University ☺f P☺rtland
Sch☺☺l ☺f Engineering

EE 262-δignals & δystems-3 cr. hrs.
Spring 2013

Final Exam

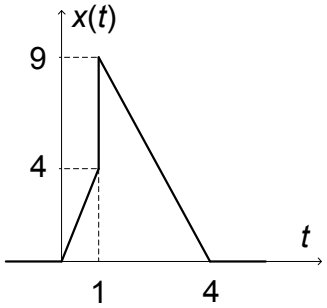
(Prepared by Professor A. S. Inan)

(Thursday, May 2, 2013, 10:30-12:30p.m.)
(Closed Book Exam, formula sheets allowed.)
(Total Time: 2 hours)

Name:_____☺

Signature:_____☺

(1) (*Total:* 20 points) **Laplace transform of singularity functions.** For the signal $x(t)$ shown:



(a) (5 points) Express $x(t)$ in terms of singularity functions.

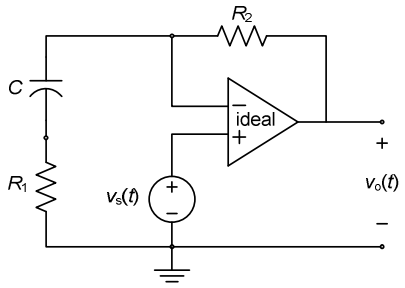
(b) (5 points) Find the Laplace transform $X(s)$ of $x(t)$.

(c) (5 points) Find the mathematical expression for $dx(t)/dt$.

(d) (5 points) Find the Laplace transform of $dx(t)/dt$.

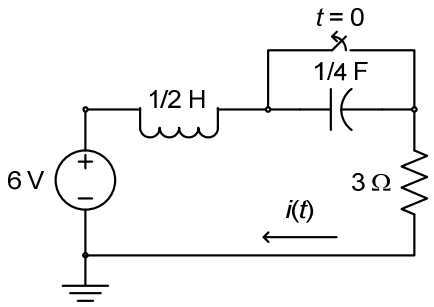
(2) (*Total:* 20 points) **Transfer function and impulse response.**

(a) (10 points) For the op-amp circuit shown, given R_1 = 1 kΩ, R_2 = 3 kΩ, and C = 1 μF, find the transfer function $H(s) = V_O(s)/V_S(s)$.



(b) (10 points) Find the impulse response $h(t)$.

(3) (20 points) **Electric circuits.** For the electric circuit shown, the switch opens at t = 0, after being closed for a long time. Use Laplace transform to find the complete mathematical expression for the current $i(t)$ for $t \geq 0$.



(4) (20 points) **Convolution integral.** Given $x(t) = 2te^{-t}u(t)$ and $h(t) = 3\cos(2t)u(t)$, find the convolution integral $y(t) = x(t) * h(t)$.

(5) (*Total:* 20 points) **Fourier series.** The trigonometric Fourier series of a periodic voltage $v_i(t)$ is given by $v_i(t) = 10 + 10\sin(1000t) - 10\cos(3000t)$.

(a) (10 points) Find the complex exponential Fourier series of $v_i(t)$ and sketch its two-sided spectra. Provide all the pertinent values on your sketch.

(b) (10 points) If $v_i(t)$ voltage signal is applied to the circuit shown below, find the complex exponential Fourier series of $v_o(t)$ and sketch its two-sided spectra. Again, provide all the pertinent values on your sketch. (Assume steady-state condition.)