ECE 53a	FINAL EXAM	Prof. Pamela Cosman	3/17/08

First Name: _____

Last Name: _____

This exam has 9 problems. They have point values between 10 and 12 points. The total number of points is 100.

On this exam, you are allowed to use ONE page of notes (both sides of the page).

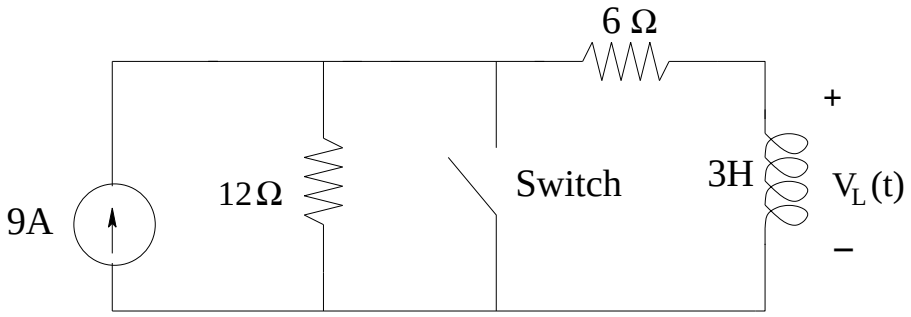
You ARE allowed to use a calculator.

Good luck!

SCORING:

Problem	Points obtained	Points possible
1		12
2		10
3		10
4		10
5		12
6		12
7		12
8		12
9		10
Total		100

Problem 1: (12 points) In this circuit, the switch is open for a long time, then closes at time t=0. The switch opens again at time t = 1 sec. Find the voltage across the inductor $V_L(t)$ for all time (that is, for $t < 0$ (2 points), for $0 < t < 1$ (5 points), and for $t > 1$ (5 points)).

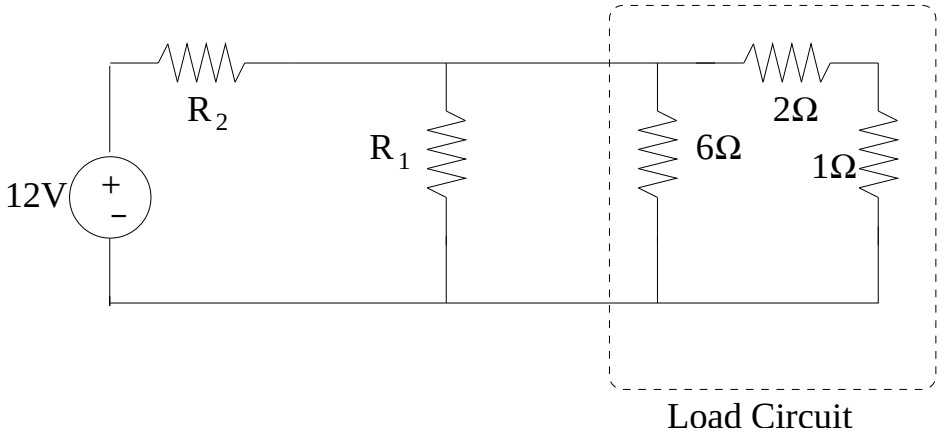


Problem 2: (10 points) An unknown linear circuit is attached to a variable load resistor R_L. This is purely a DC problem; there are no capacitors or inductors and no time-varying currents or voltages. We measure the current I_L through the load and the voltage V_L across the load. The load current I_L is defined to go from + to − across the load voltage V_L. The table below shows partial results of a series of tests with different load resistors. Fill in the table with the missing data.

V_L	I_L	R_L
	0.15 A	0
10V		200 Ω
		∞

Problem 3: (10 points) You wish to use an inductor L and two identical resistors R to design a high pass filter where frequencies above 20kHz are passed, but they are attenuated by half. That is, the maximum magnitude of the voltage transfer function is 0.5. Draw the circuit, showing the inductor and resistors, as well as the input and output voltages. Give values for R and L.

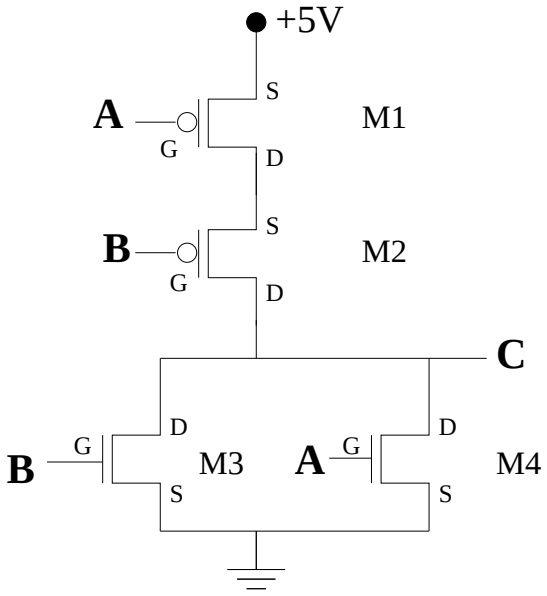
Problem 4: (10 points) In this problem, you do not have to prove your answers, although you do have to provide some justification. (a) In the circuit shown below, determine the value of R_2 that would maximize the power delivered to the load circuit under the condition that $R_1 = 6\Omega$.
(b) In the circuit shown below, determine the value of R_1 that would maximize the power delivered to the load circuit under the condition that $R_2 = 3\Omega$.



