ECE 214 — Exam # 1

Estimated time for completion: $\leq$ 1.25 hour
25 February 2014

Rules of the Exam

Rule 1: The examination period begins at 8:00am on Tuesday 25 February 2014 and ends at 9:15am on Tuesday 25 February 2014.

Rule 2: There are five problems with a total of 26 answers. Each answer is worth four points. There are four bonus points!

Rule 3: For all answers, 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 but you may use your ECE 214 Laboratory Notebook, a ruler, and a calculator.

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Name

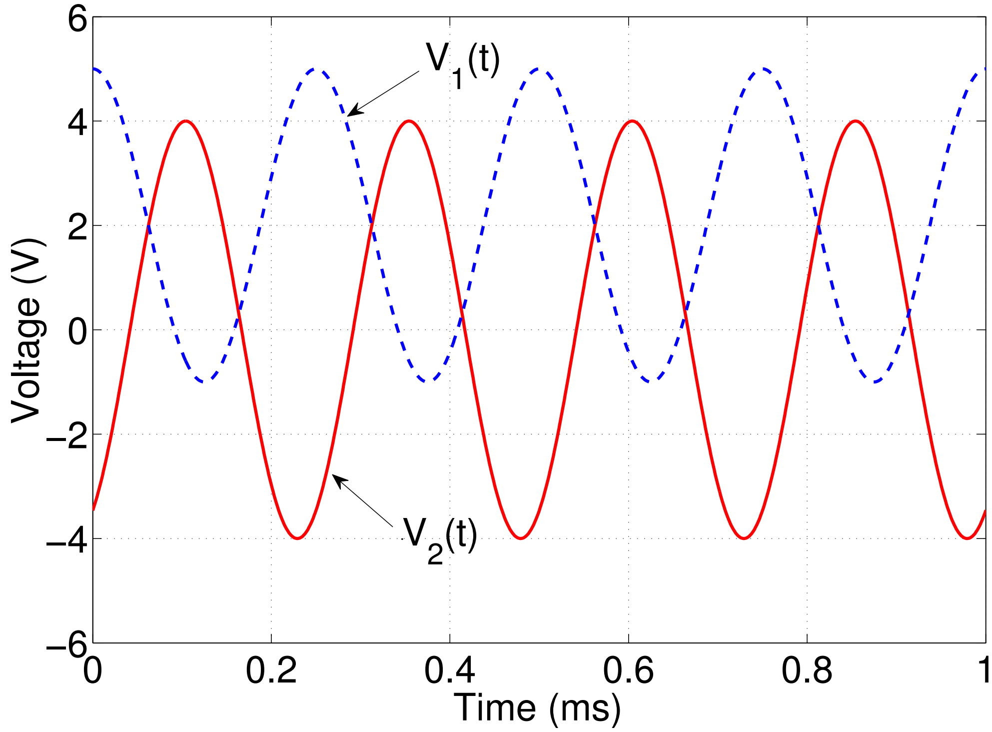
Problem 1 Oscilloscope traces for two voltage waveforms

$$V_1(t) = A_1 \cos(\omega t + \phi_1) + V_{DC_1}$$

and

$$V_2(t) = A_2 \cos(\omega t + \phi_2) + V_{DC_2}$$

are shown below.



(a) What is A_1? ________________

(b) What is A_2? ________________

(c) What is ω? ________________

(d) What is $|\phi_1 - \phi_2|$? ________________

(e) What is V_{DC_1}? ________________

(f) What is V_{DC_2}? ________________

(g) $V_2(t)$ is measured with a DVM, set to measure an ac voltage. What voltage is displayed on the DVM? ________________

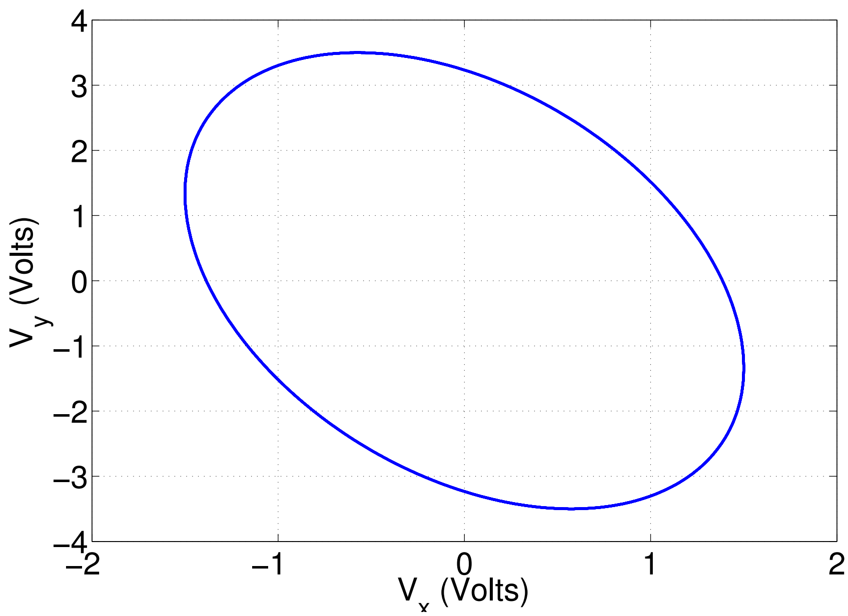
Problem 2 The Lissajous figure, using the XY–mode on the scope, produced by two voltage waveforms

