SAMPLE EXAM #1B
ELEG 305 SIGNALS AND SYSTEMS
SPRING 2019

Problem #1 (15 points)
Why is Fourier analysis an important tool for the study of linear, time-invariant systems?

Problem #2 (25 points)
a.) (3 pts) Consider a discrete-time signal x[n] = cos (3n). Is this signal periodic? Why or why not? If it is periodic, determine the period.
b.) (6 pts) Evaluate the following integral

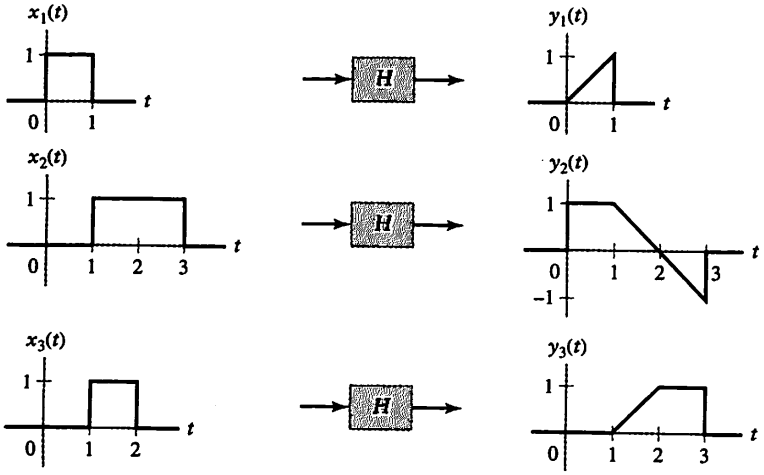
$$\int_{-2}^{2}(1+t)^2\delta(t-1)dt$$

c.) (6 pts) Determine the impulse response for a discrete-time, linear, time-invariant system with input and output related by

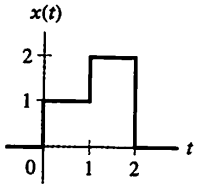
$$y[n]=\sum_{k=0}^{\infty}\alpha^k x[n-k]$$

d.) (10 pts) The response of a linear, time-invariant system to x(t) = u(t) – u(t-1) is y(t).
i) What is the response to the new input g(t) = u(t-1)- u(t-2)?
ii) What is x(t)δ(t-0.5)?
iii) What is x(t)*δ(t-0.5)?

Problem #3 (20 points)
A *linear* system has the following input-output pairs:



(a)



(b)

Answer the following questions, and please **explain** your answers (a simple "yes" or "no" will get you no points even if it is the correct answer).

a.) (5 pts) Could this system be causal?
b.) (5 pts) Could this system be time-invariant?
c.) (10 pts) What is the output of the system for the input x(t) shown in Figure (b)?

Problem #4 (20 points)
Compute the convolution y(t) = x(t)*h(t) for

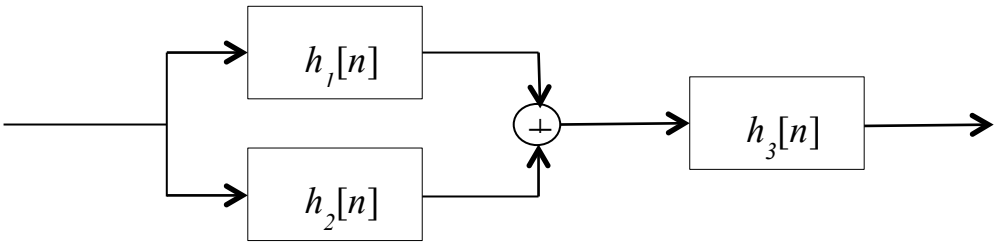
$$x(t) = u(t+1) - u(t-1)$$

and

$$h(t) = u(t-2) - u(t-5)$$

Problem #5 (20 points)
A unit impulse test signal is input to a simple discrete-time model of the information retrieval mechanism in Prof. Cimini's brain. It is known that the system can be modeled as linear, time-invariant, and causal. The output for this input is a decaying exponential α^n, where α is positive and less than 1. Suppose a new test signal, x[n] = u[n-3], is used to determine the response of the Prof. Cimini's brain to a sustained (i.e., continuing) input. What is the output for this step input?

EXTRA CREDIT (5 points)
Consider the following interconnection of linear, time-invariant systems:



What is the composite impulse response for this system if

$$h_1[n] = u[n]$$
$$h_2[n] = u[n+2] - u[n]$$
$$h_3[n] = \delta[n-2]$$

NOTE: "Composite" means the equivalent response of the system, h[n], when all of these blocks are combined into one block, as shown below.