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

EE 262-δignals & δystems-3 cr. hrs.
Spring 2014

Final Exam

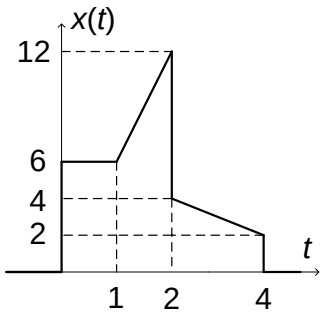
(Prepared by Professor A. S. Inan)

(Tuesday, April 29, 2014, 13:30-15:30)
(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.

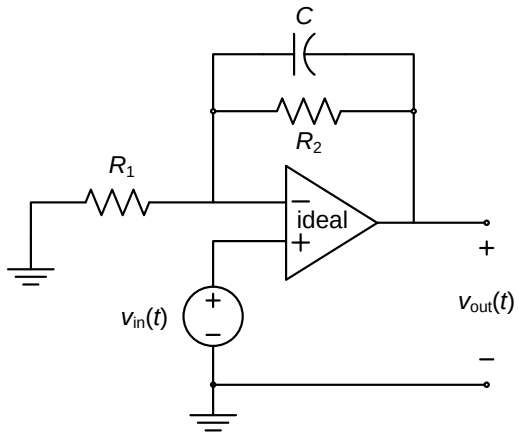
(b) (5 points) Find the Laplace transform $X(s)$ of $x(t)$.

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

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

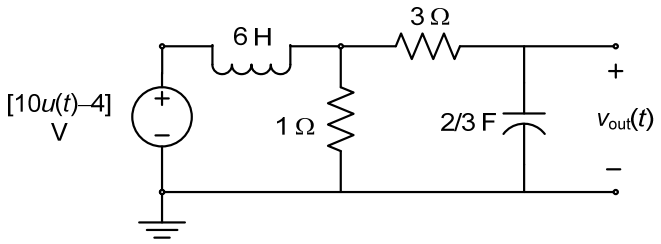
(2) (*Total:* 20 points) **Transfer function and impulse response.**

(a) (10 points) For the op-amp circuit shown, given R_1 = 5 Ω, R_2 = 10 Ω, and C = 1/10 F, find the transfer function $H(s) = V_{\text{out}}(s)/V_{\text{in}}(s)$. (Be careful!)



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

(3) (20 points) **Electric circuits.** For the electric circuit shown, use Laplace-domain circuit to find the complete mathematical expression for the voltage $v_{\text{out}}(t)$ for $t \geq 0$.



(4) (20 points) **Convolution integral.** Given $x(t)=12te^{-2t}u(t)$ and $h(t)=20\sin(3t)u(t)$, find the convolution integral $y(t)=x(t)*h(t)$.

(5) (20 points) **Fourier series.** The trigonometric Fourier series of a periodic sawtooth voltage waveform $v_i(t)$ is given by $v_i(t)=\sum_{n=1}^{\infty}(-1)^{n+1}\left(\frac{20}{n\pi}\right)\sin(n3000\pi t)$. If this signal is applied to the electric circuit shown below, calculate the first three terms of the Fourier series of the output voltage $v_{out}(t)$.