

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

**EE 262-Signals & Systems-3 cr. hrs.**  
**Spring 2011**

**Midterm Exam # 1**

(Prepared by Professor A. S. Inan)

(Friday, February 18, 2011\*)

(Closed Book Exam, One formula sheet allowed.)

(Total Time: 55 mins.)

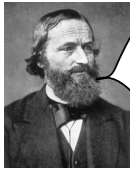
\*Today's math puzzle by Inan: Today's date expressed as a single date number as 2182011 equals  $39 \times 55949$  where 55949 is a prime number. Interestingly enough, the difference of numbers 55949 and 39 relate to Inan's age. Can you figure out how? ☺

**Name:** \_\_\_\_\_ ☺

**Signature:** \_\_\_\_\_ ☺

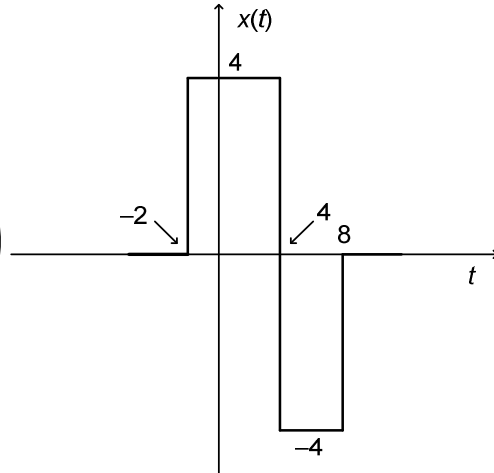
Note: 5 Problems total, 3 in-class, 2 take-home, due next Tuesday!

- (1) (10 mins., Total: 20 points) **A continuous-time signal.** Consider the continuous-time signal denoted by  $x(t)$  as shown in the figure below.

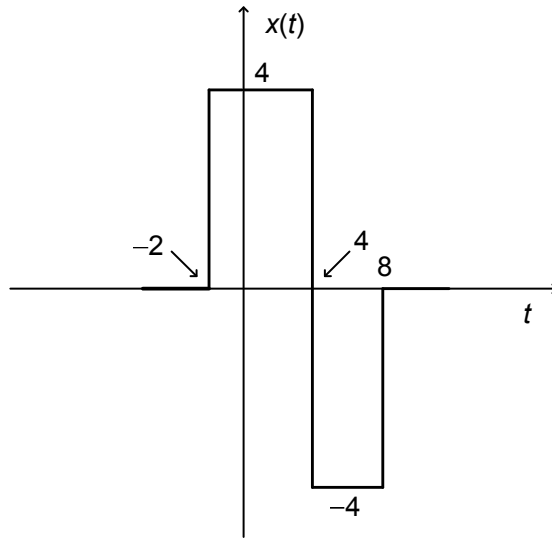


Best of luck and please, don't panic! Go step by step...

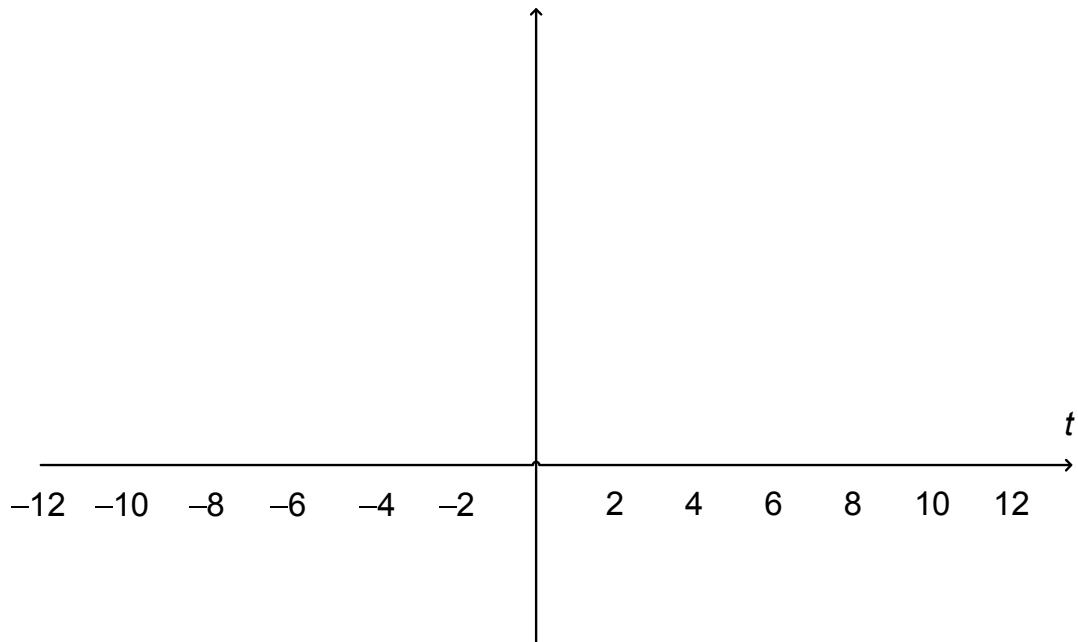
Demonstrate to Inan that you are not scared of his tests!

