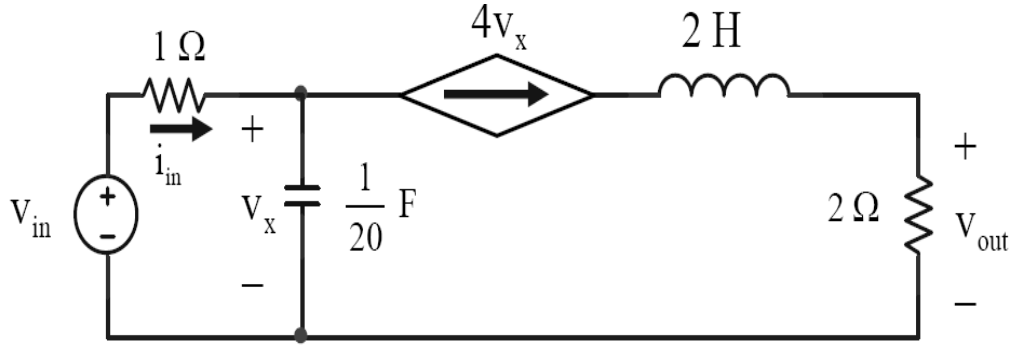
ω	
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Problem 3 (25pts)

Name _____

For all parts of this problem, assume that the initial conditions of both the inductor and capacitor are zero for $t < 0$.

a) Find $V_{out}(t)$ in the circuit if $V_{in} = 5v$. (5pts)



Problem 3 (cont)

Name _____

b) Find $H(s) = V_{out}(s)/V_{in}(s)$ (for a general $V_{in}(t)$ for the circuit shown in **part a**, assuming the circuit is in the ac steady state). Please be careful to show your work. (5pts)

H(s)	
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Problem 3 (cont)

Name _____

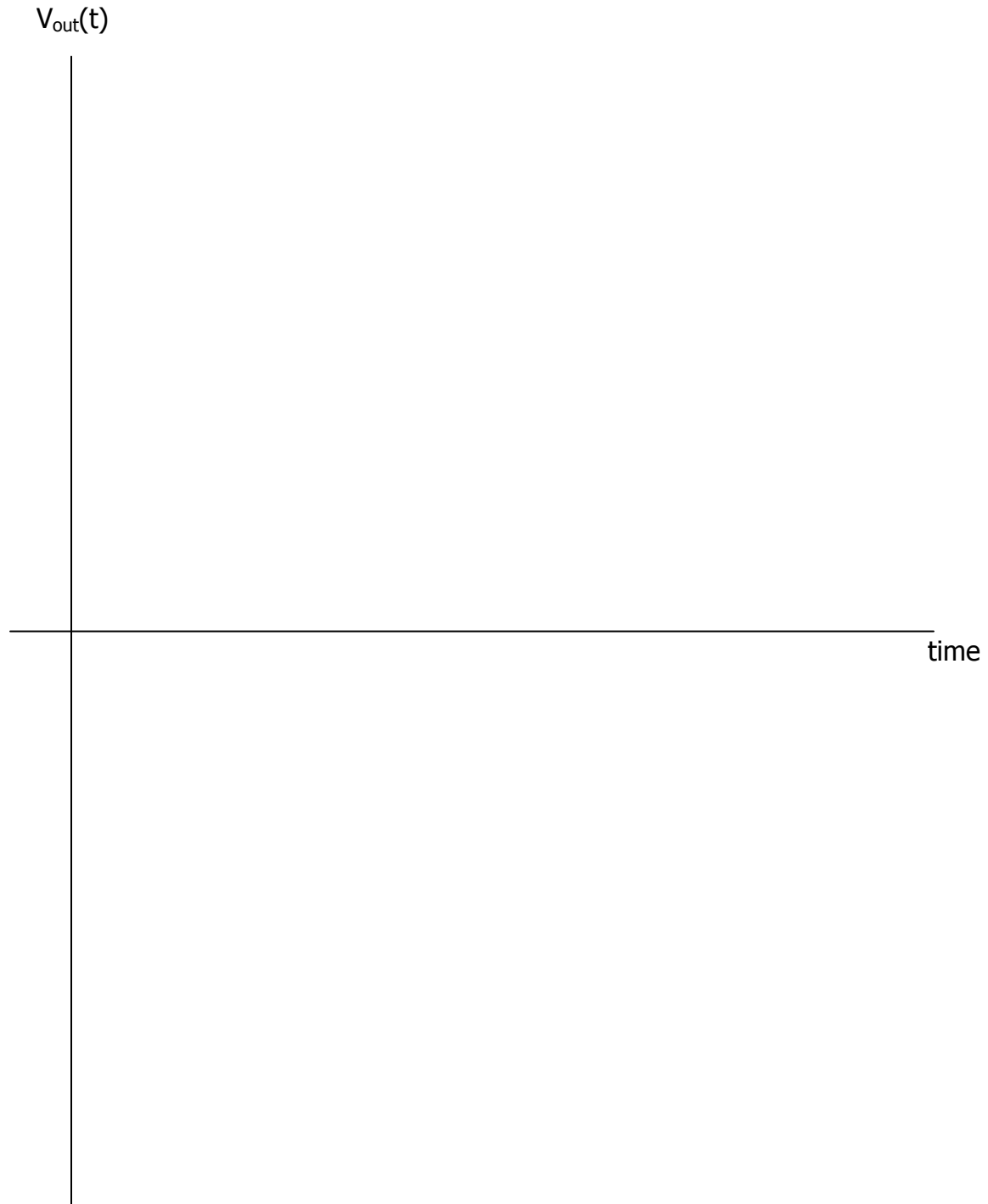
c) Find $V_{\text{out}}(t)$ in the circuit shown in **part a**, for a $V_{\text{in}} = 10u(t)$, assuming there is no stored energy at $t < 0$. (5pts)

