

Islamic University of Gaza
Electrical Engineering Department
EELE 3310 Signals & Systems
Med-Term Exam
November 17, 2009



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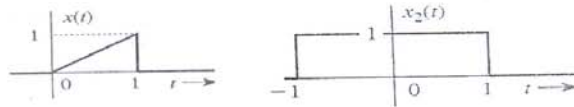
Exam Time 11:00-12:30

1. a) In Figure below, express signals $x_2(t)$ in terms of signal $x(t)$ and its time-shifted, time-scaled, or time-reversed versions. (4 Points)

$$x_2(t) = x\left(\frac{t+1}{2}\right) + x\left(\frac{1-t}{2}\right)$$

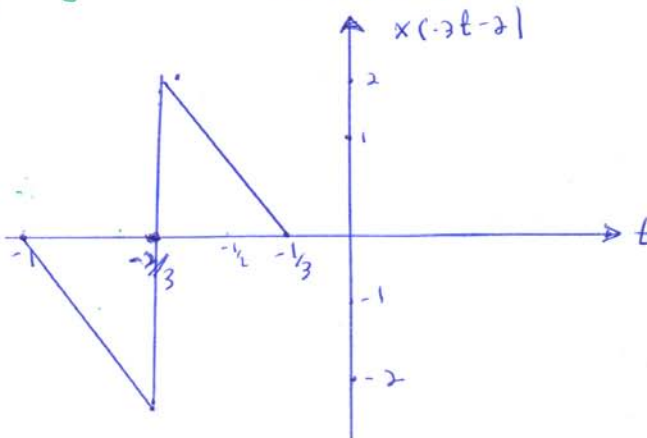
OR

$$x_2(t) = x(t) + x(-t) + x(t+1) + x(-t+1)$$



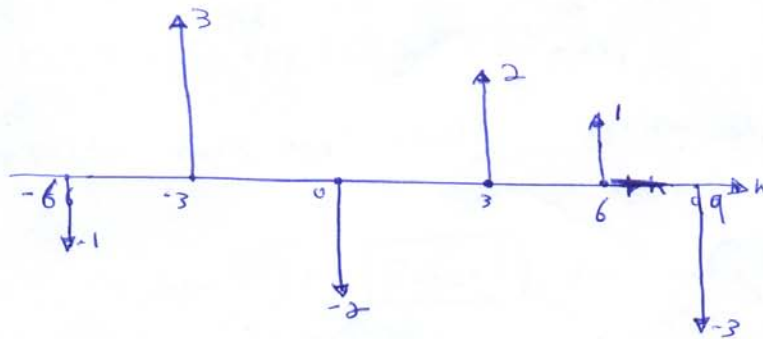
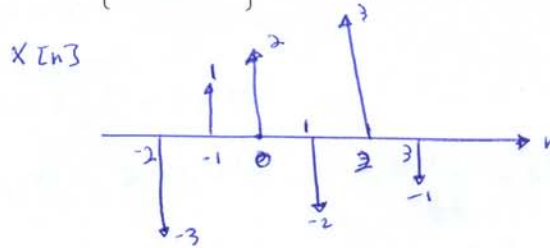
- b) Given $x(t) = \begin{cases} 2t+2 & -1 \leq t < 0 \\ 2t-2 & 0 \leq t < 1 \end{cases}$, Sketch $x(-3t-2)$ (4 Points)

$$x(-3t-2) = \begin{cases} -6t-6 & -1 \leq t \leq -2/3 \\ -6t-2 & -2/3 < t \leq -1/3 \\ 0 & \text{otherwise} \end{cases}$$



2. a) For the signal described by $x[n] = \{-3, 1, 2, -2, 3, -1\}$, find $x[-\frac{1}{3}n+1]$.

(4 Pt.)



b) Determine whether the signal is periodic, and if it is, find its period.

