I have to differentiate her so that we can get along better!

I must integrate him so that we can get along better!

Who do you think you are, Ms. Unit Step? You are simply my integral!

Oh yeah? Who do you think you are, my derivative, Mr. Impulse? Don't forget that you would have never existed if I didn't!

University of Portland
School of Engineering

EE 262-δignals & δystems-3 cr. hrs. Spring 2017

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

(Wednesday, March 1, 2017)
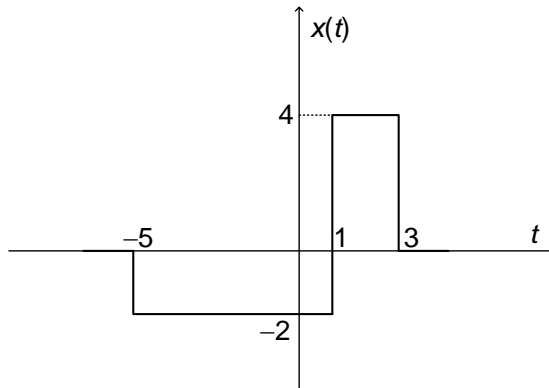(Closed Book Exam, One formula sheet allowed.)
(Total Time: 55 mins.)

Name:_____ ☺

*Signature:*_____ ☺

(You are required to do Problem (1) in-class. Select any 6 of the other 11 problems to do in-class, the 5 problems you didn't select are take-home and due this Friday, March 3, 2017.)
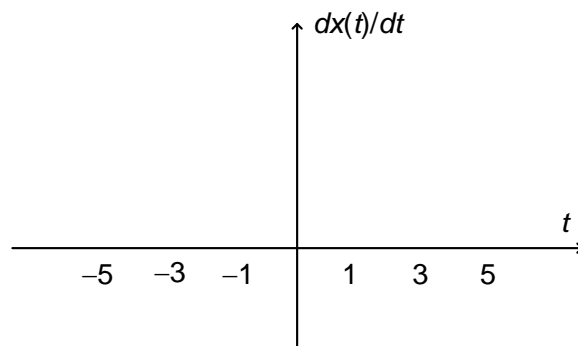
(1) (<u>Total:</u> 20 points) **Signals.** Consider a continuous-time signal, $x(t)$, as shown.

(a) (10 points) **Even and odd parts.** Sketch the even and odd parts of $x(t)$. Provide all the pertinent values on your sketch.
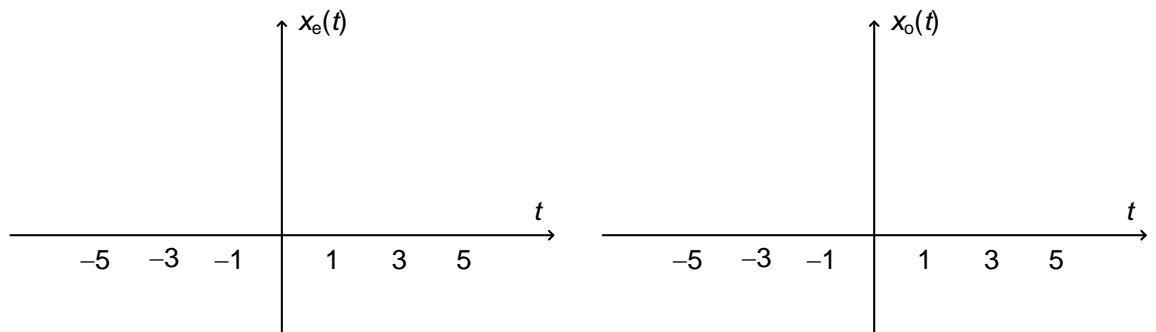
(b) (10 points) **Derivative of a signal.** Find the complete mathematical expression for the function $y(t) = dx(t)/dt$ and sketch $y(t)$ versus t. Provide all the pertinent values on your sketch.
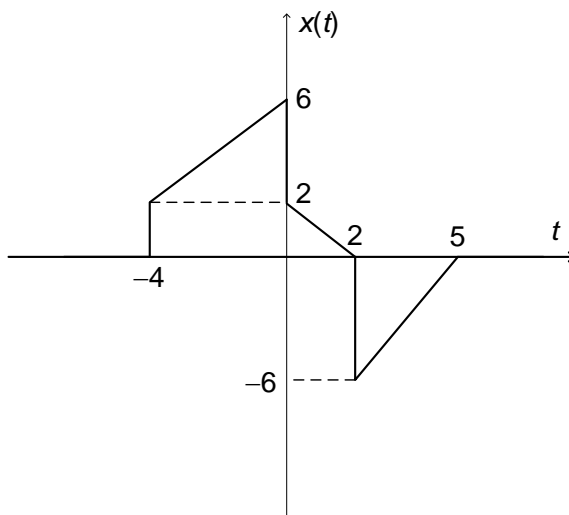
(2) (10 points) **Rectangular functions.** Express the function shown below in terms of two rectangular functions.
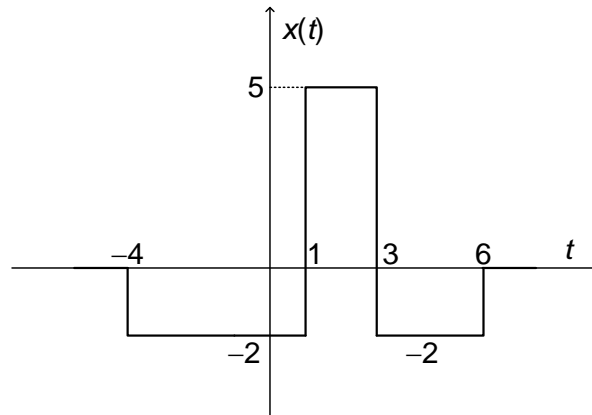
(3) (10 points) **Period of a signal.** Determine the period of the signal given by $x(t) = 11\cos(2t/3 + 7\pi/10) + 6\sin(4t/5 + 8\pi/9)$.