$V_{\text{out}}(t)$	
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Problem 3 (cont)

Name _____

d) Sketch $V_{out}(t)$ for ALL $t \geq 0$; using the circuit described in part c (above). Please label ALL pertinent values of both V_{out} and time on the representative axes. (10pts)



Problem 4 (20pts)

Name _____

The following three loads are connected across a $240V_{\text{rms}}$ 60Hz AC generator:

Load #1 has $P = 600\text{KW}$ and has a $\text{pf} = .8$ **lagging**

Load #2 has $P = 400\text{KW}$ and has a $|S| = 500\text{KVA}$

Load #3 has $Q = -207\text{KVARs}$ and has a $\text{pf} = 0$ **leading**

a) Determine the total apparent power of the three loads. (5pts)

$|S|_{\text{total}} =$

b) Determine the power factor of the combined load. (5pts)

$\text{pf}_{\text{combination}} =$

Problem 4 (cont.)

Name _____

c) Determine the value of capacitance or inductance that will need to be added in order to make the overall $\text{pf} = 1.0$, assuming that the voltage across the load is to be kept at 240V_{rms} (with $\omega = 377\text{rps}$). (5pts)

C =

d) Determine the reduction in the current drawn from the generator by the corrected combination. (5pts)

$I_{\text{uncorrected}} - I_{\text{corrected}} =$

Problem 5 (20pts)

Name _____

a) Design a circuit that would produce a high pass filter (HPF) response that has the following characteristics:

- Cutoff frequency $\omega_o = 100\text{rps}$
- $Q = .5$
- Magnitude of $H(j10\text{k}) = 40\text{dB}$
- Phase of $H(j100) = 90$ degrees

Assume that you only have one 1000uF capacitor, one inductor (your choice of value), resistors (as many as you want --- your choice of values), two op-amps and $\pm 9\text{volt}$ DC supplies available. Please provide values for your component choices (and support why you chose them)s and show your overall circuit schematic. (10pts)

Problem 5 (cont.)

