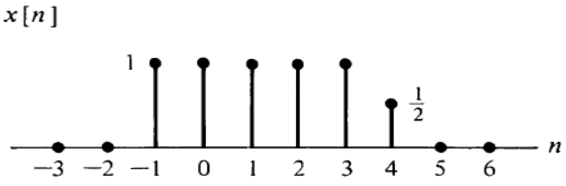
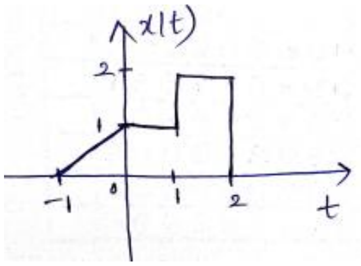
CMR
INSTITUTE OF
TECHNOLOGY

USN

Internal Assesment Test - I

Sub:	**SIGNALS AND SYSTEMS**							Code:	15EE54
Date:	08/09/2018	Duration:	90 mins	Max Marks:	50	Sem:	5th	Branch:	EEE

Answer Any FIVE FULL Questions

		Marks	OBE CO	OBE RBT
1	Define the terms Signals and Sytems.Discuss the classification of signals with examples	10	CO1	L1
2	1. A discrete-time signal x[n] is shown in **Figure P2.3.**  **Figure P2.3** (a) Sketch and carefully label each of the following signals: i) $x[n-2]$ ii) $x[4-n]$ iii) $x[2n]$	10	CO1	L2
3	Distinguish between power and energy signals. Categorize each of the following signals as power or energy signals and find the corresponding energy or average power. (a). $x[n]=\left(\frac{1}{4}\right)^n u[n]$ (b). $x[n]=u[n]$ (c). $x[n]=2^n u[-n]$	10	CO1	L2
4	Determine the discrete-time convolution sum of the given sequences. x(n) ={ 1, 2, 3, 4} and h(n)= {1, 2, 1} ⇧ ⇧	10	CO1	L3
5	Given Input output relations for the systems. Determine whether the system is (i)Linear (ii)Time invariant (iii)Causal (iv)Memory less and (v)Stable a. y[t]=H{x(t) }= $\frac{d(x(t))}{dx}$ b. y[n]=H{x[n]}= nx[n]	10	CO1	L3
6	Determine the convolution sum y[n}=x[n]*h[n] for x[n]= β^n u[n] $\lvert\beta\rvert< 1$ h[n]= α^n u[n] $\lvert\alpha\rvert<1$.	10	CO1	L3
7	Performs the following operations on given signals (i)x(4-t) (ii)x(-t+1) 	10	CO1	L2

1.

A Signal is a function of a set of independent variables, with time perhaps the most prevalent single variable. A signal itself carries some kind of information available for observation. In general, a signal is a function or sequence of values that represents information.

A system is formally defined as an entity that manipulates one or more signals to accomplish a function, thereby yielding new signals.

Classification of a Signals.

1.2.1 Continuous-Time and Discrete-Time Signals

1.2.2 Even and Odd Signals.

1.2.3 Periodic and Non-periodic Signals.

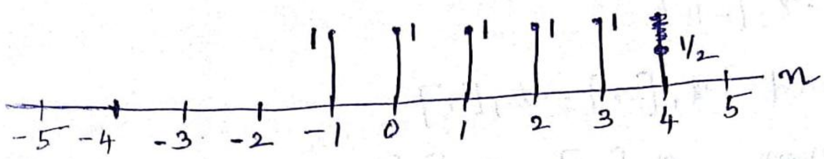
1.2.4 Deterministic and Random Signals.

1.2.5 Energy and Power Signals.

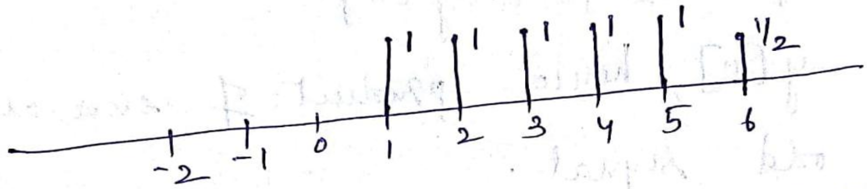
2.

(3)

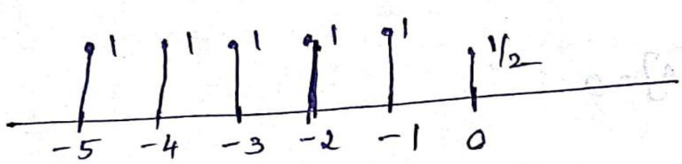
$x[n]$



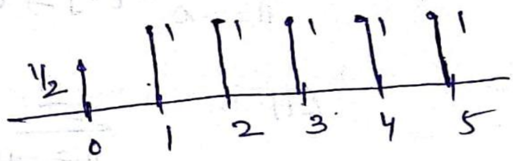
(i) $x[n-2]$ shifted 2 places to the right (delay)



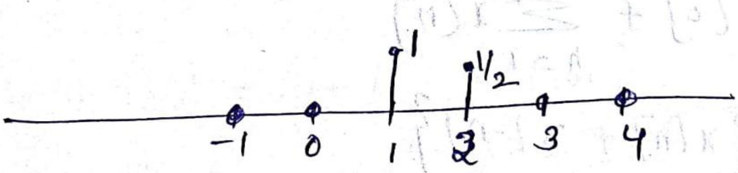
(ii) $x[4-n] = x[-n+4]$ advancing and reflection