$$V_x(t) = X_0 \sin(\omega t + \phi_1)$$

and

$$V_y(t) = Y_0 \sin(\omega t + \phi_2)$$

is shown below.



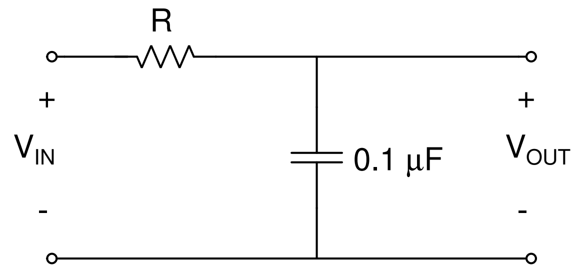
(a) What is X_0? ____________________

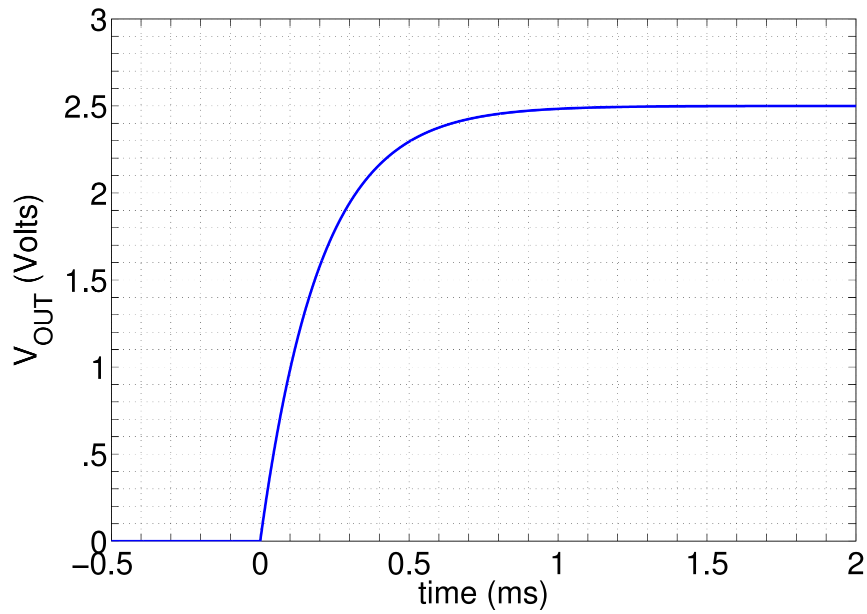
(b) What is Y_0? ____________________

(c) What is $|\phi_1 - \phi_2|$ in degrees? ____________________

(d) What is $|\phi_1 - \phi_2|$ in radians? ____________________

Problem 3 Consider the RC circuit and step response at $t = 0$ shown below:





The step response is given by $\mathrm{V_{OUT}}(t) = \mathrm{V_0}\left(1 - e^{-t/\tau}\right)$ for $t \geq 0$