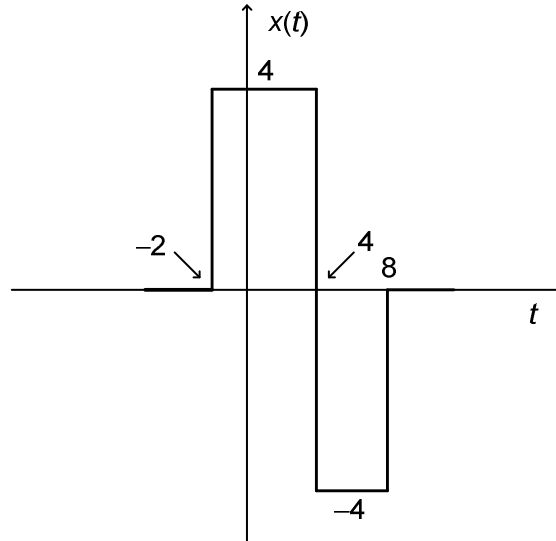


- (a) (8 points) Sketch the even and odd parts of  $x(t)$ . Provide all the pertinent values on your sketch.

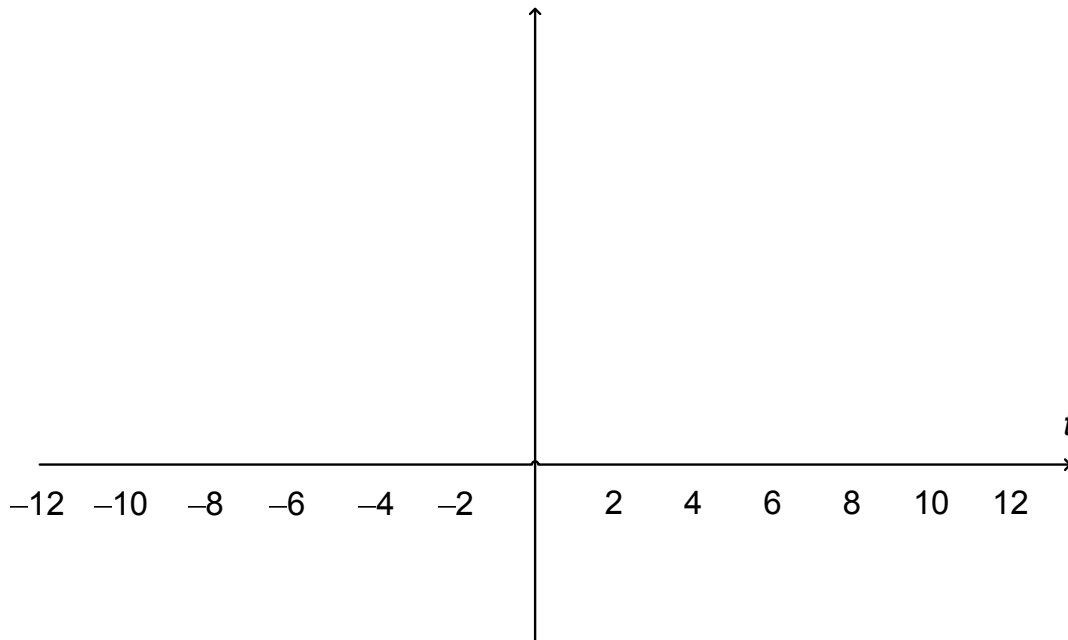


(b) (6 points) Sketch  $x(t/2+2)/2$ .





