ECE 214 — Final Exam

Estimated time for completion: $\leq$ 2.0 hour
10 May 2016

Rules of the Exam

Rule 1: The examination period begins at 8:00am on Tuesday 10 May 2016 and ends at 10:00am on Tuesday 10 May 2016.

Rule 2: The exam is worth 20% of your grade.

Rule 3: To receive credit for the answer make sure to include the units along with the numerical answer and show all work.

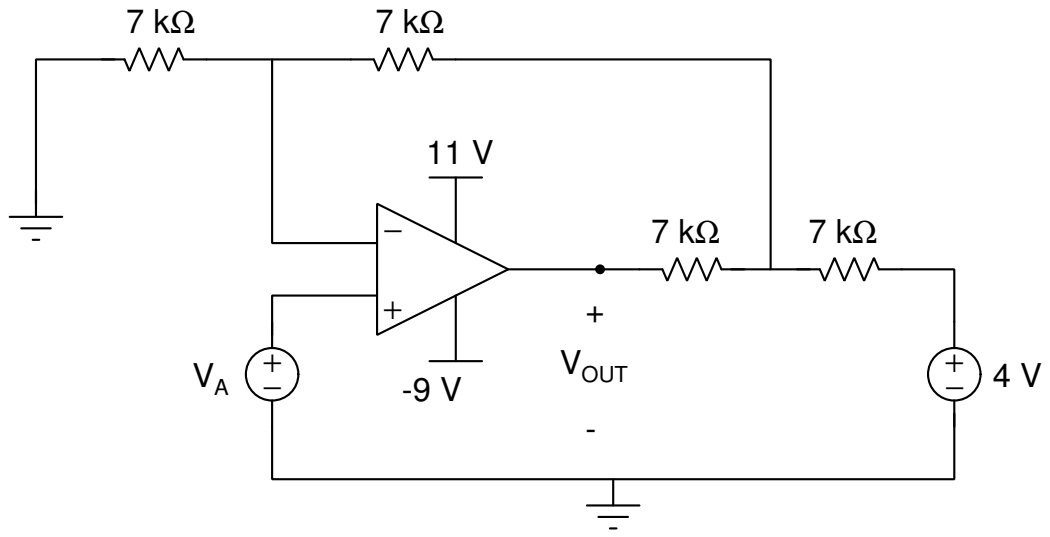
Rule 4: There is minimal partial credit.

Rule 5: The exam is closed book and closed notes. You may use your ECE 214 Laboratory Notebook and a calculator.

_____

Name

Problem 1: (10 points) The OpAmp below ideal.



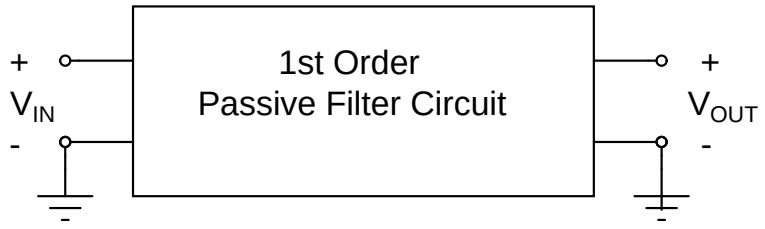
(a) Which of the following best describes the function of this circuit?

1. inverting amplifier
2. inverting amplifier with a dc offset
3. non-inverting amplifier
4. non-inverting amplifier with a dc offset
5. inverting integrator
6. inverting integrator with a dc offset
7. Schmitt trigger

(b) What are the minimum and maximum values of V_A that will prevent the output of the OpAmp (V_{OUT}) from saturating.

$V_{A_{min}}$ _____ $V_{A_{max}}$ _____

Problem 2: (10 points) Consider the 1st order ideal passive filter circuit shown below:



For the questions below circle the <u>most correct</u> answer:

1. V_{IN} is a sine wave with a frequency of 150 kHz and a peak-to-peak voltage of 5 V. V_{OUT} is a sinusoidal waveform with a frequency of 150 kHz and a peak-to-peak voltage of 2 V. What type of filter could be used to generate V_{OUT}?

