

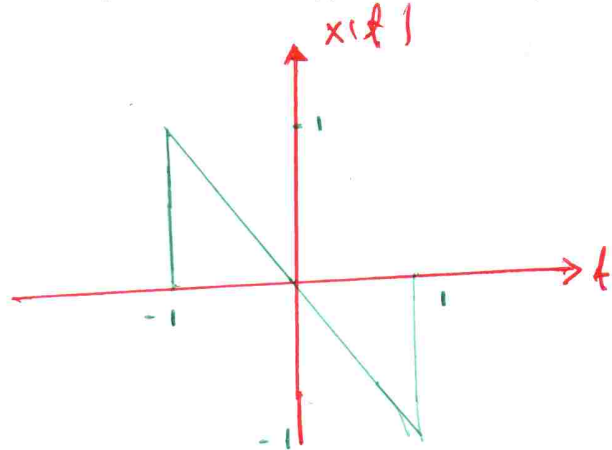
Islamic University of Gaza
Electrical and Computer Engineering Department
EELE 3310 Signals & Systems
Med-Term Exam
November 18, 2007

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Name:

Exam Time 10:00-11:30
ID:

1. a) Define $x(t) = t(u(-t-1) - u(-t+1))$, where $u(t)$ is the unit step function. Plot $x(t)$.

(3 Points)



b) Consider the continuous-time LTI system; $h(t) = 3\delta(t) + 2\delta(t-2) + \delta(t+3)$

Is this FIR system or IIR system, Causal or non Causal?

(3 Points)

* FIR, Impulse Response has finite extent

* It is non causal, depends on future inputs due to $\delta(t+3)$

c) Indicate whether the following discrete-time systems are linear, time invariant, and/or causal?

$$y[n] = e^{j2\pi n} x[n]$$

(3 Points)

$$e^{j2\pi n} = \cos 2\pi n + j \sin 2\pi n = 1$$

$$\therefore y[n] = x[n]$$

* It is Linear ; superposition hold

* Time Invariant ; It does not change with time

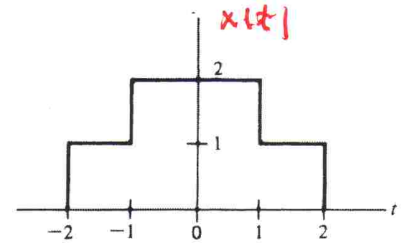
* Causal system ; It does not depend on future

2.a) Use the Fourier transform properties and $\text{rect}(t/\tau)$ to find $X(\omega)$ for the signal shown in Figure. (3 Points)

$$x(t) = \text{rect}(t/4) + \text{rect}(t/2)$$

$$X(\omega) = 4 \text{sinc}\left(\frac{4\omega}{2\pi}\right) + 2 \text{sinc}\left(\frac{2\omega}{2\pi}\right)$$

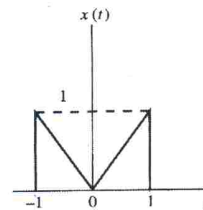
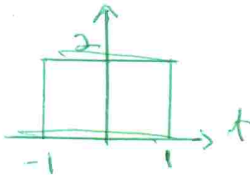
$$X(\omega) = 4 \text{sinc}(4f) + 2 \text{sinc}(2f)$$



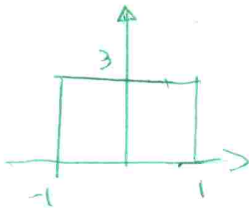
b) The input $x(t)$ and the output $y(t)$ of LTI system are shown in Figure. Sketch the response to $2x(t) + 3x(-t)$ (3 Points)

LTI system

$$2x(t) \Rightarrow 2y(t)$$

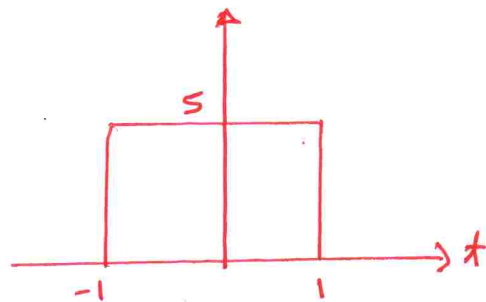


$$3x(-t) \Rightarrow 3y(-t)$$



+

$$2y(t) + 3y(-t)$$



c) For the discrete-time signal shown in Figure, sketch $x[(2/3)n+4]$ (3 Points)