(a) What is $\mathrm{V_0}$? ________________

(b) What is R? ________________

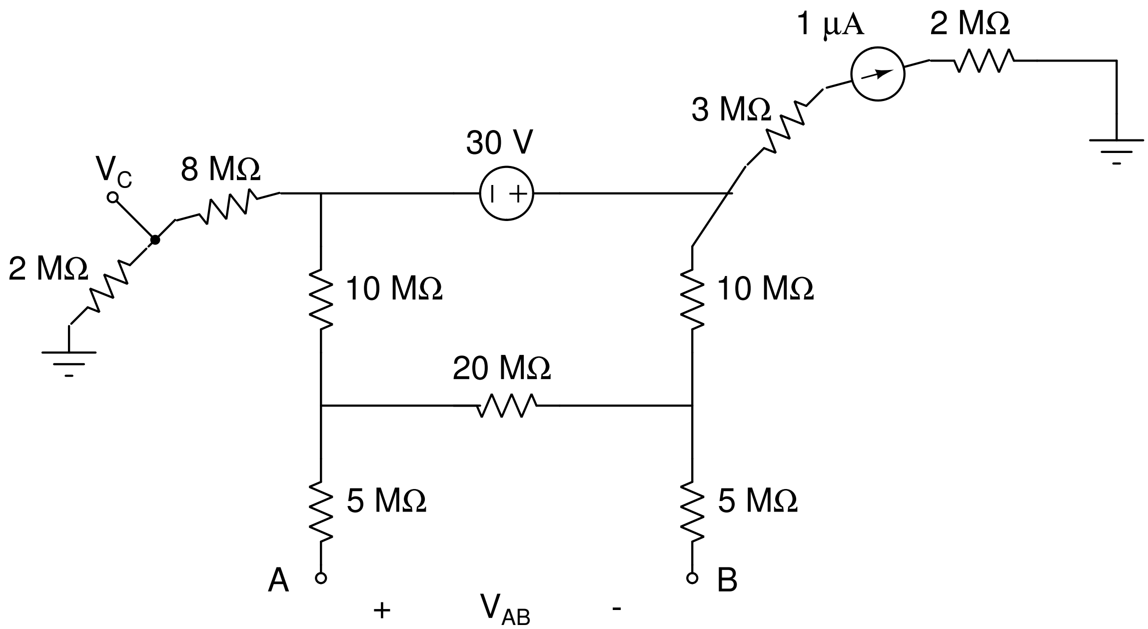
(c) What is the rise-time? ________________

(d) Is this circuit a low pass, high pass, band pass or band reject filter? ________________

(e) At what frequency is $\mathrm{V_{OUT}}/\mathrm{V_{IN}} = -20\mathrm{dB}$? ________________

(f) At what frequency is $\mathrm{V_{OUT}}/\mathrm{V_{IN}} = -28\mathrm{dB}$? ________________

Problem 4 A digital volt meter (DVM), having an input resistance of 10 MΩ, is used to make measurements on the circuit below.



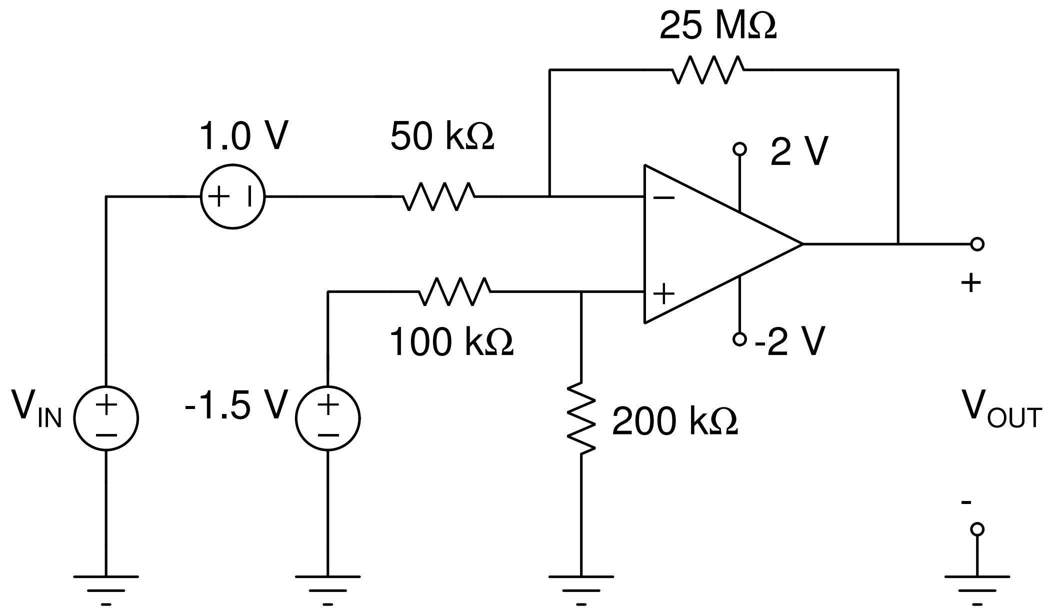
(a) What is the actual voltage V_{AB}? ________________

(b) What is the measured voltage V_{AB}? ________________

(c) What is the actual voltage V_C with respect to ground? ________________

(d) What is the measured voltage V_C with respect to ground? ________________

Problem 5 In the schematic below, assume the OpAmp is ideal.



(a) Is this circuit an inverting amplifier, a non-inverting amplifier, an inverting differentiator, an inverting integrator, or a Schmitt trigger? ________________

(b) When $V_{IN} = 1.0\text{mV}$, what is V_{OUT}? ________________

(c) When $V_{IN} = -1.0\text{mV}$, what is V_{OUT}? ________________

(d) When $V_{IN} = 10\text{mV}$, what is V_{OUT}? ________________

(e) When $V_{IN} = -10\text{mV}$, what is V_{OUT}? ________________