Name____

ELC 3335 – Signals and Systems

Fall 2018

Test 1 – October 2, 2018

Closed Book/Closed Notes

1 hour and 15 minutes

1. The exam is closed-book/closed-notes.

2. A calculator may be used to assist with the test. No laptops or tablets are allowed. No cellular phones may be used in any way during the test. Unauthorized electronic device use will result in disqualification.

3. You must circle or box your answers to get full credit.

4. All work and steps toward a solution must be clearly shown to obtain credit.

5. Partial credit may be given provided that the grader can clearly follow your work to the extent that an understanding of the problem is demonstrated.

6. No collaboration is allowed on this examination. Only Dr. Baylis or the teaching assistant may be consulted for clarification.

7. You may attach extra sheets to the exam if necessary. Each page should contain your name, the problem number, and the page number for that problem.

Please sign the statement below. YOU MUST SIGN THE STATEMENT OR YOU WILL GET A ZERO FOR THIS EXAMINATION!!!

I hereby testify that I have neither provided or received information from unauthorized sources during the test and that this test is the sole product of my effort.

Signed ____ Date______________________

PROBLEM 1 (15 points): Consider the function

$$f(t) = 2[u(t+3) - u(t)] + (2-t)[u(t) - u(t-2)]$$

(a) (4 points) Sketch $f(t)$. Label all amplitudes and appropriate axis points.

(b) (6 points) Calculate the energy of $f(t)$.

(c) (5 points) Sketch $f(2t - 3)$. Label all amplitudes and appropriate axis points.

PROBLEM 2 (20 points): Find the zero-input response $y_0(t)$ for a system given by the differential equation

$$(D^2 + 6D + 9)(D + 2)y(t) = (D + 1)f(t)$$

with initial conditions $y_0(0) = 0, y_0'(0) = 1, y_0''(0) = 2$.

PROBLEM 3 (20 points): Find the unit impulse response of a system specified by the equation

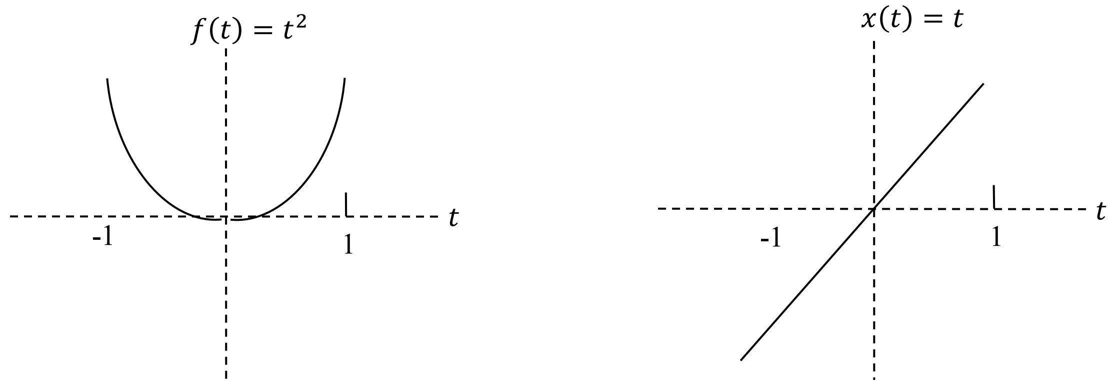
$$(D^2 + 4D + 3)y(t) = (D^2 + 4D)f(t)$$

PROBLEM 4 (25 points): The unit impulse response of an LTIC system is $h(t) = e^{-3t}u(t)$. Use convolution to find the zero-state response $y(t)$ of this system for the input $f(t) = 2u(t) - u(t-2) + 2u(t-4)$. Provide a single, closed-form expression for y(t) containing appropriate unit step functions. You do not need to simplify.

(Extra workspace on next page)

(Extra Workspace for Problem 4):

PROBLEM 5 (20 points): Consider the signals $f(t) = t^2$ and $x(t) = t$ as shown below:



(a) (18 points) Find the optimum value of c for the approximation

$$f(t) \cong cx(t)$$

over the range $-1 < t < 1$ such that the error signal energy is minimized.

(b) (2 points) From the result to part (a), are the signals orthogonal over the range $-1 < t < 1$? How can you tell?