ECE 214 Linear Circuits Lab — Final Exam

3 May 2012

Rules of the Exam

Rule 1: There are four exam questions each worth 5 points.

Rule 2: There are two optional bonus question each worth 5 points. The 10 points from the bonus questions will be added to your overall class score. The bonus questions are graded all or nothing – no partial credit will be awarded for the bonus question.

Rule 3: You have 120 minutes to complete the exam. The exam is open book and open notes. You may use your ECE 214 Engineering Notebook and a calculator.

Rule 4: If you leave the room during the exam your exam will not be accepted.

Rule 5: Show all work and **intermediate steps** in your solutions. Answers without supporting work will receive no credit. Clearly state all assumptions. Be neat!!!

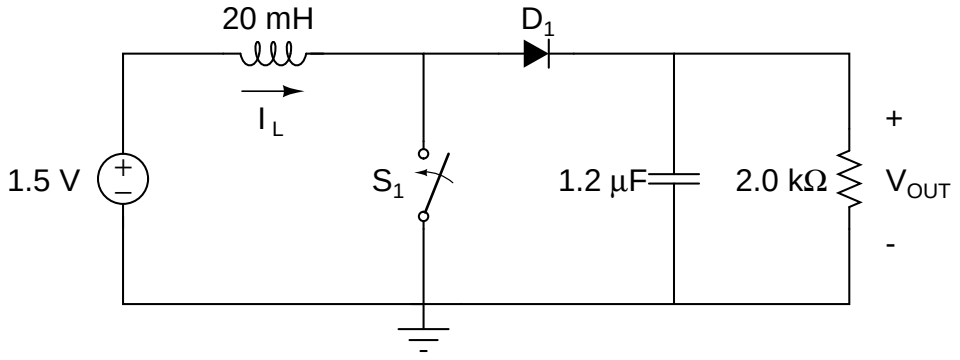
_____

Name

Have a Good Summer!!!

Problem 1: Boost Circuit

Consider the boost circuit shown below. Assume all components are ideal. The voltage drop across the diode is 0.7 V when current flows through the diode.



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 $t = 2.8$ ms? _____

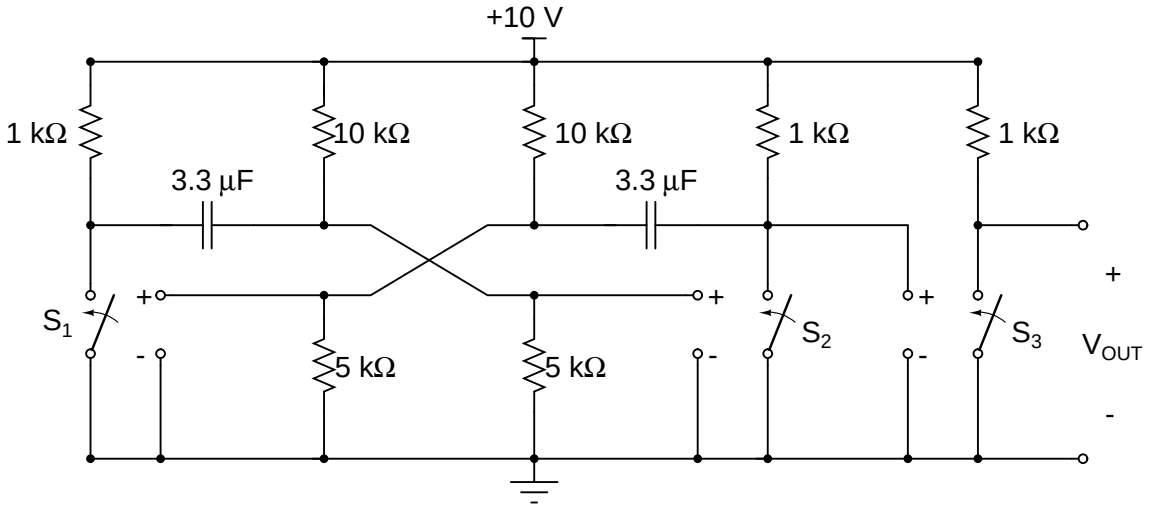
d) What is V_{OUT} at $t = 2.8$ms? _____

e) What is I_L at $t = 300$ 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 3.0 V and are opened when the control voltage is below 3.0 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}? _____

Problem 3: DC–DC Converter Circuit

Consider the DC–DC converter circuit shown below:

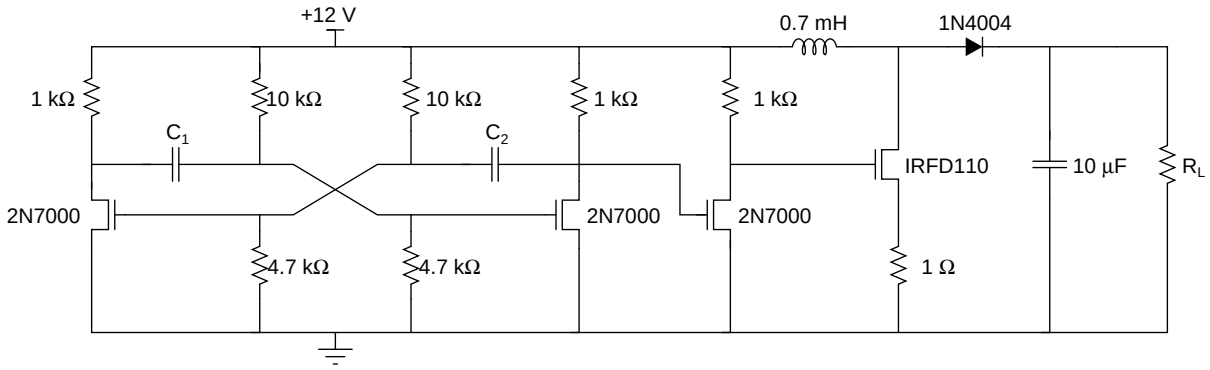


Figure 1: DC–DC converter circuit.