$$x\left[\frac{2}{3}n+4\right]$$

$$n=0 \rightarrow x\left[\frac{4}{3}\right] = 2$$

$$n=1 \rightarrow x\left[\frac{8}{3}\right] = 0$$

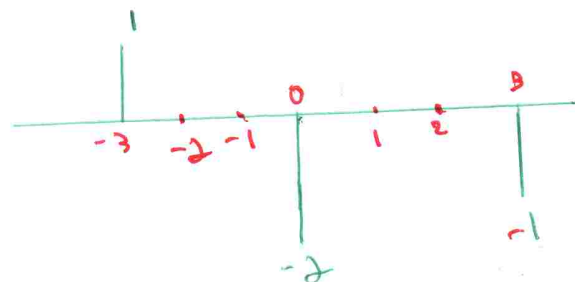
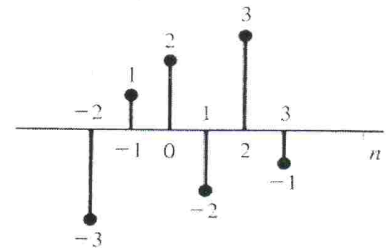
$$n=2 \rightarrow x\left[\frac{10}{3}\right] = 0$$

$$n=3 \rightarrow x[4] = -1$$

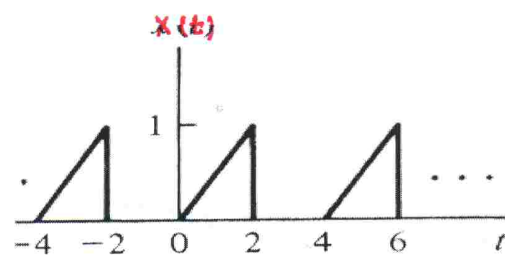
$$n=-1 \rightarrow x\left[\frac{10}{3}\right] = 0$$

$$n=-2 \rightarrow x\left[\frac{8}{3}\right] = 0$$

$$n=-3 \rightarrow x[2] = 1$$



3.a) Find the exponential Fourier-series representation of the signal shown in Figure. Plot the magnitude and phase spectrum for $n = \pm 1, \pm 2, \dots$. (6 Points)



$$x(t) = \begin{cases} \frac{1}{2}t & 0 \leq t < 2 \\ 0 & 2 \leq t < 4 \end{cases}$$

$$c_n = \frac{1}{T} \int_0^T f(t) e^{-jn\omega_0 t} dt$$

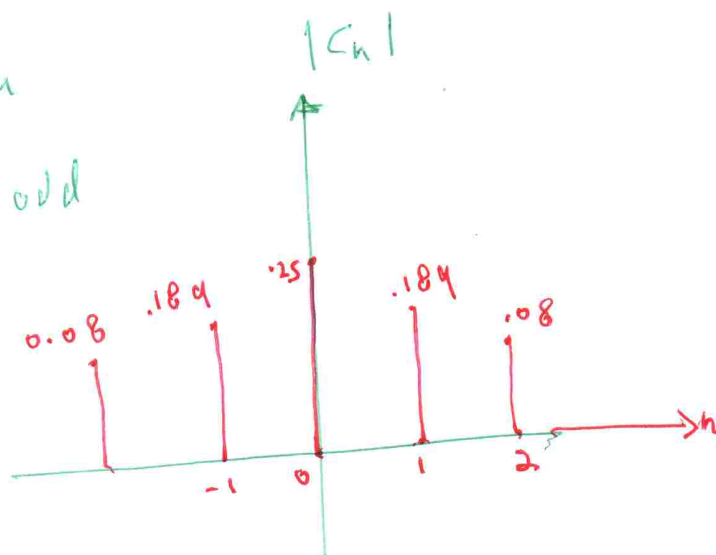
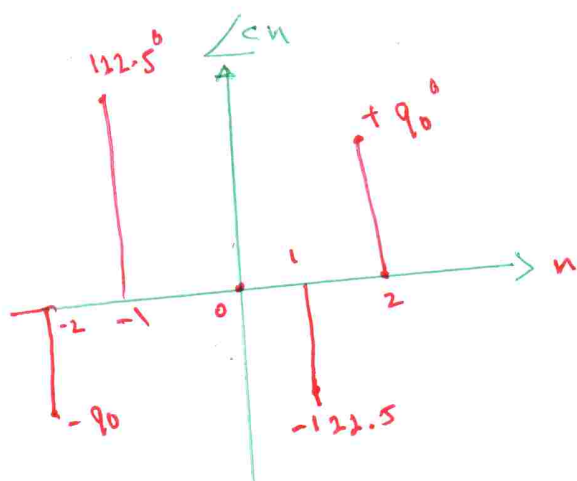
$$= \frac{1}{4} \int_0^2 \frac{1}{2}t e^{-jn\pi/2 t} dt = \frac{1}{2n^2\pi^2} \left[e^{-jn\pi} (1+jn\pi) - 1 \right]$$

