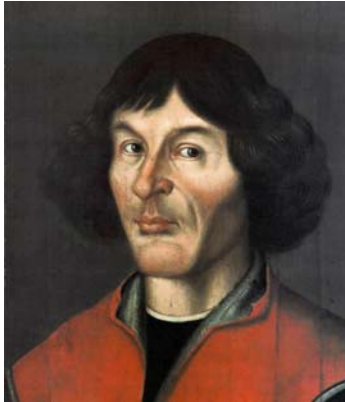# *Happy 543ʳᵈ Birthday Copernicus!*

Nicolaus Copernicus
(19-2-1473—24-5-1*543*)

University of Portland
School of Engineering

EE 262-δignals & δystems-3 cr. hrs.
Spring 2016

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

(Friday, February 19, 2016)
(Closed Book Exam, One formula sheet allowed.)
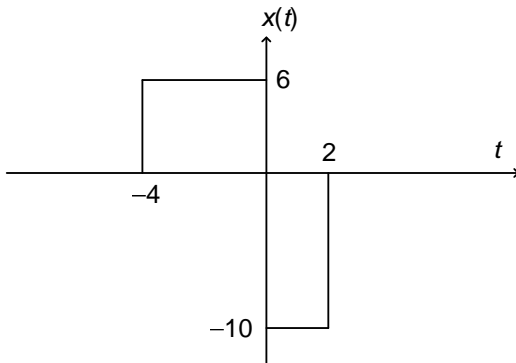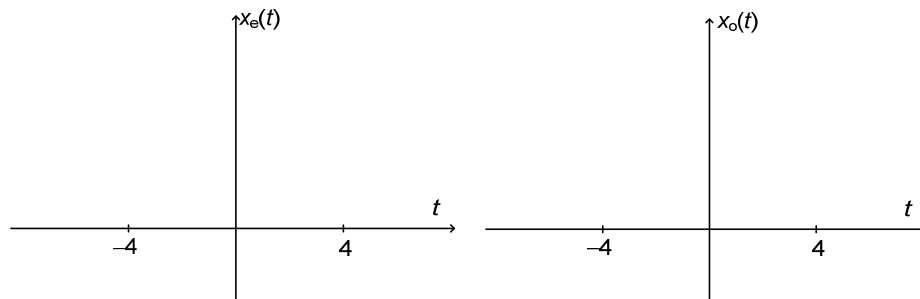(Total Time: 55 mins.)

Name:_____☺

*Signature:*_____☺

(Any 7 problems in-class, the other 5 problems take-home due Monday, February 22, 2016)
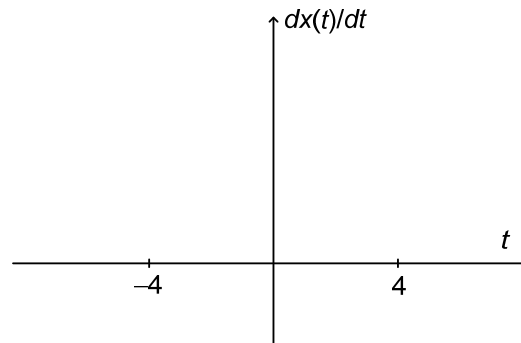
(1) (<u>Total:</u> 10 points) **Signals.** Consider a continuous-time signal, $x(t)$, as shown.

(a) (5 points) **Even and odd parts.** Sketch the even and odd parts of $x(t)$. Provide all the pertinent values on your sketch.
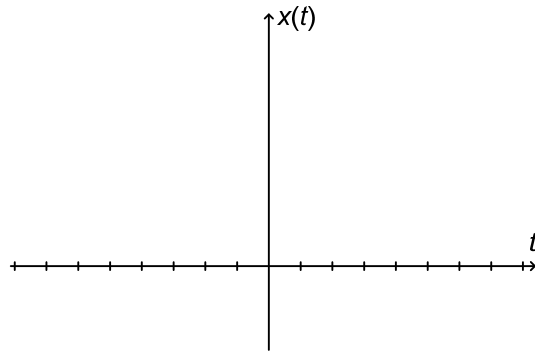

