

*University ☺ of P ☺ r t l a n d*  
*Sch ☺ o l ☺ of Engineering*

**EE 262-Signals & Systems-3 cr. hrs.**

**Spring 2013**

**Midterm Exam # 1**

(Prepared by Professor A. S. Inan)

(Friday, February 22, 2013)

(Happy 281<sup>st</sup> Birthday, George Washington!)

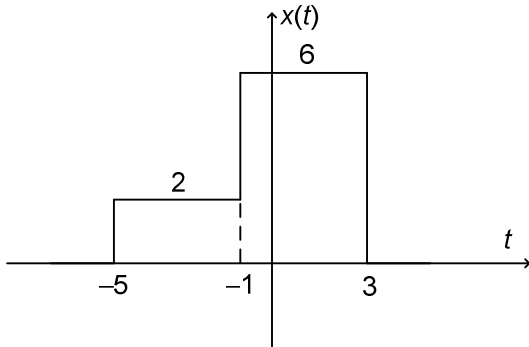
(Closed Book Exam, One formula sheet allowed.)

(Total Time: 55 mins.)

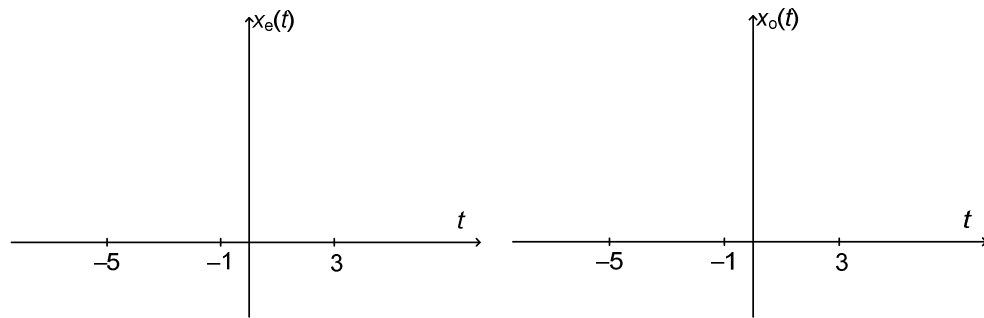
**Name:** \_\_\_\_\_ ☺

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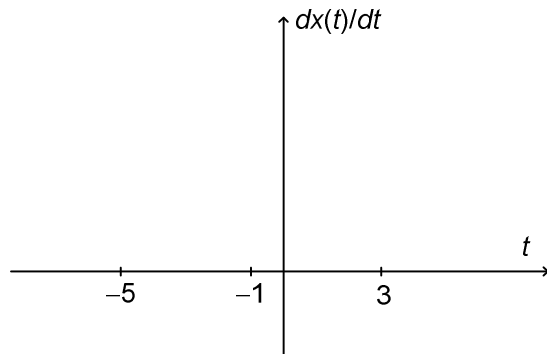
(1) (Total: 20 points) **Signals.** Consider a continuous-time signal,  $x(t)$ , as shown.



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

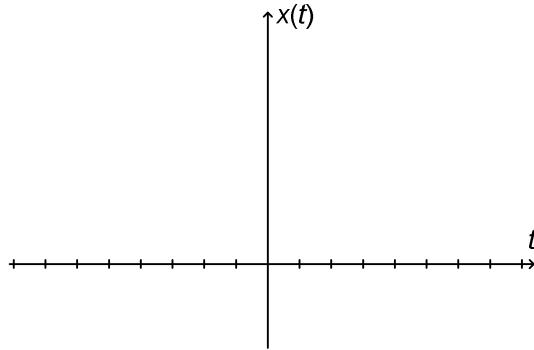


(b) (10 points) **Derivative of a signal.** Find the complete mathematical expression for the function  $y(t) = dx(t)/dt$  and sketch  $y(t)$  versus  $t$ . Provide all the pertinent values on your sketch.