$$c_n = \frac{1}{2n^2\pi^2} \left[(\cos n\pi - j \sin n\pi) (1+jn\pi) - 1 \right]$$

$$\therefore c_n = \frac{1}{2n^2\pi^2} \left[\cos n\pi - 1 \right] + j \frac{1}{2} \frac{\cos n\pi}{n\pi} \quad \underline{n \neq 0}$$

$$c_0 = \frac{1}{4}$$

$$c_n = \begin{cases} \frac{j}{2n\pi} & n \text{ even} \\ \frac{1}{2jn\pi} - \frac{1}{n^2\pi^2} & n \text{ odd} \end{cases}$$



$$.189 \angle 122.5^\circ$$

$n=1$;

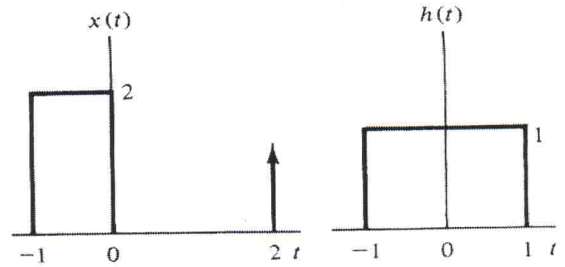
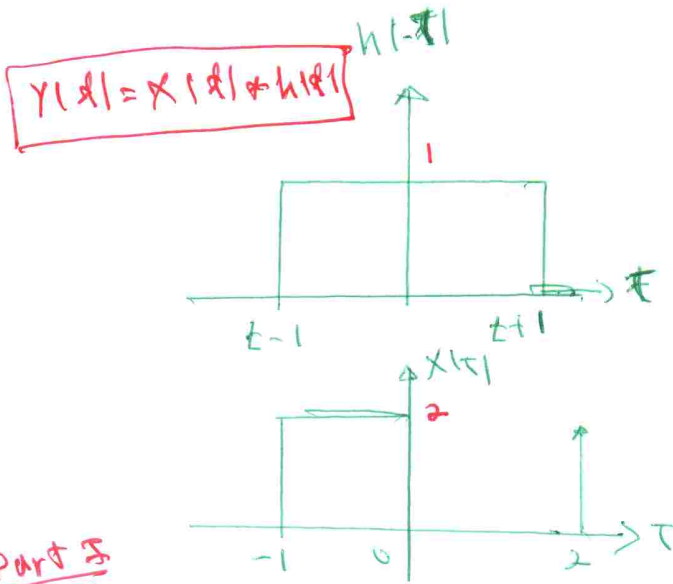
$$\frac{1}{j2\pi} - \frac{1}{\pi} = \frac{\pi - j2}{j2\pi} = \frac{3.724 \angle -32.5^\circ}{2\pi \angle 90^\circ} = .189 \angle 122.5^\circ$$

$n=2$;

$$\frac{j}{4\pi} = \frac{1}{-j4\pi} = \frac{1 \angle 0^\circ}{4\pi \angle -90^\circ} = .08 \angle 90^\circ$$

b) Graphically determine the convolution of the pairs of signals shown in Figure?

(6 Points)



$y(t) = 0 \quad t \leq -2$

* $-2 < t \leq -1$

$$y(t) = \int_{-1}^{t+1} 2(1) d\tau = 2\tau \Big|_{-1}^{t+1} = 2[t+1-(-1)] = 2[t+2]$$

* $-1 < t \leq 0$

$$y(t) = \int_{-1}^0 2(1) d\tau = 2\tau \Big|_{-1}^0 = 2$$

* $0 < t < 1$

$$y(t) = \int_{t-1}^0 2(1) d\tau = 2\tau \Big|_{t-1}^0 = -2(t-1)$$

Part II $h(t) * \delta(t-2) = \underline{h(t-2)}$

