University of Portland
School of Engineering

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

Midterm Exam # 1
(Prepared by Professor A. S. Inan)

(Monday, February 24, 2014)
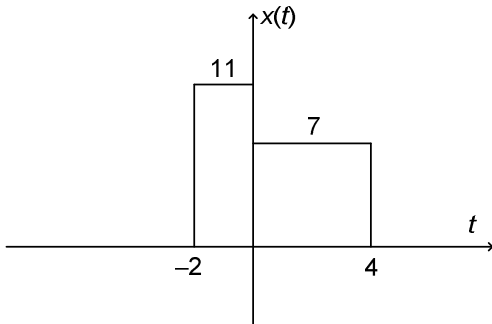(Closed Book Exam, One formula sheet allowed.)
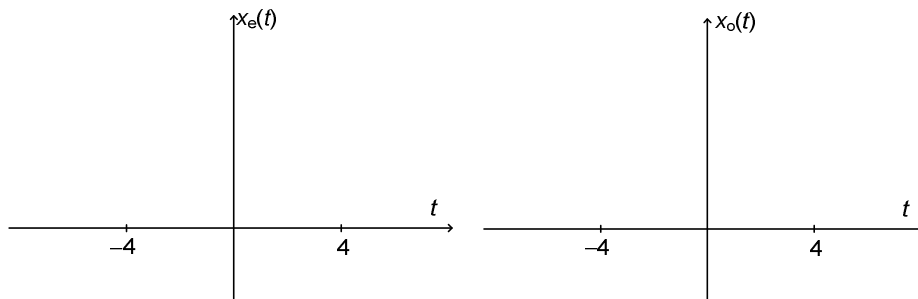(Total Time: 55 mins.)

Name:_____ ☺

*Signature:*_____ ☺

(Any 6 problems in-class, the other 6 problems take-home due this Wednesday, February 26, 2014)

(1) (Total: 20 points) **Signals.** Consider a continuous-time signal, $x(t)$, as shown.

$x(t)$

11

7

t

−2   4

(a) (10 points) **Even and odd parts.** Sketch the even and odd parts of $x(t)$. Provide all the pertinent values on your sketch.
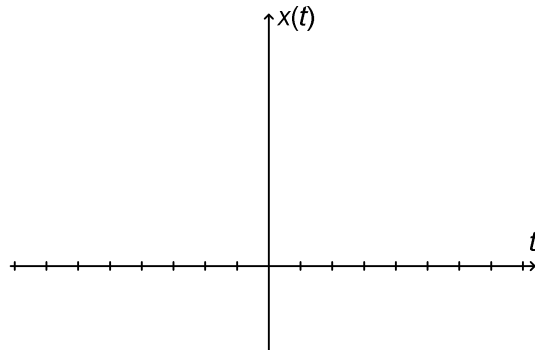
$x_e(t)$

t

−4   4

$x_o(t)$

t

−4   4

(b) (10 points) **Derivative of a signal.** Find the complete mathematical expression for the function $y(t) = dx(t)/dt$ and sketch $y(t)$ versus t. Provide all the pertinent values on your sketch.
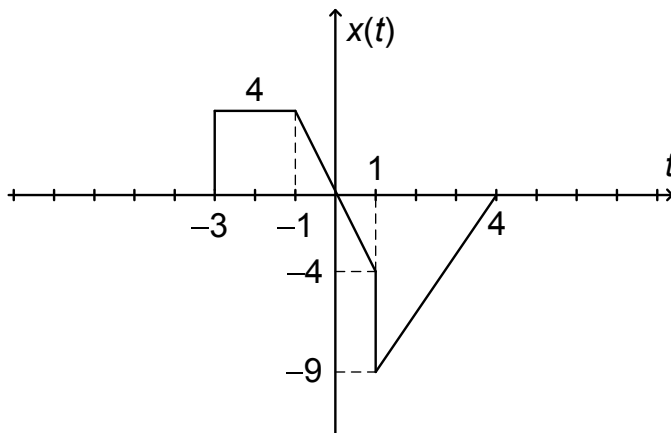
$dx(t)/dt$

t

−4   4
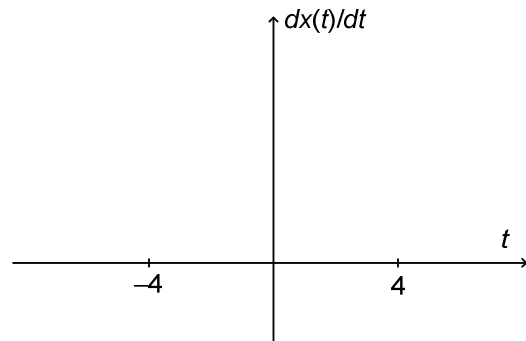
(2) (10 points) **Rectangular pulse signal.** Sketch the rectangular pulse signal given by