(3 Points)

$$x[n] = \sin\left[\frac{3\pi n}{4}\right] + \cos\left[\frac{\pi n}{3}\right]$$

$$\omega_{01} = \frac{3\pi/4}{2\pi} = 3/8$$

$$\therefore N_1 = 8$$

$$\omega_{02} = \frac{\pi/3}{2\pi} = 1/6 \quad \therefore N_2 = 6$$

$$\therefore \frac{N_1}{N_2} = \frac{8}{6} = \frac{4}{3} = \frac{P}{Q}$$

$$\therefore N = PN_2 = QN_1 = 8(3) = 6(4) = \boxed{24}$$

3) Determine whether the system described by the following input/output relationships are linear or nonlinear, causal or noncausal, time variant, or invariant, memory, or memoryless. (Justify your answer) (7 Points)

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

* Linear

$$\text{Let } x(t) = ax_1(t) + bx_2(t)$$

$$a \frac{dy_1(t)}{dt} + 2ay_1(t) = 2ax_1^2(t)$$

$$b \frac{dy_2(t)}{dt} + 2by_2(t) = 2bx_2^2(t)$$

$$\frac{d}{dt} [ay_1 + by_2] + 2[ay_1 + by_2] = 2[a x_1^2 + b x_2^2]$$

$\therefore$ Superposition does not hold system is nonlinear

* Causal system is Causal does not depend on future

* Time Invariant system because there is no multiplication of t .

* system is with memory because it is not instantaneous [there is derivative].

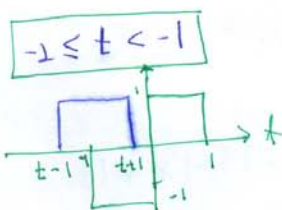
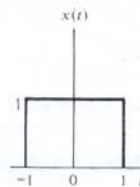
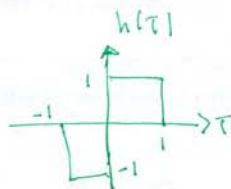
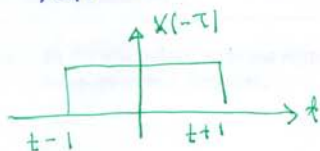
4) Find $y(t)$ for given $x(t)$, and $h(t)$.

(8 Pt.)

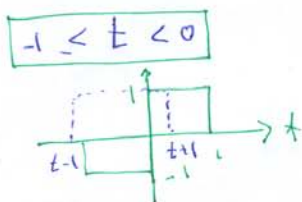
$$y(t) = x(t) * h(t)$$

$y(t)$ starts at -2 and ends at 2

$$\therefore y(t) = 0 \quad t < -2$$

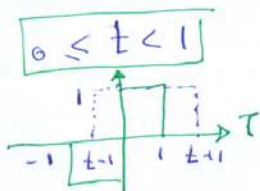


$$y(t) = \int_{-1}^{t+1} 1 \cdot 1 \, d\tau = -\tau \Big|_{-1}^{t+1} = -(t+2)$$

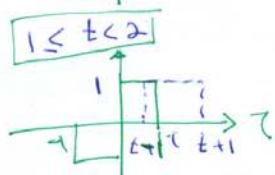


$$y(t) = \int_{-1}^0 1 \cdot 1 \, d\tau + \int_0^{t+1} 1 \cdot 1 \, d\tau = -\tau \Big|_{-1}^0 + \tau \Big|_0^{t+1} = t$$

$$y(t) = t$$



$$y(t) = \int_{t-1}^0 1 \cdot 1 \, d\tau + \int_0^1 1 \cdot 1 \, d\tau = t$$



$$y(t) = \int_{t-1}^1 1 \cdot 1 \, d\tau = -t + 2$$

$$\therefore y(t) = \begin{cases} -(t+2) & -2 \leq t < -1 \\ t & -1 \leq t < 0 \\ t & 0 \leq t < 1 \\ -t+2 & 1 \leq t < 2 \\ 0 & \text{otherwise} \end{cases}$$