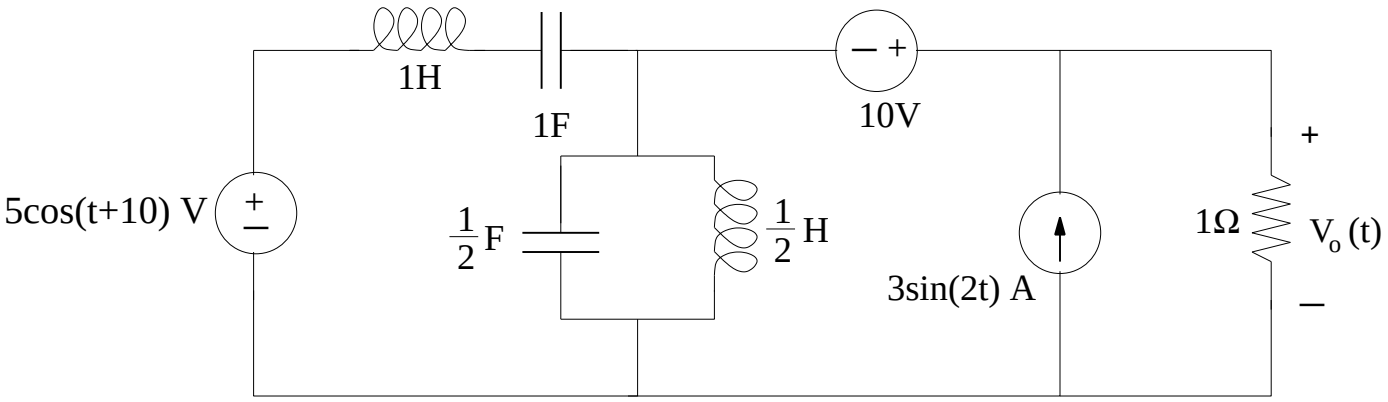
Problem 5: (12 points) Use an amplifier (a finite gain amplifier with gain A=100) and two resistances to design a non-inverting amplifier for which the voltage gain is 5. The feedback circuit should draw 0.1mA when the output voltage is 1V. Draw the circuit and specify the values of the two resistors.

Problem 6: (12 points) In this CMOS circuit, the PMOS transistors M1 and M2 have threshold voltage $V_t = -1V$ whereas the NMOS transistors M3 and M4 have threshold voltage $V_t = 1V$. (a) Using the switch model for the transistors, complete the table below listing the gate-to-source voltage and the drain-to-source voltage for each device as well as whether each transistor is ON or OFF, for the case where input A is low (0V) and input B is high (5V). (b) C is the output. What type of logic gate is this CMOS circuit?

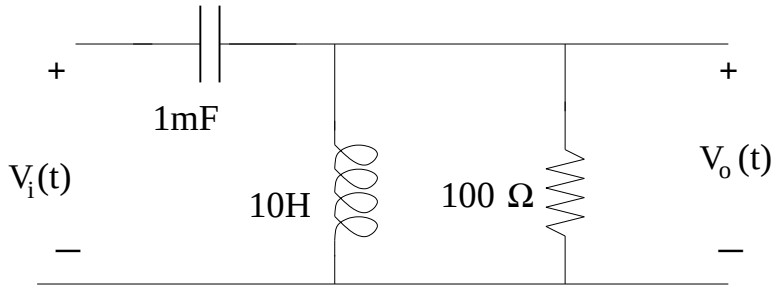
	V_{GS}	OFF/ON	V_{DS}
M1			
M2			
M3			
M4			



Problem 7: (12 points) Find $V_o(t)$ in the following circuit.



Problem 8: (12 points) For the following circuit: (a) find the transfer function $H(j\omega)$ which is the ratio of the output voltage phasor to the input voltage phasor, (b) find the magnitude of the transfer function, and (c) identify what kind of filter this is.



Problem 9: (10 points) For the following circuit:
(a) What is the energy stored by the inductor as a function of time?
(b) What is the energy stored by the capacitor as a function of time?
(c) What is the energy dissipated by the resistor in one period?