Name _____

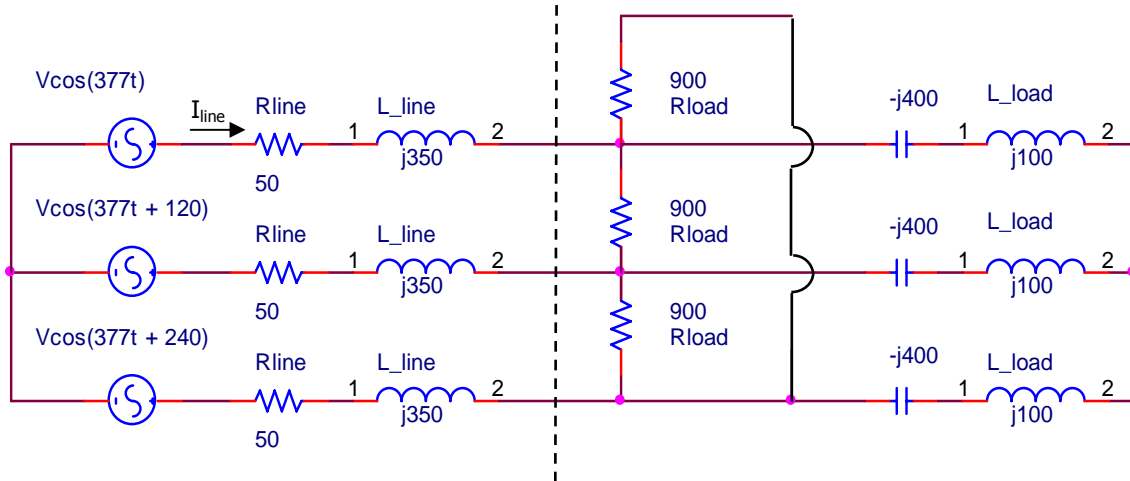
b) What is the resulting $H(s)$ for the filter circuit described in **part a** (using the characteristics provided)? (10pts)

$H(s)$	
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Problem 6 (20pts)

Name _____

a) Given the following 3 phase circuit, what is the equivalent single phase load impedance to the right of the dashed line? (10pts) (Please justify your response)



Z_{load}	
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b) What is the total average real power (in rms) dissipated by the three phases' line resistances (R_{line}) if each of the phase voltages $V_{\phi} = 15k$ Volts-rms? (10pts) (Please justify your response)

P_{total}	
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Problem 7 (20pts/2pts each)

a) Having the $\text{Im}(Z(j\omega)) \Rightarrow 0$ can be observed in: (circle one)

pf correction resonance max. power transfer all of these

b) A 3-phase balanced delta load with $Z_{\Delta} = j300$ ohms is connected to a 3-phase generator producing a line voltage of $173.2 \angle 60^{\circ}$ volts. The resulting line current is:

$1 \angle -60^{\circ}$ A $.33 \angle 30^{\circ}$ A $1 \angle 30^{\circ}$ A $1.73 \angle -60^{\circ}$ A

c) If $Y(s) = \frac{4s^2 + 6s + 10}{s^3 + 4s^2 + 3s + 5}$, the DC steady-state value for $y(t)$ is:

4 1 0 ∞ none of these

d) Millard played a purple Gibson "Flying V" guitar: (circle one)

True False

e) If $H(s) = \frac{2s}{s^2 + g_m s + 25}$ for a circuit, the value of g_m that would make the circuit critically damped is: (circle one)

6 4 -4 0 none of these

f) If $H(s) = \frac{2s}{s^2 + g_m s + 64}$ for a circuit, the value of g_m that would make the circuit oscillate: (circle one)

6 4 -4 0 none of these

Problem 7 (cont)

g) If $H(s) = \frac{10s^2}{(s^2+4s+4)}$ for a circuit, the damping coefficient is:

-2 4 1 2 none of these

h) A possible $H(s)$ for a bandpass filter is:

$40s/(s+40)$ $40s/(s^2+14s+40)$ $40/(s+40)^2$ none of these

i) In the Tee model for mutual inductance, all of the model's inductances are always negative:

True False

j) An ideal Op Amp always has the voltage at the inverting terminal equal to the non-inverting terminal voltage.

True False

Extra space (if needed)

Name _____

Extra space (if needed)

Name _____