(4) (10 points) **Singularity functions.** Express the signal $x(t)$ sketched below in terms of singularity functions.

(5) (10 points) **Inverse Laplace transform.** Find the inverse Laplace transform of the signal given by

$$X(s) = \frac{5s^2 + 9s + 10}{(s+1)^2 (s+3)}$$

(6) (10 points) **Causal system?** The input-output relationship of the system shown below is described as $y(t) = 5e^{2(t+1)}x(3t-4)$. Is this system causal? (Provide a meaningful justification.)

$x(t)$ → | System | → $y(t)$
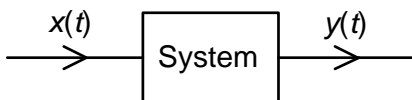
(7) (10 points) **Linear system?** The input-output relationship of the system shown below is described as $y(t) = \int_t^\infty x(2\tau - 3)d\tau$. Is this system linear? (Provide a meaningful justification.)

$x(t)$ → | System | → $y(t)$
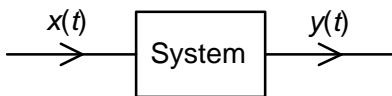
(8) (10 points) **Time-invariant system?** The input-output relationship of the system shown below is described as $y(t) = 3\sin[2tx(t-1)]$. Is this system time invariant? (Provide a meaningful justification.)

(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) plot: value 4 from t=1 to t=5, value −2 from t=0 to t=1
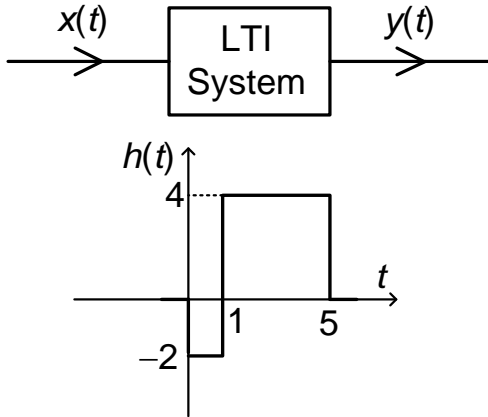
(10)   (10 points) **LTI system.** The zero-state response of an LTI system excited by $x(t) = 3\delta(t-1)$ is given by $y(t) = 6e^{-t}u(t-1)$. If an input signal given by $x(t) = 3u(t-1) + 4\delta(t-2)$ is applied to this system, what will be the output signal $y(t)$?

$x(t) = 3\delta(t-1)$ → [LTI System] → $y(t) = 6e^{-t}u(t-1)$

Initially at zero state
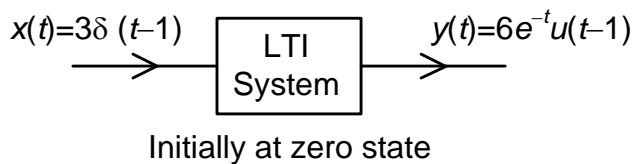
(11)   (10 points) **LTI system.** The impulse response of an LTI system is as shown. Determine whether this system is (a) causal or non-causal; and (b) BIBO stable or unstable. (Show your work.)

$x(t)$ → | LTI System | → $y(t)$

$h(t)$

6

3

(5)

t

−1
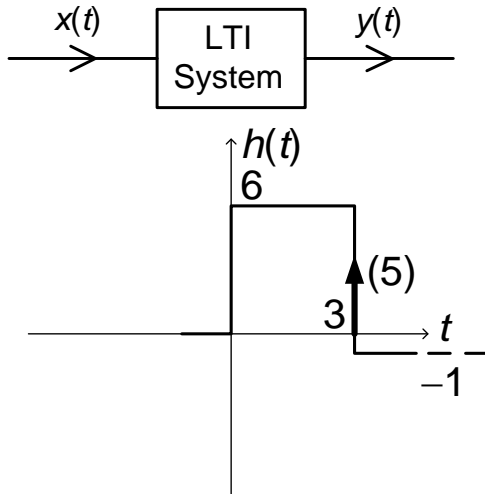
(12)   (10 points) **Impulse response.** Find the impulse response of the following circuit shown.

$x(t)$

30 Ω

5 H

30 Ω

30 Ω

$y(t)$

+

−