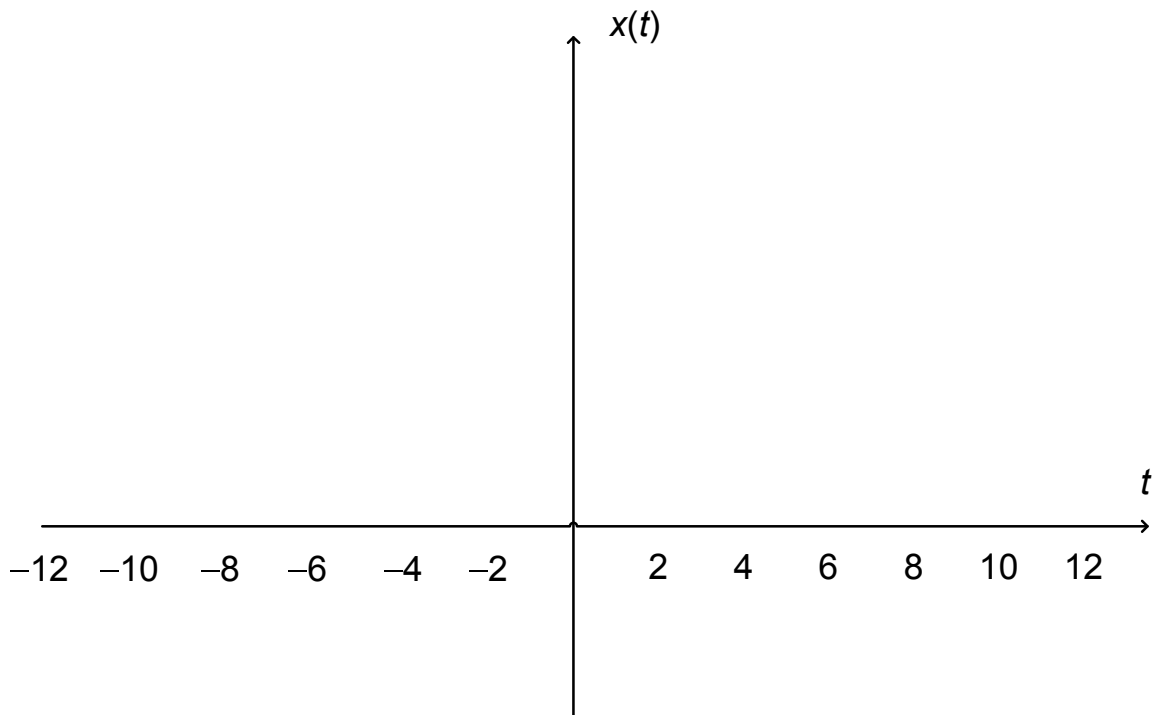
(c) (6 points) Find the complete mathematical expression for the function  $y(t)=dx(t)/dt$  and sketch  $y(t)$  versus  $t$ . Provide all the pertinent values on your sketch.



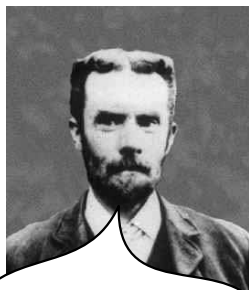
(2) (15 mins., Total: 20 points) **Impulse, step, and ramp functions.** A continuous-time signal is given by

$$x(t) = 5r(t+4) - 6u(t+4) - 10u(t) - 5r(t) - 3r(t-2) + 3r(t-6) + 11u(t-6) - 3u(t-8)$$

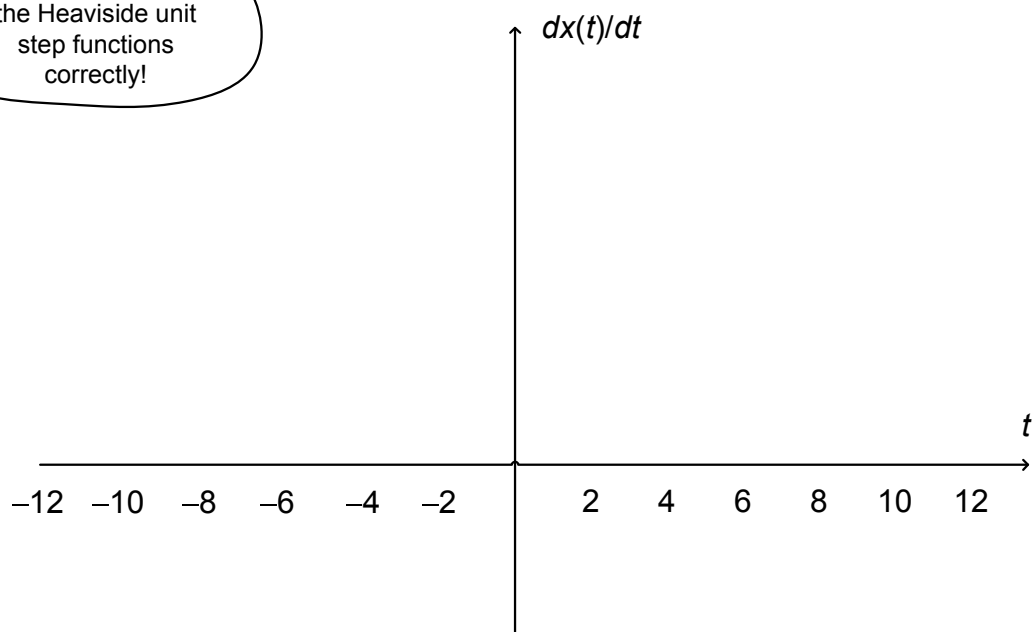
(a) (10 points) Sketch this signal. Provide all the necessary values on your sketch.

