ECE 214 Linear Circuits Lab — Final Exam

3 May 2011

Rules of the Exam

- Rule 1: There are four exam questions each worth 5 points.
- **Rule 2:** There is an optional bonus question worth 10 points. The 10 points will be added to your overall class score. The bonus question is graded all or nothing no partial credit will be awarded for the bonus question.
- **Rule 3:** You have 120 minutes to complete the exam. You may use your ECE 214 Engineering Notebook, a few pages of notes with equations and a calculator.
- **Rule 4:** Show all work and **intermediate steps** in your solutions. Answers without supporting work will receive no credit. Clearly state all assumptions. Be neat!!!

Name

Have FUN!!!

Problem 1: Boost Circuit

Consider the boost circuit shown below. Assume all components are ideal.



The switch S_1 has been open for a very long time. At time t = 0 the switch is closed. The switch remains closed for 15 ms at which time the switch opens and remains open for the remainder of all time.

a)	What is I_L at $t = 0$ s?	
b)	What is V_{OUT} at $t = 0$ s?	
c)	What is I_L at $t = 3$ ms?	
d)	What is V_{OUT} at $t = 3ms$?	
e)	What is I_L at $t = 300 \text{ ms}$?	
f)	What is V_{OUT} at $t = 300$ ms?	

Problem 2: Astable Multivibrator

Consider the circuit shown below. The ideal switches S_1 , S_2 and S_3 are closed when the control voltage is above 1.8 V and are opened when the control voltage is below 1.8 V.



- a) Is the output signal, V_{OUT}, a DC voltage, a sine wave, a square wave, a triangular wave, sawtooth wave, or something else?
- b) What is the approximate period of V_{OUT} ?
- c) What is the amplitude of V_{OUT} ?

Problem 3: Filter

Consider the filter circuit shown below:



- 1 Is this circuit a low-pass, band-pass, notch, or high-pass filter?
- 2 What is the transfer function H(s) for this filter?

- 3 What is the -3 dB frequency of this filter?
- 4 What is the -6 dB frequency of this filter?
- 5 When a 1 V peak-to-peak square wave with a frequency of 3 kHz is applied to the input of this filter, what is the dominant frequency component in the output signal from the filter?

Problem 4: OpAmp Circuit

Consider the circuit shown below: Assume $\mathrm{V}_{\mathrm{dd}}=6$ V.



- a) Is the output signal, V_{OUT}, a DC voltage, a sine wave, a square wave, a triangular wave, sawtooth wave, or some-thing else?
- b) What is the approximate period of V_{OUT} ?
- c) What is the amplitude of V_{OUT}?

Bonus Problem: Energy / Power Question

In the circuit below, the 3 A source delivers no power and absorbs no power. The circuit dissipates a total of 200 W of power and stores 1.0 mJ of energy. Determine the values of R_1 , R_2 and L.

