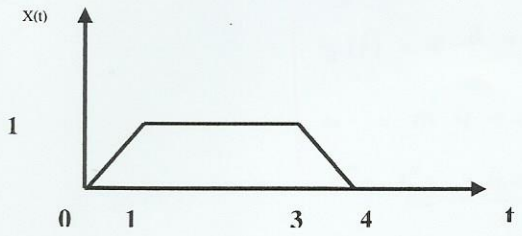
Benha University
Faculty of Engineering at Shoubra
Electrical Engineering Department
2nd Year Communications

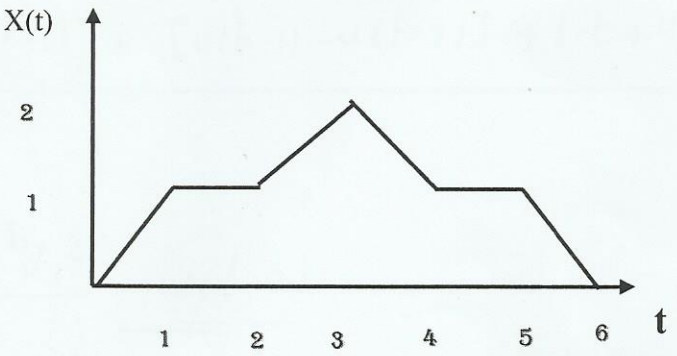
Mid Term Exam
Date: Sunday 26/3/2017
Subject: Signals
Duration: 60 Mins

- Answer all the following questions
- Illustrate your answers with sketches when necessary (20 Marks)

1. Describe the following signal in terms of unit step function: (3 marks)



2. For the following signal sketch: (7 marks)
   - The signal delayed by 2.
   - The signal Attenuated by 2.
   - X(t) [u(t)-u(t-3)].
   - The sampled version (Discrete) x1[n], (Ts = 1 sec).
   - The sampled version (Discrete) x2[n], (Ts = 0.5 sec).
   - X1[2n].
   - X1[n^2-2n]



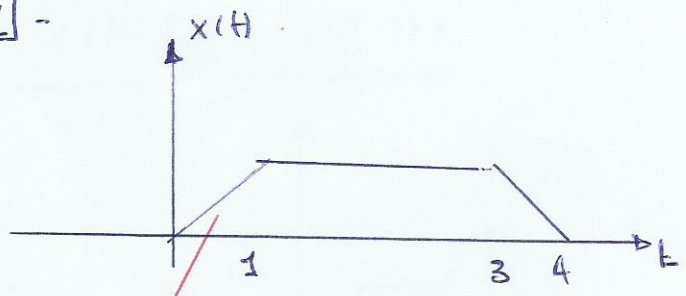
3. State with a brief explanation if the following systems are linear/non-linear, causal/non-causal, time-invariant/time-varying. (6 marks)
   a. Y(t) = 3x(t) Cos(w_0t +20).
   b. Y(t) = 2 x(at).
4. Determine whether or not the signal below is periodic and if it is periodic determine the fundamental period [8 Marks]:

$$x(n) = \cos(\frac{n\pi}{6}) + \mathrm{Re}[e^{\frac{jn\pi}{7}}] + \mathrm{Im}[e^{\frac{jn\pi}{8}}]$$

GOOD LUCK

DR. MICHAEL NASIEF

1 -



Part (1)

$t\,[u(t)-u(t-1)]$

Part (2)

$1\,[u(t-1)-u(t-3)]$

Part (3)