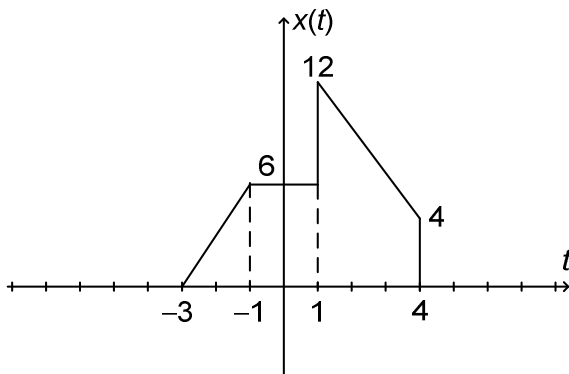
- (2) (10 points) **Rectangular pulse signal.** Sketch the rectangular pulse signal given by

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

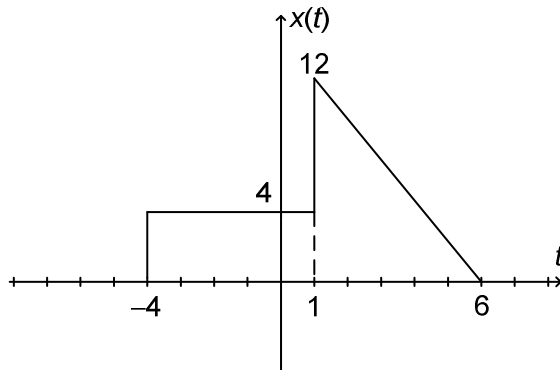


- (3) (10 points) **Period of a signal.** Determine the period of the signal given by  $x(t) = 4\cos(3\pi t - 2\pi/5) - 2\sin(10\pi t)$ .

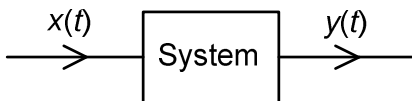
- (4) (10 points) **Singularity functions.** Express the signal  $x(t)$  sketched below in terms of singularity functions.



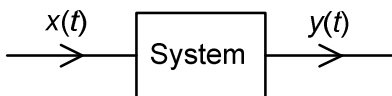
- (5) (10 points) **Energy of a signal.** Determine the total energy of the signal  $x(t)$  shown below.



- (6) (10 points) **Causal system?** The input-output relationship of the system shown below is described as  $y(t) = x(2t)$ . Is this system causal? (Provide a meaningful justification.)

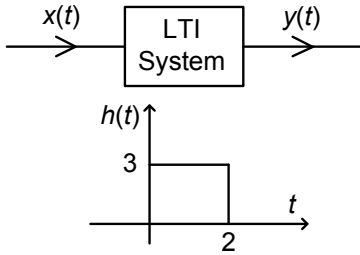


- (7) (10 points) **Linear system?** The input-output relationship of the system shown below is described as  $y(t) = \ln[x(t)]$ . Is this system linear? (Provide a meaningful justification.)

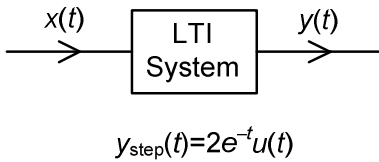


- (8) (10 points) **Time-invariant system?** The input-output relationship of the system shown below is described as  $y(t) = 2x(t-1)$ . Is this system time invariant? (Provide a meaningful justification.)

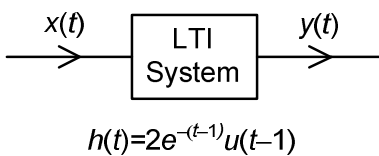
- (9) (10 points) **LTI system.** The impulse response of an LTI system is given as shown. Find and sketch the unit-step response of this system.



- (10) (10 points) **LTI system.** The unit-step response of an LTI system is given by  $y_{\text{step}}(t) = 2e^{-t}u(t)$ . 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.)



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



- (12) (10 points) **Discrete-time LTI system.** The impulse response of a discrete-time LTI system is given as shown. If an input signal  $x[n]$  given by  $x[n] = 2\delta[n] - 3\delta[n - 2]$  is applied to this system, what will be the output signal  $y[n]$ ? (Assume zero-state condition.)