   (a) low pass filter
   (b) high pass filter
   (c) low pass filter and high pass filter
   (d) none of the above

2. V_{IN} is a square wave with a 50% duty cycle, a frequency of 50 kHz, and a peak-to-peak voltage of 5 V. V_{OUT} that is a sinusoidal waveform with a frequency of 200 kHz and peak-to-peak voltage of 1 V? What type of filter could be used to generate V_{OUT}?

   (a) low pass filter
   (b) band pass filter
   (c) band reject filter
   (d) high pass filter
   (e) none of the above

3. V_{IN} is a square wave with a 50% duty cycle, a frequency of 50 kHz, and a peak-to-peak voltage of 5 V. The filter is a low pass filter with a cutoff frequency of 100 kHz. What is the relative amplitude of the 7th harmonic to the fundamental at the output of the filter?

   (a) -3.00 dB
   (b) -7.96 dB
   (c) -10.88 dB
   (d) -16.90 dB
   (e) -24.86 dB
   (f) none of the above

4. V_{IN} is a square wave with a 50% duty cycle, a frequency of 50 kHz, and a peak-to-peak voltage of 10 V. The filter is a high pass filter with a cutoff frequency of 50 kHz. What is the relative amplitude of the 5th harmonic to the fundamental at the output of the filter?

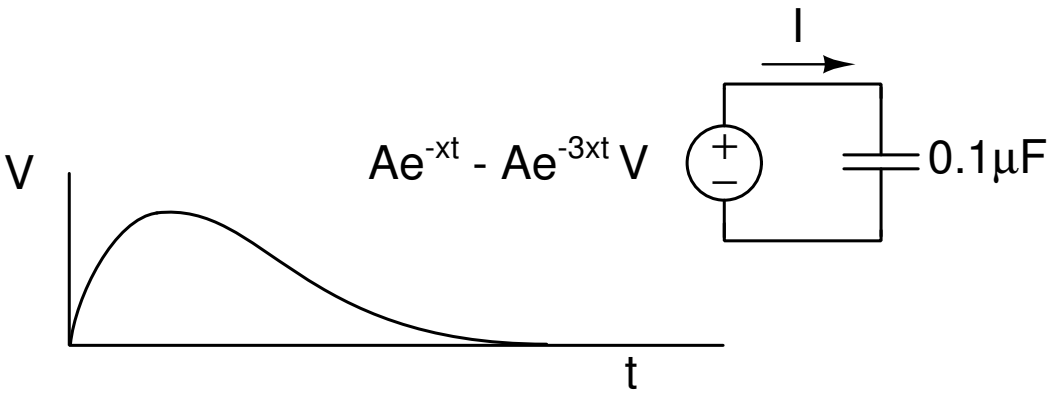
   (a) +3.00 dB
   (b) -6.02 dB
   (c) -10.98 dB
   (d) -13.98 dB
   (e) -16.98 dB
   (f) none of the above

5. V_{IN} is a square wave with a 50% duty cycle, a frequency of 50 kHz, and a peak-to-peak voltage of 10 V. The filter is a high pass filter with a cutoff frequency of 100 kHz. What is the peak amplitude of the 10th harmonic at the output of the filter?

   (a) 0.318 V
   (b) 0.637 V
   (c) 1.27 V
   (d) 1.91 V
   (e) 2.54 V
   (f) none of the above

Bonus Question: (5 points)

The voltage pulse shown below is equal to zero for $T < 0$. At $t = 549.3\mu$s, the current I through the capacitor is zero. At some point in time the current I reaches a maximum negative value of 5 mA. What is the value of x? What is the value of A?



x = _____

A = _____

Name: _____

Name: _____