University of Portland
School of Engineering

EE 262-Signals & Systems-3 cr. hrs.
Spring 2010

Final Examination

(Prepared by Professor A. S. Inan)

(Wednesday, April 28, 2010, 8:00-10:00a.m.)
(Formula sheets are allowed!)

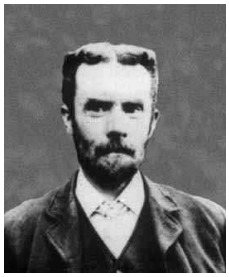
Best of luck! And do only 5 out of 6 problems!


Euler


Laplace


Fourier


Kirchhoff


Heaviside

Name:_____ ☺

Signature:_____ ☺

"Honesty is the best policy."
Aesop (~ 620B.C. –?)

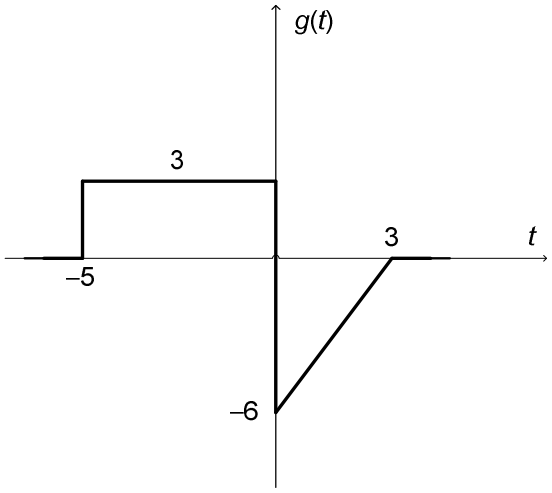
"An honest mind possesses a kingdom."
Lucius Annaeus Seneca (4B.C.–65A.D.)

"Honest people are the true winners of the universe."
Anonymous

Inan's table to be used for grading!

Problem #	***Points gained***
# 1	
# 2	
# 3	
# 4	
# 5	
# 6	
Total score	

(1) (*Total:* 20 points) **Basic properties of signals.** The signal $g(t)$ is given as shown. Do the following:



(a) (5 points) Write the complete mathematical expression for $g(t)$ using step and ramp functions.

(b) (5 points) Write the complete mathematical expression for $\frac{dg(t)}{dt}$ and **sketch** it.

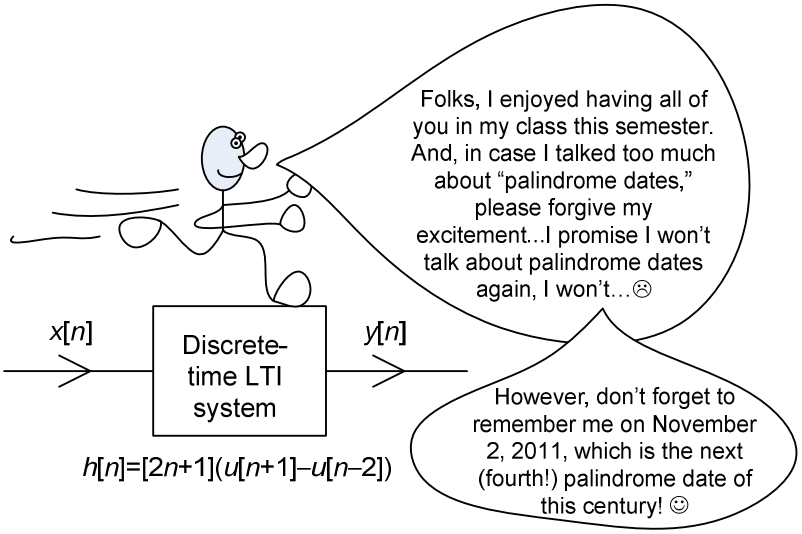
(c) (10 points) Write down the mathematical expressions found in parts (a) and (b) again:

