# ECE 214 Linear Circuits Lab — Exam # 2

3 April 2012

## Rules of the Exam

**Rule 1:** Each question is multiple choice and has equal weight.
**Rule 2:** Circle the correct answer.
**Rule 3:** You have 75 minutes to complete the exam.
**Rule 4:** The exam is open book, open notes, and open laboratory notebook. You may use a calculator.
**Rule 5:** Show all work and **intermediate steps** in your solutions. Clearly state all assumptions. Be neat!!!

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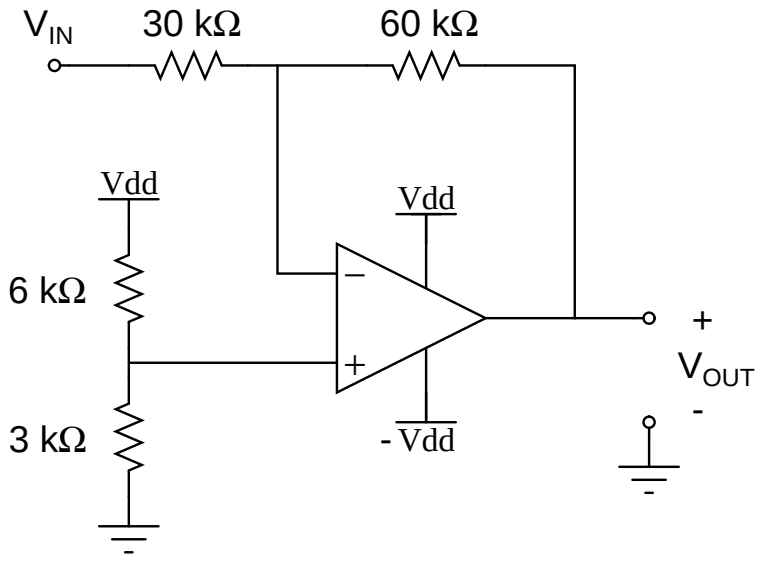
Name

**Try and Have a Good Time!!!**

**Problem 1**: OpAmp Circuit #1

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




1. What is the function of this circuit?
   (a) inverting amplifier
   (b) non–inverting amplifier
   (c) comparator
   (d) Schmitt trigger
   (e) inverting integrator
   (f) none of the above

2. $V_{IN}$ is a triangular waveform with 1 V peak–to–peak voltage and 0 V DC offset. What type of waveform is $V_{OUT}$?
   (a) sinusoidal waveform
   (b) triangular waveform
   (c) square waveform
   (d) DC output equal to 0 V
   (e) DC output equal to $V_{dd}$
   (f) DC output equal to $-V_{dd}$

3. $V_{IN} = 0$ V. What is $V_{OUT}$?

(a) -15 V (b) -9 V (c) -6 V (d) -3 V (e) 0 V (f) 3 V (g) 6 V (h) 9 V (i) 15 V

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

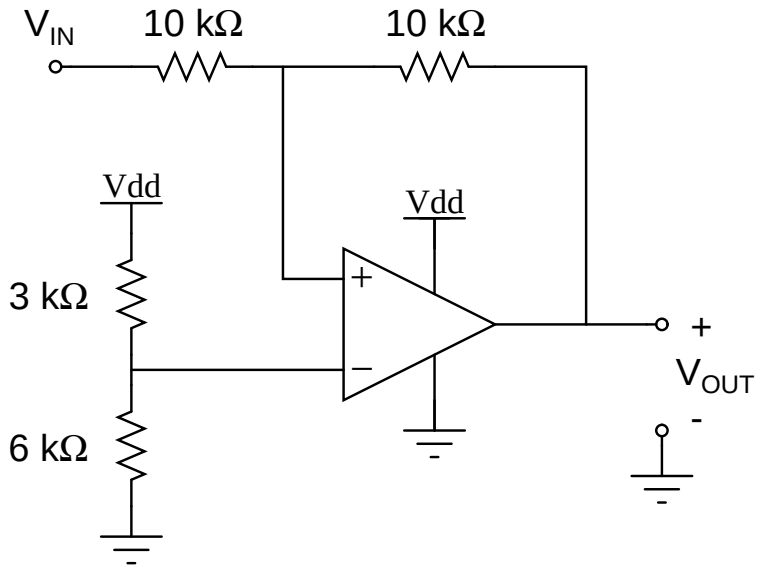
(a) -15 V (b) -9 V (c) -6 V (d) -3 V (e) 0 V (f) 3 V (g) 6 V (h) 9 V (i) 15 V