This circuit is designed to produce a 30 V DC output with ±50 mV of ripple across resistor R_L.

a) If the value of C1 is decreased by 15%, what is the approximate output voltage? _____

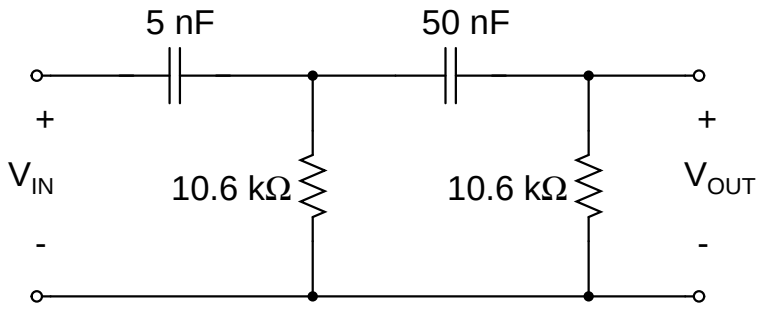
b) If the value of C1 is decreased by 15%, what is the approximate ripple? _____

c) If the values of C1 and C2 are both doubled, what is the approximate output voltage? _____

d) If the values of C1 and C2 are both doubled, what is the approximate ripple? _____

Problem 4: Filter Circuit

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?

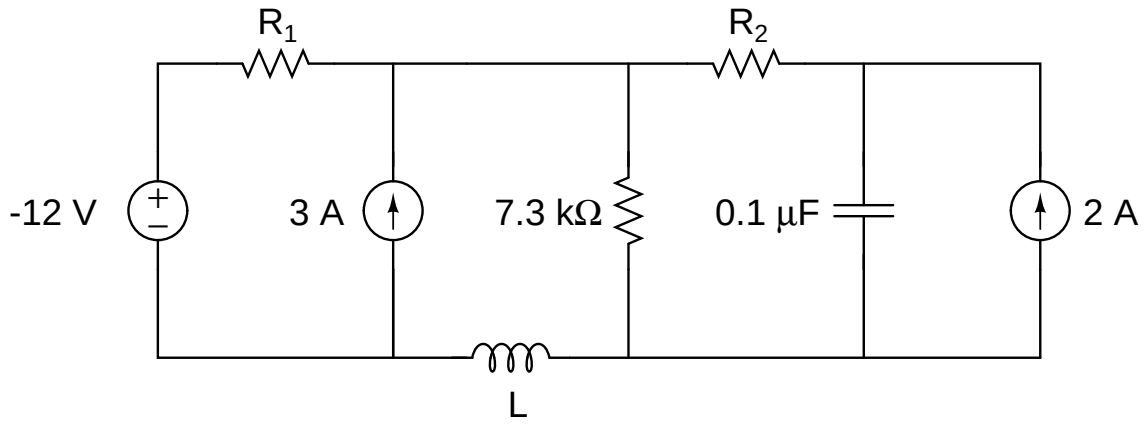
3 What is/are the -3 dB frequency/frequencies of this filter? _____

4 What is/are the -6 dB frequency/frequencies 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 in the output signal from the filter? _____

Bonus Problem 1: 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.



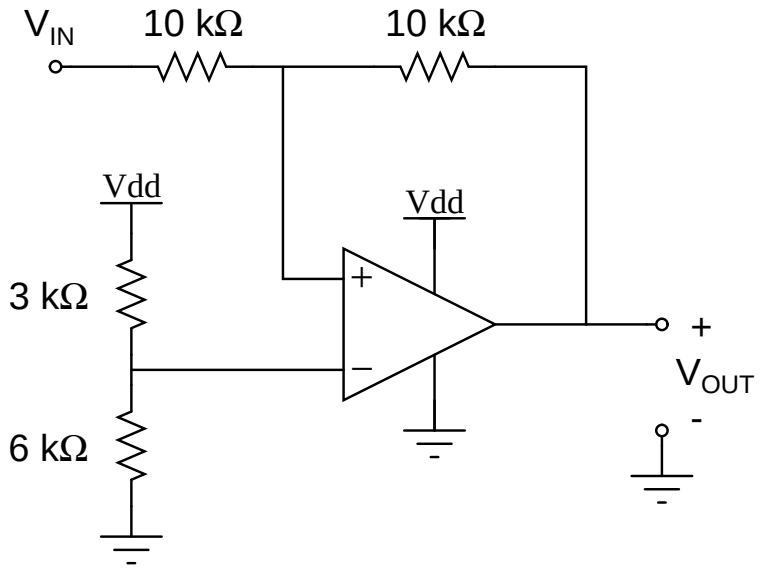
$R_1 =$ _____

$R_2 =$ _____

$L =$ _____

Bonus Problem 2: OpAmp Circuit

Consider the OpAmp circuit shown below. Assume the OpAmp is ideal and $V_{dd} = 9$ V.



1. What is the function of this circuit?

2. V_{IN} is a triangular waveform with 1 V peak–to–peak voltage and 0 V DC offset. What type of waveform is V_{OUT}?

3. $V_{IN} = 2$ V. What is V_{OUT}?

4. $V_{IN} = 12$ V. What is V_{OUT}?

5. $V_{IN} = 9$ V. What is V_{OUT}?