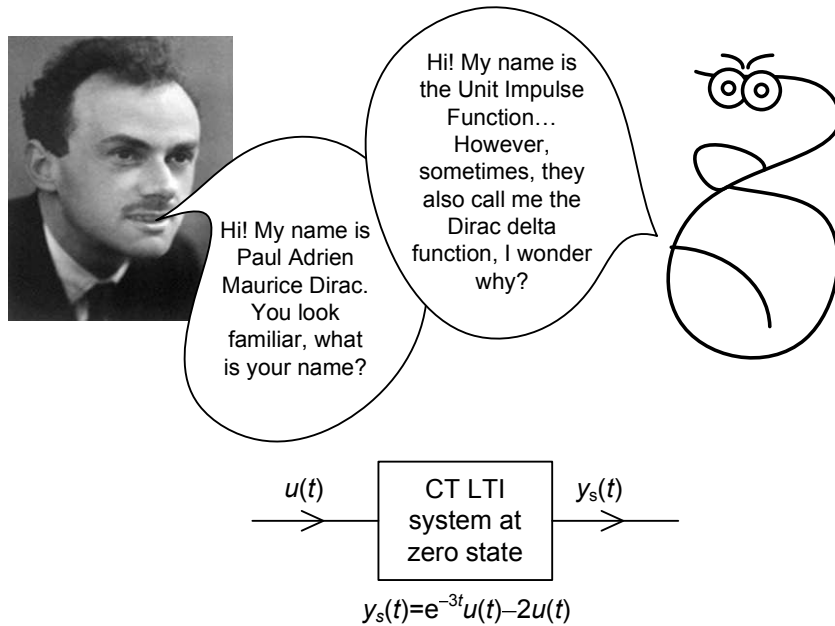


(b)(10 points) Using  $x(t)$  given in part (a), sketch the derivative signal,  $dx(t)/dt$ . Provide all the appropriate values on your sketch.



Please, differentiate the Heaviside unit step functions correctly!





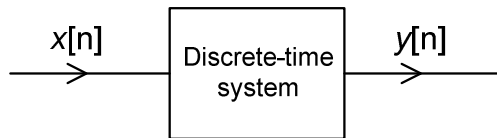
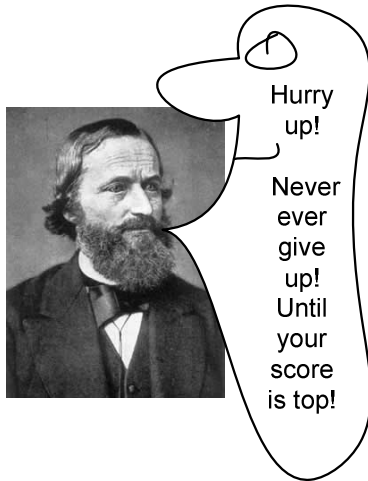
(3) (15 mins., Total: 20 points) **CT LTI system.** The unit-step response  $y_s(t)$  of a continuous-time (CT) linear time-invariant (LTI) system is given as shown.

(a) (10 points) Find the impulse response  $h(t)$  of this system.

(b) (10 points) Find the response of this system due to an input signal given by  $x(t) = 2\delta(t-1) + 3u(t-2)$ . (Assume zero initial conditions.)



(4) (15 mins., Total: 20 points) **Properties of a discrete-time system.** The input  $x[n]$  and the output  $y[n]$  relationship of a discrete-time system is given by  $y[n] = (n-1)e^{x[n/2]}$ .



(a) (3 points) Is this system memory-less? (Provide a clearly stated justification for your answer.)

(b) (3 points) Is this system causal? (Clear justification required!)

(c) (3 points) Is this system BIBO stable? (Justification required!)

(d) (3 points) Is this system invertible? (Justification required!)

(e) (4 points) Is this system linear? (Justification required!)

(f) (4 points) Is this system time invariant? (Justification required!)

(5) (15 mins., 20 points) **LTI system.** Find the complete mathematical expression and sketch the output response  $y(t)$  of the linear time-invariant (LTI) system due to the input signal  $x(t)$  as shown.

