ECE 214 — Exam #1

Estimated time for completion: $\leq$ 1.25 hour
1 March 2016

Rules of the Exam

Rule 1: The examination period begins at 8:00am on Tuesday 1 March 2016 and ends at 9:15am on Tuesday 1 March 2016.

Rule 2: The exam is worth 15% of your grade. There are a total of 17 answers. Each answer is worth 1 point. Two answers are extra credit.

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, a ruler, and a calculator.

Rule 6: Do not discuss this exam with anyone until after 2:00pm on Tuesday 1 March 2016.

Answer Key
Name

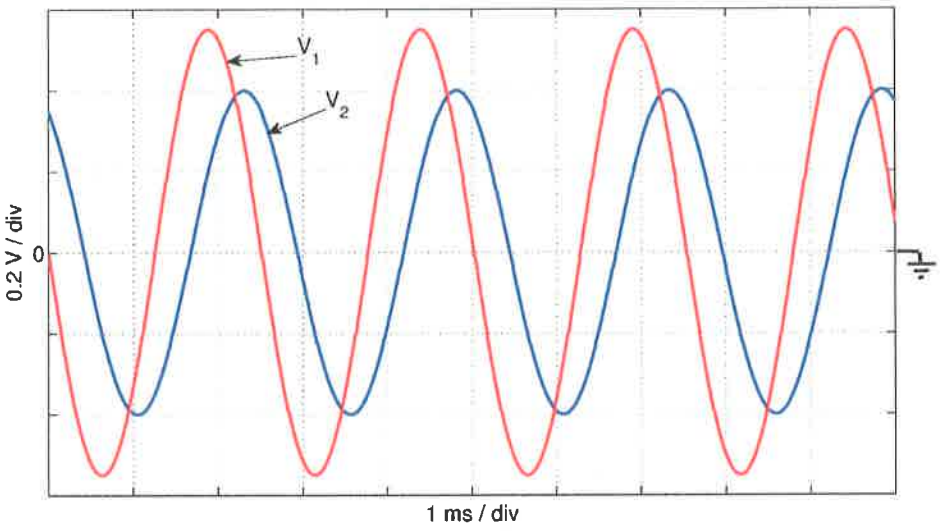
Problem 1: Two sinusoidal signals:

$$V_1(t) = A_1 \cos(\omega t + \phi_1) - 0.18V$$

and

$$V_2(t) = A_2 \cos(\omega t + \phi_2) + 0.025V$$

are input into an oscilloscope and the time-domain traces are shown below:



T = 2.5 ms
f = 400 Hz

(a) What is A_1? 0.55V

(b) What is ω? 800π or 2513 rad/s

(c) What is $\phi_2 - \phi_1$ in degrees? −60°

(d) What is answer in "(c)" above in radians? $-\frac{\pi}{3}$ or −1.047

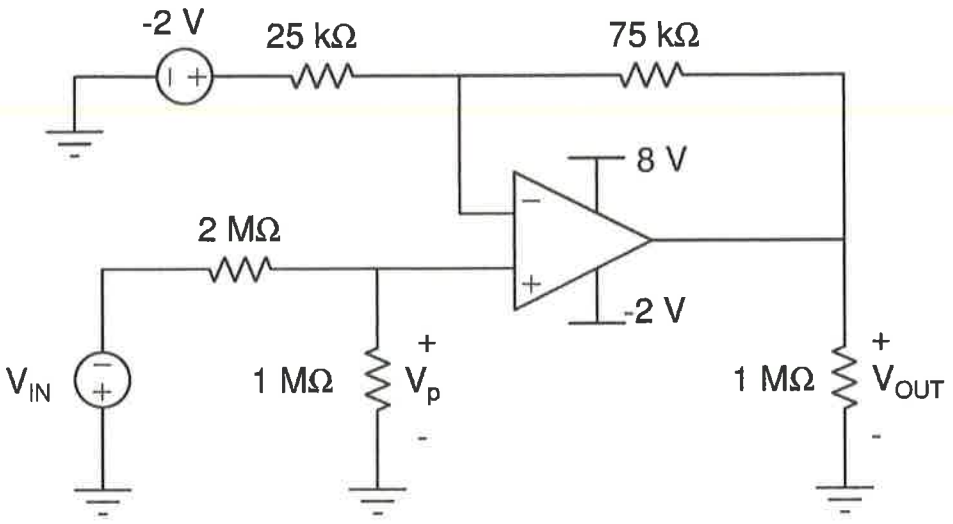
(e) What type of input coupling was used on the scope?

