MADE EASY PUBLICATIONS

POSTAL BOOK PACKAGE 2025

ELECTRICAL ENGINEERING

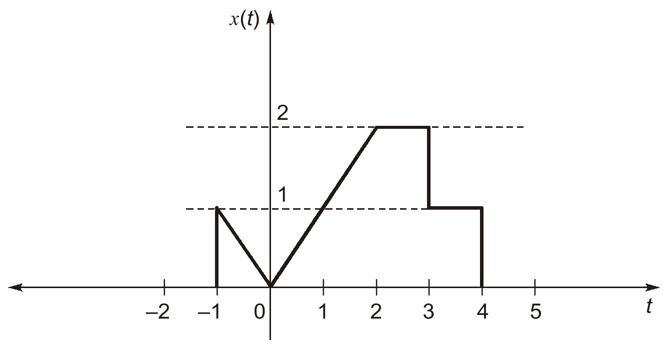
CONVENTIONAL Practice Sets

CONTENTS

SIGNALS AND SYSTEMS

1 CHAPTER Continuous Time Signal & System

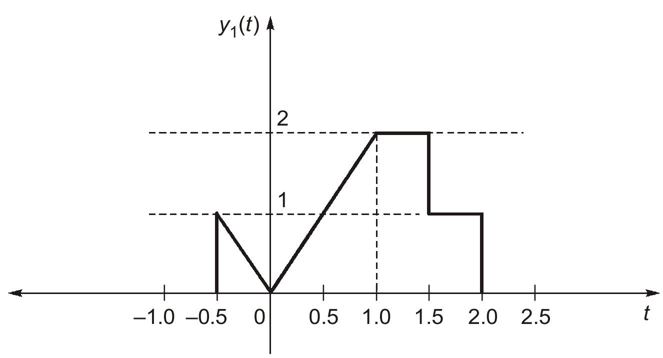
Q.1 For the given signal $x(t)$ as shown below, sketch the following signals.



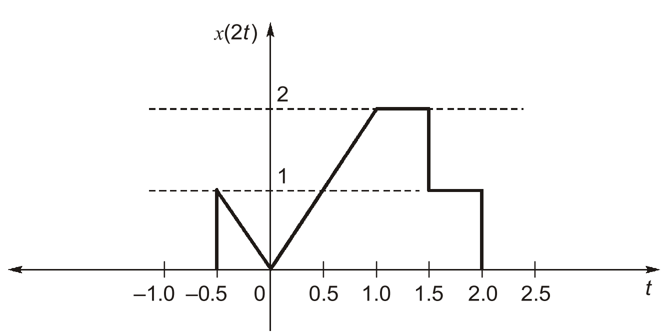
(a) $y_1(t) = x(2t)$ (b) $y_2(t) = x(2t + 4)$ (c) $y_3(t) = x\left(\frac{t}{2} + 2\right)$

Solution:

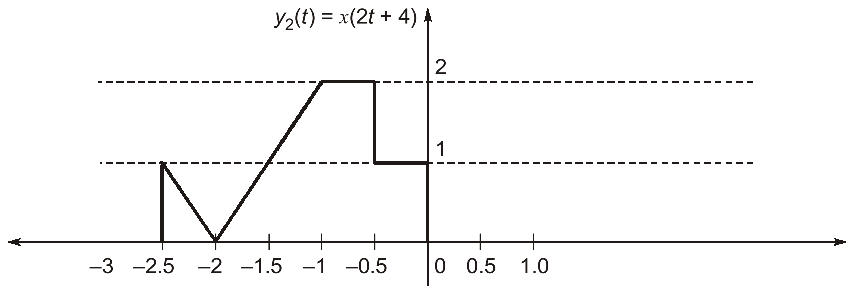
(a) We have to sketch, $y_1(t) = x(2t)$ since, $y_1(t)$ is a 2 times slowed or compressed version of $x(t)$ in time domain. So, the curve is;



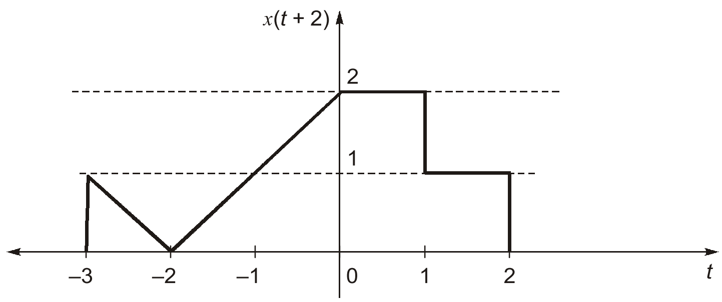
(b) We have to sketch, $y_2(t) = x(2t + 4)$ i.e. $y_2(t) = x[2(t + 2)]$.
So, we can say $y_2(t)$ is the 2 times compressed version in time of a signal which is an advance shift of 2 unit of $x(t)$.
At first we sketch the following:



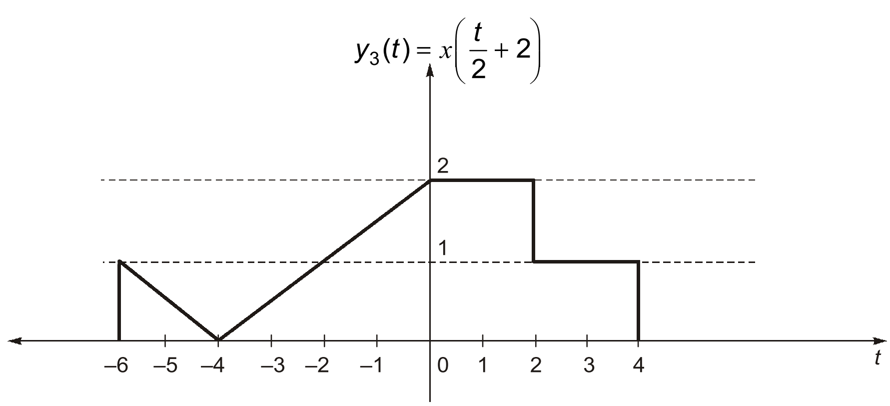
Again, we have to sketch this $x(2t)$ for an advance shift of 2 units means shift the above curve 2 unit in left side as below:



(c) We have to sketch, $y_3(t) = x(t/2 + 2)$. For this firstly, we shift 2 unit in advance shift of $x(t)$ and then expanded this signal $x(t + 2)$, by $1/(1/2) = 2$ units of the signal.



Now finally we have to sketch, $y_3(t) = x\left(\frac{t}{2}+2\right)$ as below:



Q.2 For the signals $y_1(t)$ and $y_2(t)$ shown below. Draw the differentiation of the signals and find the equations of differentiated signals.

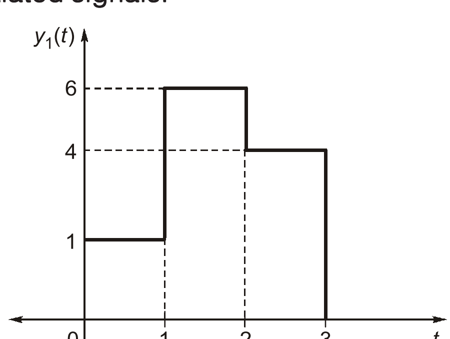


Fig. (a)

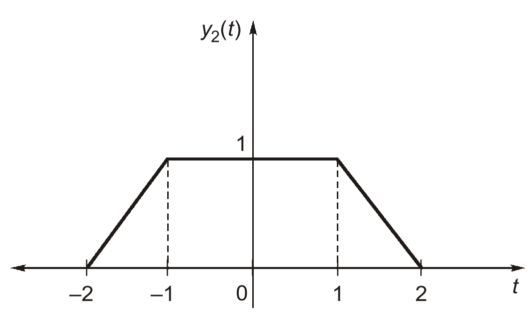


Fig. (b)

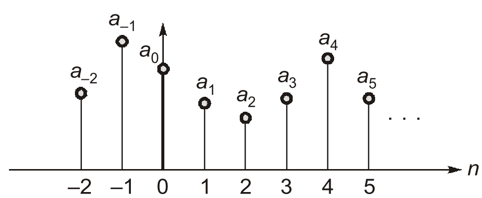
2 CHAPTER Discrete Time Signal and System

Q.1 How can you express a discrete signal as a sequence of a sum of scaled delayed unit sample sequence?

Solution:

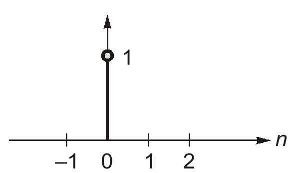
Let the discrete signal be given by

$x[n] =$



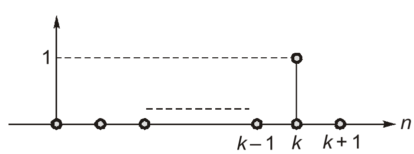
Now,

Unit sample sequence, $\delta[n] =$



Delayed unit sample sequence,

$\delta[n-k] =$



Thus, the discrete signal $x[n]$ can be expressed as a sum of scaled delayed unit sample sequence.

$$x[n] = a_{-1}\,\delta[n+1] + a_0\,\delta[n] + a_1\delta[n-1] + a_2\delta\,[n-2] + ...$$