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

(a) -15 V (b) -9 V (c) -6 V (d) -3 V (e) 0 V (f) 3 V (g) 6 V (h) 9 V (i) 15 V

**Problem 2**: OpAmp Circuit #2

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




6. What is the function of this circuit?

   (a) inverting amplifier
   (b) non–inverting amplifier
   (c) comparator
   (d) Schmitt trigger
   (e) inverting integrator
   (f) none of the above

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

   (a) sinusoidal waveform
   (b) triangular waveform
   (c) square waveform
   (d) DC output equal to 0 V
   (e) DC output equal to $V_{dd}$
   (f) DC output equal to -$V_{dd}$

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

(a) -9 V (b) 0 V (c) 1 V (d) 3 V (e) 5 V (f) 7 V (g) 9 V (h) 12 V
(i) can not be determined (j) none of the others

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

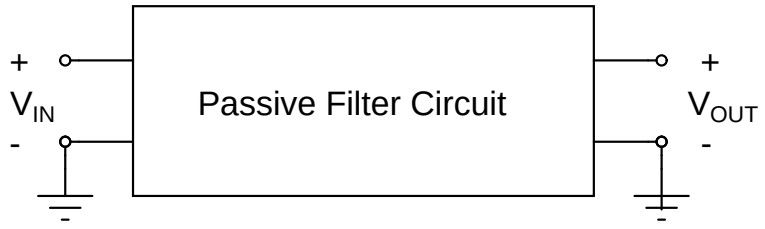
(a) -9 V (b) 0 V (c) 1 V (d) 3 V (e) 5 V (f) 7 V (g) 9 V (h) 12 V
(i) can not be determined (j) none of the others

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

(a) -9 V (b) 0 V (c) 1 V (d) 3 V (e) 5 V (f) 7 V (g) 9 V (h) 12 V
(i) can not be determined (j) none of the others

**Problem 3**: Filter Circuit

Consider the passive filter circuit shown below:




11. $V_{IN}$ is a square wave with a 50% duty cycle, a frequency of 10 kHz and a peak–to–peak voltage of 6 V. What type of filter could be used to generate $V_{OUT}$ that is a sinusoidal waveform with a frequency of 30 kHz?

    (a) low pass filter
    (b) band pass filter
    (c) band reject filter
    (d) high pass filter
    (e) no filter can produce the desired output waveform

12. For the conditions in question 11, what would be the maximum peak–to–peak voltage of the 30 kHz signal?

    (a) 0 V (b) 1 V (c) 1.5 V (d) 2 V (e) 2.5 V (f) 3 V (g) 4 V (h) 5 V

13. $V_{IN}$ is a sinusoidal wave with a frequency of 10 kHz and a peak–to–peak voltage of 5 V. What type of filter could be used to generate $V_{OUT}$ that is a sinusoidal waveform with a frequency of 30 kHz?

    (a) low pass filter
    (b) band pass filter
    (c) band reject filter
    (d) high pass filter
    (e) no filter can produce the desired output waveform

14. $V_{IN}$ is a square wave with a 50% duty cycle, a frequency of 50 kHz and a peak–to–peak voltage of 10 V. What type of filter could be used to generate $V_{OUT}$ that is a sinusoidal waveform with a frequency of 100 kHz?

    (a) low pass filter

    (b) band pass filter

    (c) band reject filter

    (d) high pass filter

    (e) no filter can produce the desired output waveform

15. $V_{IN}$ is a square wave with a 50% duty cycle, a frequency of 1 kHz and a peak–to–peak voltage of 10 V. The filter is a low pass filter. What is the minimum required order of the filter such that the 11th harmonic is at least 40 dB below the fundamental frequency?

    (a) 0th order

    (b) 1st order

    (c) 2nd order

    (d) 3rd order

    (e) 4th order

    (f) can not be done