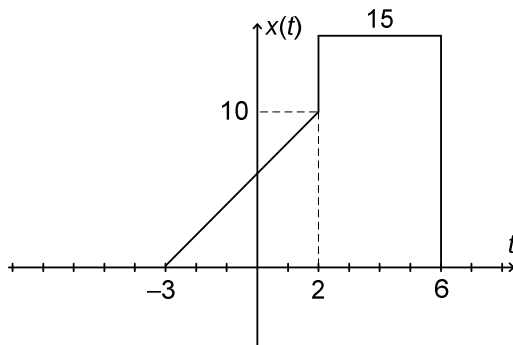$$x(t) = 2\mathrm{rect}\left(\frac{t-1}{4}\right) + 4\mathrm{rect}\left(\frac{t-3}{2}\right)$$

(3) (10 points) **Period of a signal.** Determine the period of the signal given by $x(t) = 3\sin(8\pi t + 3\pi/5) + 8\cos(5\pi t - \pi/3)$.
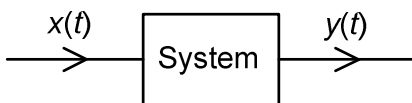
(4) (10 points) **Singularity functions.** Express the signal $x(t)$ sketched below in terms of singularity functions.

(5) (10 points) **Energy of a signal.** Determine the total energy of the signal $x(t)$ shown below.

(6) (10 points) **Causal system?** The input-output relationship of the system shown below is described as $y(t)=x(1-t)$. Is this system causal? (Provide a meaningful justification.)


(7) (10 points) **Linear system?** The input-output relationship of the system shown below is described as $y(t)=3\sin[x(t)]$. Is this system linear? (Provide a meaningful justification.)
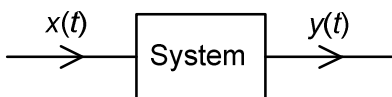

(8) (10 points) **Time-invariant system?** The input-output relationship of the system shown below is described as $y(t)=e^{-t}x(t)$. Is this system time invariant? (Provide a meaningful justification.)

(9) (10 points) **LTI system.** The impulse response of an LTI system is given as shown. Find and sketch the unit-step response of this system.

$x(t)$ → | LTI System | → $y(t)$

$h(t)$

1 at t = 1, then −1 between 1 and 3
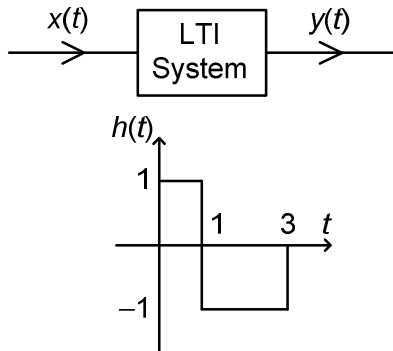
(10) (10 points) **LTI system.** The unit-step response of an LTI system is given by $y_{step}(t) = 3e^{-(t-1)}u(t)$. If an input signal $x(t)$ given by $x(t) = 2u(t-1) - 3\delta(t-2)$ is applied to this system, what will be the output signal $y(t)$? (Assume zero-state condition.)

$x(t)$ → | LTI System | → $y(t)$

$y_{step}(t) = 3e^{-(t-1)}u(t)$
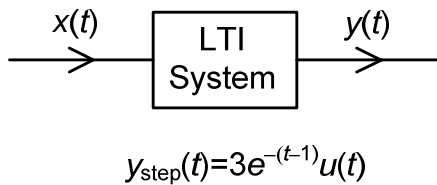
(11) (10 points) **LTI system.** The impulse response of an LTI system is given by $h(t) = 2u(t+1) - 3u(t-2) + u(t-4)$. Determine whether this system is (a) causal or non-causal; and (b) BIBO stable or unstable. (Show your work.)

$x(t)$ → | LTI System | → $y(t)$

$h(t) = 2u(t+1) - 3u(t-2) + u(t-4)$
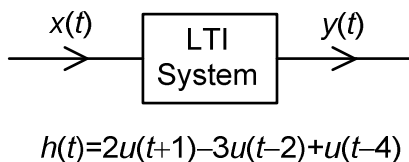
(12)　(10 points) **Impulse response.** Find the impulse response of the following circuit shown.