Fall 2018 - Problem Set 2
ECE 301: Signals and Systems

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Due Date : September 28, 2018

Intructions

1. Please write clearly and legibly.
2. Your solutions must include detailed steps and/or explanations. Do not simply state the answer.
3. Write your full name(first,last), PUID on your homework submission.
4. All problems carry almost equal weight.

Problem 1

For each of the below systems with input x and output y, determine if they are :
1. Linear or Non linear, 2. Causal or Non causal , 3. Time Variant or Time Invariant, 4.Stable or Unstable

a) $y[n] = x^2[n]$

b) $y[n] = 5(n-1)x[n] + 2$

c) $y(t) = x(t+1)\cos(6\pi(t-1))$

d) $y(t) = e^{-10t}x(t)$

e) $y(t) = e^{-10jt}x(t)$

Problem 2

The output at time n is obtained by accumulating the values of the input from $n-5$ to $n+5$.

a What is the impulse response?

b What is $y[n]$ when $x[n] = u[n] - u[n-4]$, where $u[n]$ indicates unit step.

c Is this system

i Causal?

ii Memoryless?

iii Stable?

iv Invertible? If so, what is the impulse response of the inverse system.

Problem 3

a A discrete LTI system with input $x_1[n]$ (shown in 1(a)) produces the output $y_1[n]$(shown in 1(b)). Find the output produced by this system for the input $x_2[n]$(shown in 1(c))

b A continuous LTI system with input $x_1(t)$ (shown in 2(a)) produces the output $y_1(t)$(shown in 2(b)). Find the output produced by this system for the input $x_2(t)$(shown in 2(c))

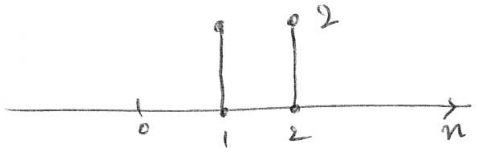

Fig a : $x_1[n]$

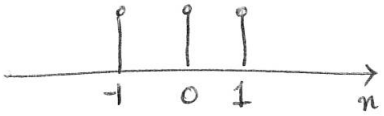

Fig b : $y_1[n]$

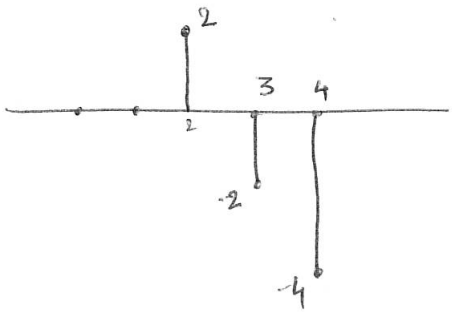

Fig c: $x_2[n]$

Figure 1

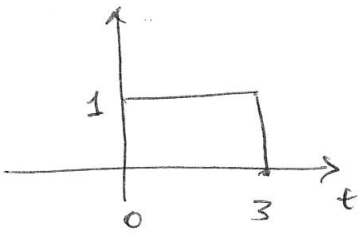

Fig a: $x_1(t)$.

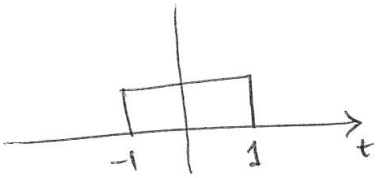

Fig b: $y_1(t)$.

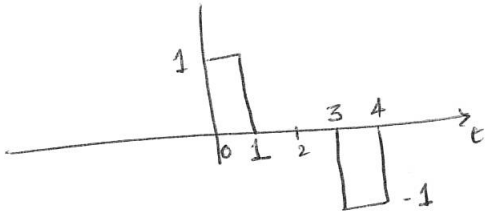

Fig c: $x_2(t)$.

Figure 2

Problem 4

a If $x(t) * h(t) = y(t)$ where $*$ indicates convolution, then show that

$$x(t + t_1) * h(t - t_2) = y(t - (t_2 - t_1))$$

b Find $\int_{-\infty}^{\infty} x(t)\delta(t - t_0)dt$

c Find $\int_{-\infty}^{\infty} x(\tau)\delta(t + t_0 - \tau)d\tau$

d Find $\int_{-\infty}^{\infty} x(\tau)\delta(t + \tau)d\tau$

Problem 5

a For $x(t)$ and $y(t)$ in the figure 3, (Note: $x(t)$ is periodic) find $x(t) * y(t)$.

b $x[n] = \delta[n + 5] + \delta[n - 4] + \delta[n]$
$y[n] = u[n] - u[n - 2]$
Find $x[n] * y[n]$. Note: $u[n]$ is unit-step

c Calculate $x_1[n] * x_2[n] * x_3[n]$. Note: $u[n]$ is unit-step
$x_1[n] = \frac{1}{3}^n u[n]$
$x_2[n] = u[n]$
$x_3[n] = \delta[n - 2]$

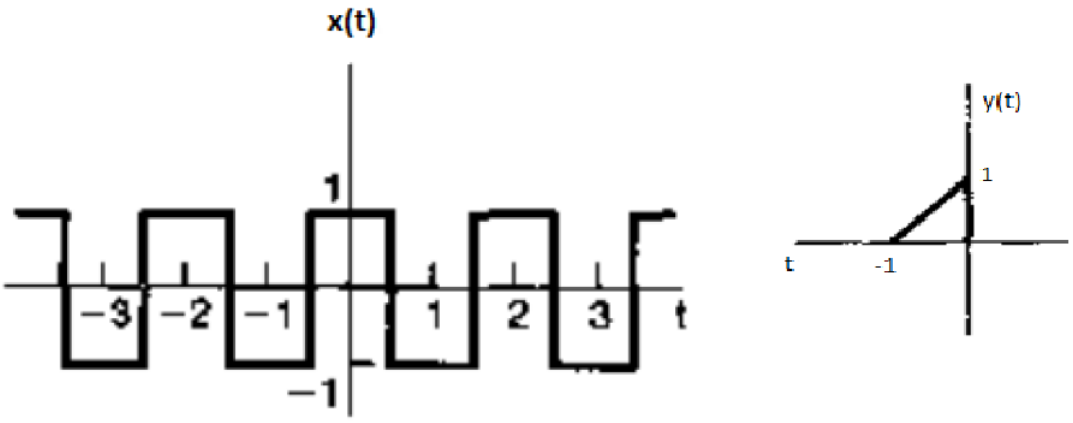

Figure 3