$y = mx + c$

$x(t) = m\,t + c$

$0 = m\,4 + c$

$\therefore c = -4m$

x	y
3	1
4	0

$x(t) = mt - 4m$

$1 = 3m - 4m$

$1 = -m$

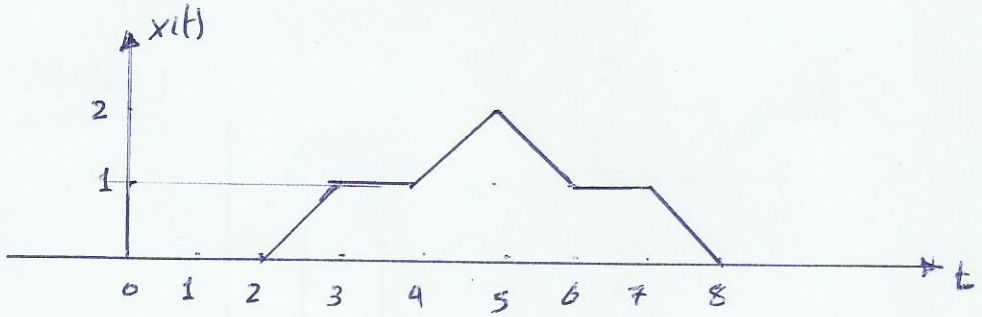
$\therefore C = 4$

$\therefore x(t) = (-t+4)\,[u(t-3) - u(t-4)]$

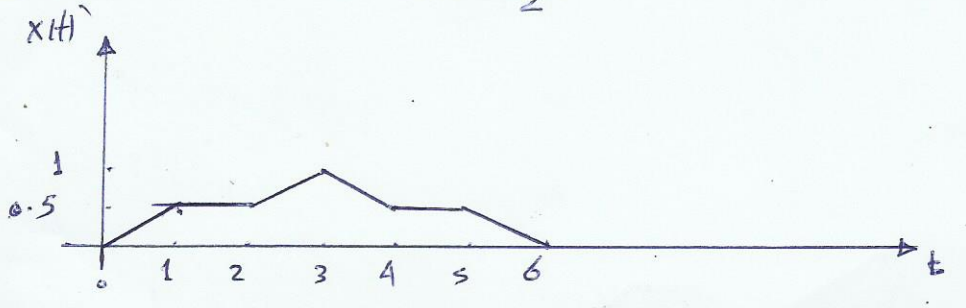
$\therefore X(t) = t\,[u(t)-u(t-1)] + [u(t-1)-u(t-3)] + (-t+4)\,[u(t-3)-u(t-4)]$

2

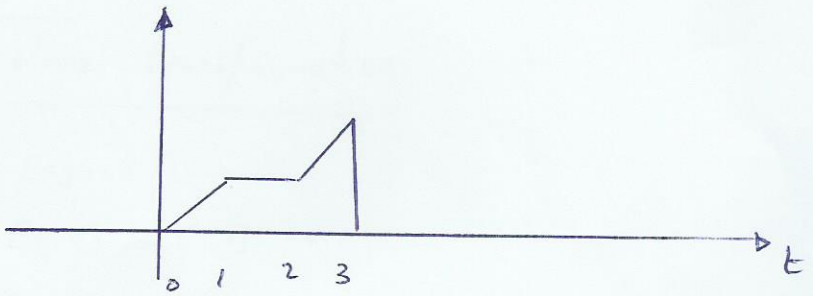
\# The signal delayed by 2 $\quad x(t-2)$



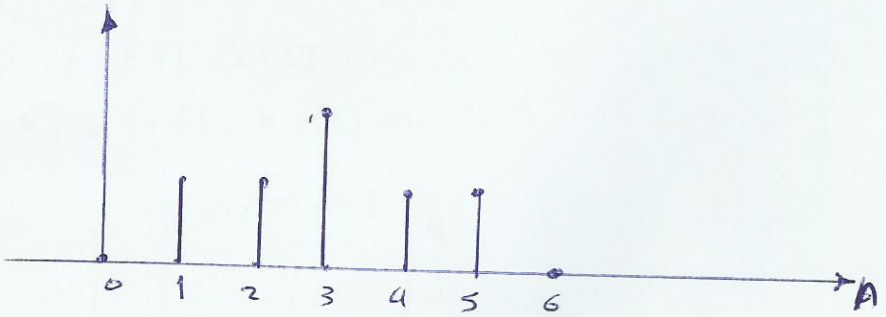
* The signal attenuated by 2 $\quad \frac{x(t)}{2}$