$g(t) =$

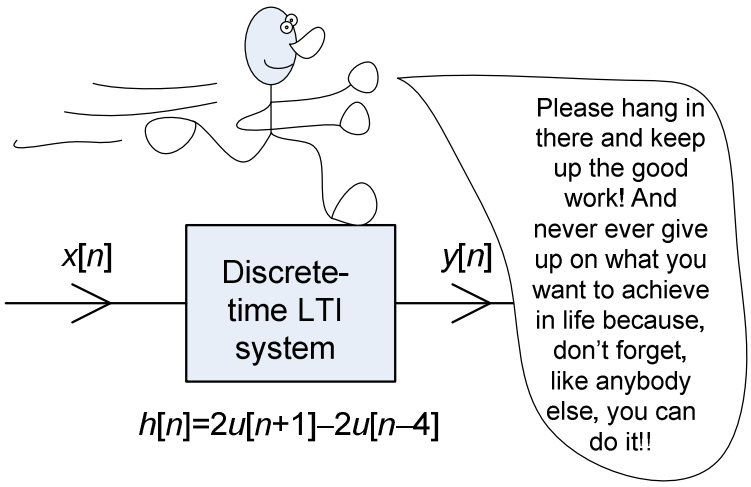
$\frac{dg(t)}{dt} =$

Now, find the complete mathematical expression for the function $y(t) = g(t) * \frac{dg(t)}{dt}$ and sketch(!) it.

(2) (20 points) **The unit impulse response of an LTI system.** Consider an LTI (linear time-invariant) discrete-time system with its impulse response provided as shown. Find and <u>sketch(!)</u> the zero-state response $y_{zs}[n]$ of this system due to an input signal given by $x[n]=2\delta[n]-3\delta[n-2]$. Please show your work step by step.



(3) (Total: 20 points) **Discrete-time LTI system.** A discrete-time LTI system with its unit-impulse response is as shown.

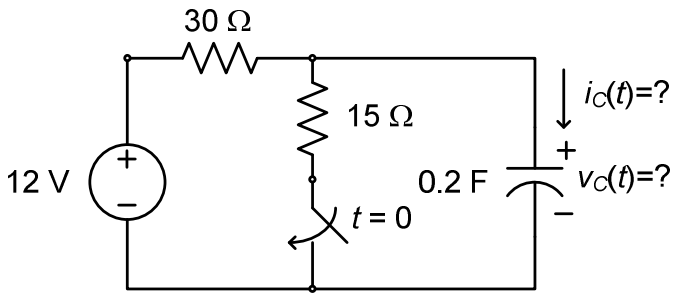


(a) (5 points) Is this system memoryless? (Provide a clear justification for your answer.)

(b) (5 points) Is this system causal? (Provide a clear justification.)

(c) (10 points) Is this system stable? (Provide a clear justification.)

(4) (20 points) **Application of Laplace transform.** For the circuit shown, assume the switch to be open for a long time before it closes at t=0. Use the Laplace-domain equivalent circuit to find the mathematical expression for the capacitor voltage $v_C(t)$ and current $i_C(t)$ for $t > 0$. Draw the Laplace domain circuit in complete form. Please present your work clearly and provide your answers in simplified form.



(Extra page for solution of Problem (4).

(5) (20 points) **Inverse Fourier transform.** Use tables of Fourier transform to find and sketch(!) the inverse Fourier transform of the following signal:

$$X(\omega) = 2\cos^2(3\omega)\frac{\sin(5\omega)}{\omega}$$

Provide your work step by step and justify each step!

(6) (Total: 20 points) **LTI system.** Consider an LTI system described by the differential equation given by

$$\frac{d^2y(t)}{dt^2} + 5\frac{dy(t)}{dt} + 6y(t) = 3x(t)$$

(a) (10 points) Using Laplace transform, find the unit-step response $s(t)$ of this system.

(b) (10 points) Find the unit-impulse response $h(t)$ of this system.