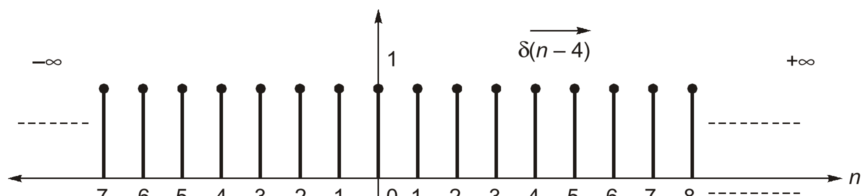
$$\Rightarrow \qquad x[n] = \sum_{k=-\infty}^{\infty} a_k\delta[n-K]$$

Q.2 Consider a DTS, $x[n]$ is given by $x[n] = 1 - \sum_{K=3}^{\infty} \delta(n-1-K)$. This $x[n]$ can be represented by an unit step function as, $x[n] = u[Mn - n_0]$. Then find the value of M and n_0?

Solution:

Given discrete-time system is,

$$x[n] = 1 - \sum_{K=3}^{\infty} \delta[n-(K+1)] \qquad ...(i)$$

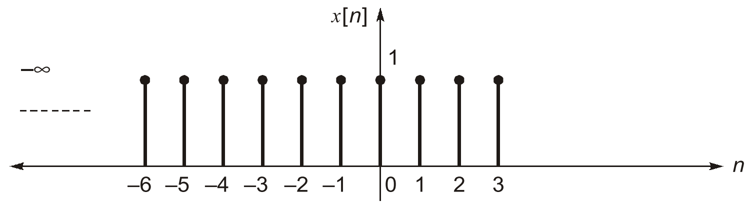


$$\therefore \qquad x[n] = 1 - [\delta(n-4) + \delta(n-5) + \delta(n-6) + \delta(n-7) + ...]$$

So, $x[n] = 1;\quad \text{for } -\infty \le n \le 3$ ...(ii)

As we know that, $u[n] = 1 \quad \text{for} \quad 0 \le n \le \infty$

and $u[-n] = 1 \quad \text{for} \quad -\infty \le n \le 0$



$\Rightarrow \quad u[-(n-3)] = u[-n+3] = x[n]$ ...(iii)

And we have given if $x[n]$ can be represented by a step function as,

$$x[n] = u[Mn - n_0] \quad \text{...(iv)}$$

Comparing equation (iii) and (iv) we get,

$$Mn = -n \quad \Rightarrow \quad M = -1$$

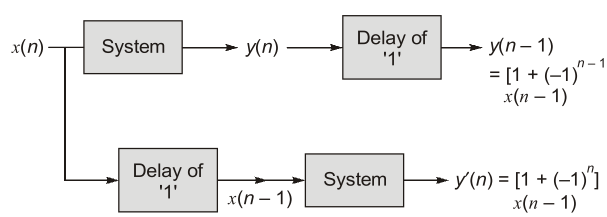
and $n_0 = -3$

Q3 **Consider the system with following input-output relation $y[n] = (1 + (-1)^n)\, x[n]$, where $x[n]$ is the input and $y[n]$ is the output. Check whether the above system is (a) time variant (b) invertible**

Solution:

Given relationship, $y(n) = [1 + (-1)^n]\, x(n)$

(a) Time invariance test:



Since, $y(n-1) \neq y'(n)$

So, the system is time variant.

(b) Invertibility test:

$x(n)$	$y(n)$
$\delta(n-1)$	$[1+(-1)^n]\,\delta(n-1) = [1+(-1)^1]\,\delta(n-1) = 0 \cdot \delta(n-1) = 0$
$2\delta(n-1)$	$[1+(-1)^n]\,2\delta(n-1) = [1+(-1)^1]\,2\delta(n-1) = 0.2\delta(n-1) = 0$

Thus, we are getting many to one mapping between input and output. So, the system is non-invertible.

Q4 **The step response $s[n]$ of a discrete-time LTI system is given by:**

$$s[n] = \alpha^n u[n];\ 0 < \alpha < 1$$

Determine the impulse response h[n] of the system?

Solution:

Step response, $s[n] = \alpha^n u[n];\quad 0 < \alpha < 1$ ...(i)

By using the property of discrete-time LTI systems, the impulse response $h[n]$ of the system is given by,

$$h[n] = s[n] - s[n-1]$$

$$= \alpha^n u[n] - \alpha^{n-1} u[n-1] = \left\{\underbrace{\delta[n] + \alpha^n u[n-1]}_{\text{Because, } 0 < \alpha < 1}\right\} - \alpha^{n-1} \cdot u[n-1]$$

$$= \delta[n] + \alpha^n u[n-1] - \alpha^{n-1} u[n-1]$$

$$= \delta[n] - \alpha^{n-1} u[n-1] + \alpha^{n-1} \cdot \alpha\, u[n-1]$$

$$\therefore \quad h[n] = \delta[n] - (1-\alpha)\, \alpha^{n-1} \cdot u[n-1]$$