(b) (5 points) **Derivative of a signal.** Find the complete mathematical expression for the function $y(t) = dx(t)/dt$ and sketch $y(t)$ versus t. Provide all the pertinent values on your sketch.
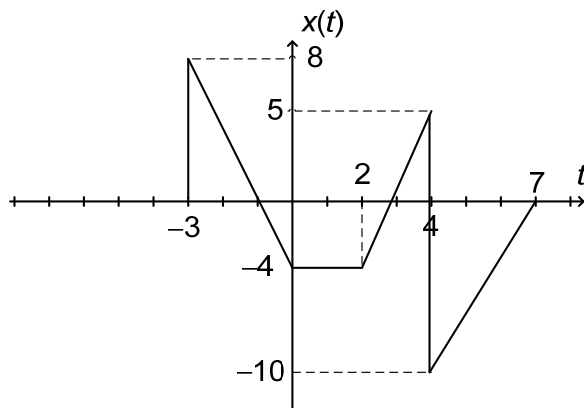
(2) (10 points) **Rectangular pulse signal.** Sketch the rectangular pulse signal given by

$$x(t) = 4\text{rect}\left(\frac{t-2}{4}\right) - 6\text{rect}\left(\frac{t+2}{8}\right)$$
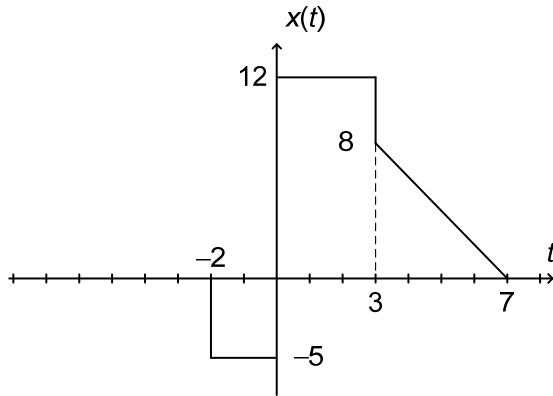

(3) (10 points) **Period of a signal.** Determine the period of the signal given by $x(t) = 3\cos(6\pi t - 2\pi/5) + 8\sin(15\pi t + 5\pi/8)$.
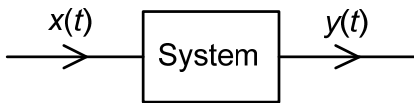
(4) (10 points) **Singularity functions.** Express the signal $x(t)$ sketched below in terms of singularity functions.

(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 $y(t) = x(3-t)$. 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 $y(t) = 3x(t)x(t-1)$. Is this system linear? (Provide a meaningful justification.)
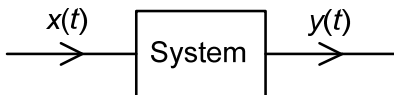
(8) (10 points) **Time-invariant system?** The input-output relationship of the system shown below is described as $y(t) = e^{(3-t)}x(t+1)$. Is this system time invariant? (Provide a meaningful justification.)

(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.
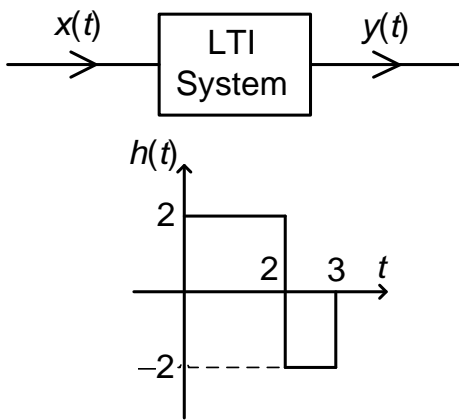
(10)   (10 points) **LTI system.** The unit-step response of an LTI system is given by $y_{step}(t) = 3e^{(5-2t)}u(t)$. If an input signal $x(t)$ given by $x(t) = 2\delta(t-1) - 3u(t-2)$ is applied to this system, what will be the output signal $y(t)$? (Assume zero-state condition.)

$y_{step}(t) = 3e^{(5-2t)}u(t)$
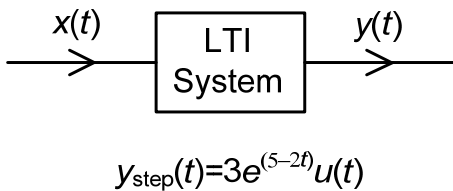
(11)   (10 points) **LTI system.** The impulse response of an LTI system is given by $h(t) = 2r(t+1) - 3u(t-2) - 2r(t-4) - 7u(t-6)$. Determine whether this system is (a) causal or non-causal; and (b) BIBO stable or unstable. (Show your work.)

$x(t)$ → | LTI System | → $y(t)$

$h(t)=2r(t+1)-3u(t-2)-2r(t-4)-7u(t-6)$

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

2 Ω

$x(t)$ (+/−)   0.2 H   2 Ω $y(t)$ +/−