1. ac coupling
2. dc coupling
3. elastic coupling
4. regenerative coupling
5. none of the above

(f) If $V_2(t)$ is measured with a DVM set to measure a dc voltage, what voltage is displayed on the DVM? 0.025V

(g) If $V_2(t)$ is measured with a DVM set to measure an ac voltage, what voltage is displayed on the DVM? $\frac{0.4}{\sqrt{2}}$ or 0.283V

Problem 2: Consider the OpAmp circuit below. The OpAmp is ideal. Measurements are made using a DVM which has an input resistance of 1 MΩ.



$V_p = -\frac{V_{in}}{3}$

$\frac{-2-(-\frac{V_{in}}{3})}{25} = \frac{-\frac{V_{in}}{3}-V_{OUT}}{75}$

$-6+V_{in} = -\frac{V_{in}}{1} - V_{OUT}$

$V_{OUT} = 6 - \frac{4}{3}V_{in}$

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

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

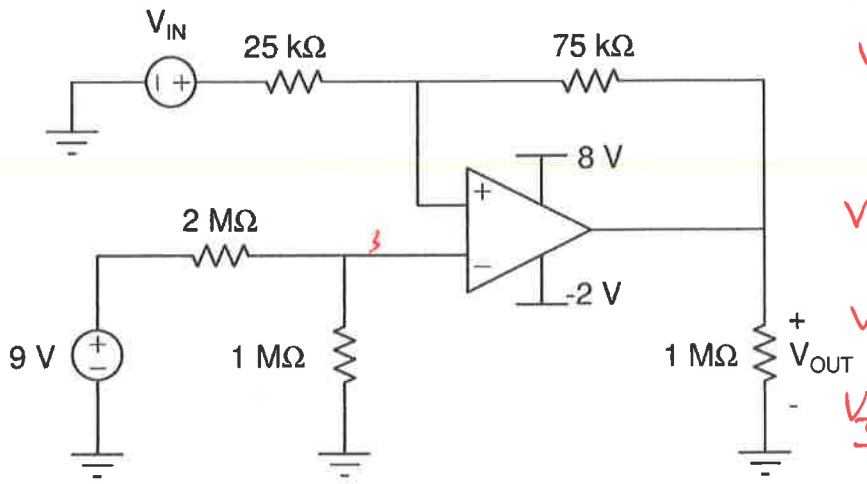
(b) When $V_{IN} = 3$ V what is the actual value of V_{OUT}? 2 V

(c) When $V_{IN} = 3$ V what is the measured value of V_{OUT}? 2 V

(d) When $V_{IN} = 3$ V what is the actual value of V_P? -1 V

(e) When $V_{IN} = 3$ V what is the measured value of V_P? $-\frac{3}{5}V = -0.6V$

Problem 3: Consider the OpAmp circuit below. The OpAmp is ideal.



$V_{out} = 8$

$\frac{V_{in} - 3}{25} = \frac{3-8}{75}$

$V_{t_1} = V_{in} = -\frac{5}{3} + 3 = \frac{4}{3} V$

$V_{out} = -2$

$\frac{V_{t_2} - 3}{25} = \frac{3+2}{75}$

$V_{t_2} = \frac{5}{5} + 3 = \frac{14}{3} V$

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

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

$V_{t_1} = \frac{4}{3} V$

$V_{t_2} = 4\frac{2}{3} V$

(b) When $V_{IN} = 0$ V, what is the value of V_{OUT}?

1. -2 V
2. 0 V
3. +2 V
4. +6 V
5. +8 V
6. can not be determined

(c) When $V_{IN} = 3$ V, what is the value of V_{OUT}?

1. -2 V
2. 0 V
3. +2 V
4. +6 V
5. +8 V
6. can not be determined

Problem 4: Which is the following is the "most correct" course of action to take if someone near you receives an electrical shock?

1. Scream: help! help! help!, then leave the area so you are not injured
2. Stay calm, wait at least 45 minutes for any excess charge to leak off, then call 911
3. Stay calm, keep the person agitated to prevent their heart from stopping, and provide a lot of water to keep the person hydrated
4. Stay calm, keep the person agitated to prevent their heart from stopping, but do not provide any water
5. Stay calm, keep the person calm, and provide a lot of water to keep the person hydrated
6. Stay calm, keep the person calm, but do not provide any water as it may cause a stroke

Problem 5: Draw below the complete schematic of the non-inverting integrator you designed and tested in ECE 214 Laboratory #4. Include the values of all components, the power supply voltages and the model number of the OpAmp.