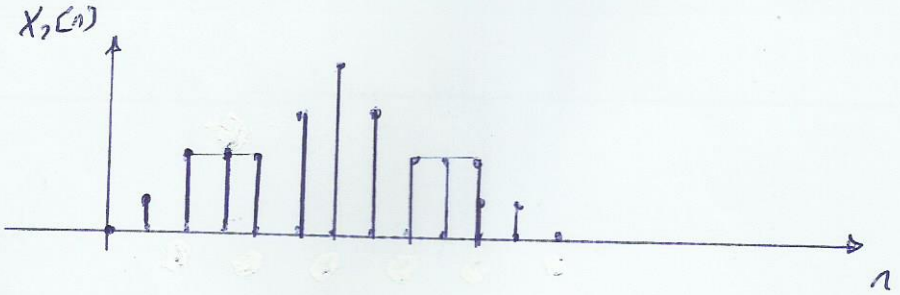
$x(t)\,[u(t) - u(t-3)]$



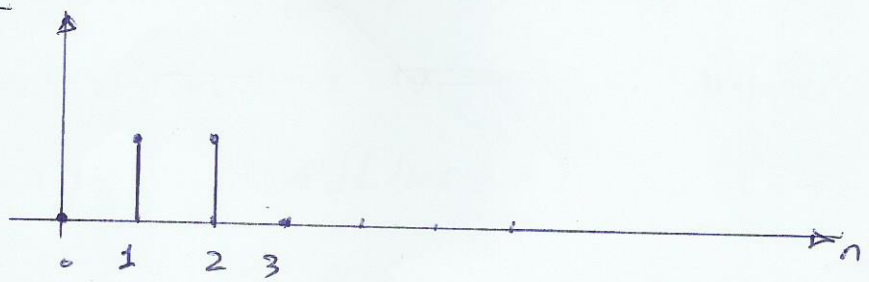
Sampled $x_1[n]$ & $T_s = 1$ sec



Sampled $x_2[n]$ & $T_s = 0.5$ sec



$x_1[2n]$



$X_1[n^2-2n]$

using non linear transformation.

$y[0] = X_1[0] = 0$

$y[1] = X_1[1-2] = X[-1] = 0$

$y[2] = X_1[4-4] = X[0] = 0$

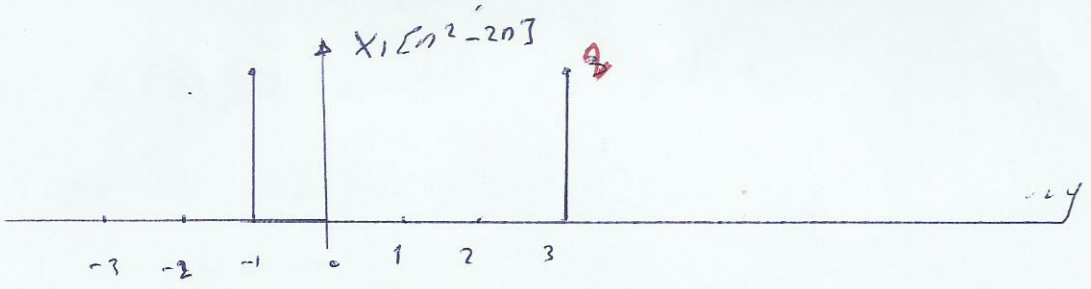
$y[3] = X_1[9-6] = X[3] = 2$

$y[4] = X_1[16-8] = X_1[8] = 0$ $\leq n > 4 \quad y = 0$

$y[-1] = X_1[1+2] = X[3] = 2$

$y[-2] = X_1[4+4] = X[8] = 0$

$y[-3] = X_1[9+6] = X[15] = 0$ $\leq n < -2 \rightarrow y = 0$



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[3] (A)

Linearity check

$y_1 = 3X_1 \cos(\omega_0 t + 2\theta) + 3X_2 \cos(\omega_0 t + 2\theta)$ .... after

$y_2 = 3(X_1 + X_2) \cos(\omega_0 t + 2\theta)$ ... before.

$\therefore y_1 = y_2$ $\therefore$ Additive

$y_1' = a[3X_1 \cos(\omega_0 t + 2\theta)]$ ... after

$y_2' = 3(aX_1) \cos(\omega_0 t + 2\theta)$ ... before.

$\therefore y_1' = y_2'$ $\therefore$ homogeneous

$\therefore$ Linear sys.

* Causal sys since it depends on $x(t)$

* check for time varying

$y_1 = 3x(t-t_0)\cos(\omega_0(t-t_0)+2\theta)$

$y_2 = 3x(t-t_0)\cos(\omega_0 t + 2\theta)$

$\therefore y_1 \neq y_2 \quad \therefore$ time varying sys.

B Linearity check

$y_1 = 2x_1(at) + 2x_2(at)$ ... after

$y_2 = 2(x_1(at) + x_2(at))$ .. before

$y_1 = y_2 \quad \therefore$ additive

& $y_1' = 2kx(at)$

$y_2' = 2kx(at) \quad \therefore y_1' = y_2' \quad \therefore$ homogeneous

$\therefore$ linear sys.

* Causal sys. since it depends only on $x(t)$

$y_1 = 2x(at-t_0)$ ... after

$y_2 = 2x(a(t-t_0))$ .. before

$\therefore y_1 \neq y_2 \quad \therefore$ shift varying sys.

(4) $N_1 = 12 \qquad N_2 = 14 \qquad N_3 = 16$

Periodic signal

$N_T = 336$