$x[-n+4)$



iii) $x[2n]$ time scaling - compression



3.

$$x[n] = \cancel{n}\left(\tfrac{1}{2}\right)^n u[n]$$

$$E = \sum_{n=0}^{\infty} \left(\tfrac{1}{4}\right)^n = \frac{1}{1-\frac{1}{4}} = \frac{1}{\frac{3}{4}} = \frac{4}{3}$$

Energy signal

$$x[n] = u[n]$$

$$P = \lim_{N \to \infty} \frac{1}{2N+1} \sum_{n=-N}^{N} |x[n]|^2$$

$$= \lim_{N \to \infty} \frac{1}{2N+1} \sum_{n=0}^{N} 1^2 = \lim_{N \to \infty} \frac{1}{2N+1}(N+1) = \frac{1}{2} < \infty$$

[L.Hospitals Rule)

~~L.Hospitals~~.

$$x[n] = 2^n u[-n].$$

$$E = \sum_{n=-\infty}^{\infty} |x[n]|^2 = \sum_{n=-\infty}^{0} 4^n$$

sub $n = -m$

$$E = \sum_{m=\infty}^{0} 4^{-m} = \sum_{m=0}^{\infty} \left(\tfrac{1}{4}\right)^m = \frac{1}{1-\frac{1}{4}} = \frac{4}{3}\,J$$

4.

$$x[n] = \{1, \underset{\uparrow}{2}, 3, 4\}$$
$$h[n] = \{1, \underset{\uparrow}{2}, 1\}$$

h[n] \ x[n]	1	2	3	4
1	1	2	3	4
2	2	4	6	8
1	1	2	3	4

$$y[n] = \{\underset{y[-2]}{1}, \underset{y[-1]}{4}, \underset{\underset{\uparrow}{y[0]}}{8}, \underset{y[1]}{12}, \underset{y[2]}{11}, \underset{y[3]}{4}\}$$

5.

ion : Let $y(t) = T\{x(t)\} = \dfrac{dx(t)}{dt}$

(i) Linearity : $T\{ax_1(t)+bx_2(t)\} = \dfrac{d}{dt}\{ax_1(t)+bx_2(t)\}$

$$= a\frac{dx_1(t)}{dt} + b\frac{dx_2(t)}{dt}$$

$$= a\,T\{x_1(t)\} + b\,T\{x_2(t)\}$$

$\therefore$ System is linear

(ii) Time-invariance : $T\{x(t-t_o)\} = \dfrac{d}{dt}x(t-t_o)$

$$y(t-t_o) = \frac{d}{dt}x(t-t_o)$$

$$\therefore y(t-t_o) = T\{x(t-t_o)\}$$

$\therefore$ System is time-invariant

(iii) Memory : Differentiator has memory.

(iv) Causal : The output doesnot depend on the future values of the input. So causal.

(v) Stability : If $|x(t)| \le B_x$,

$$\text{then } |y(t)| = \left|\frac{dx(t)}{dt}\right| \nleq B_y$$

$\therefore$ system is unstable.

(a) Since the output value at n depends on only the input value at n, the system is memoryless.

(b) Since the output does not depend on the future input values, the system is causal.

(c) Let $x[n] = \alpha_1 x_1[n] + \alpha_2 x_2[n]$. Then

$$\begin{aligned} y[n] = \mathbf{T}\{x[n]\} &= n\{\alpha_1 x_1[n] + \alpha_2 x_2[n]\} \\ &= \alpha_1 n x_1[n] + \alpha_2 n x_2[n] \\ &= \alpha_1 y_1[n] + \alpha_2 y_2[n] \end{aligned}$$

Thus, the superposition property (1.68) is satisfied and the system is linear.

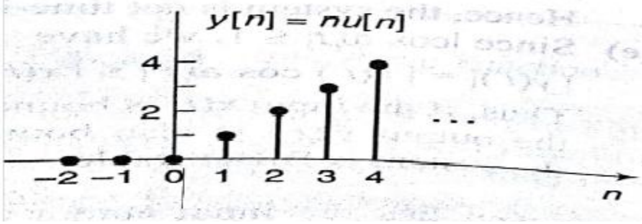
(d) Let $y_1[n]$ be the response to $x_1[n] = x[n - n_0]$. Then

$$y_1[n] = \mathbf{T}\{x[n - n_0]\} = nx[n - n_0]$$

But $y[n - n_0] = (n - n_0)\, x[n - n_0] \neq y_1[n]$

Hence, the system is not time-invariant.

(e) Let $x[n] = u[n]$. Then $y[n] = nu[n]$. Thus, the bounded unit step sequence produces an output sequence that grows without bound. (Fig. 1.38) and the system is not BIBO stable.



6.

(i) $x[n] = \beta^n u[n] \quad |\beta| < 1$

$h[n] = \alpha^n u[n] \quad |\alpha| < 1$

$$y[n] = x[n] * h[n] = \sum_{K=-\infty}^{\infty} x[K]\, h[n-K]$$

$x[K] = \beta^K u[K] \qquad h[n-k] = \alpha^{(n-k)} u[n-k]$

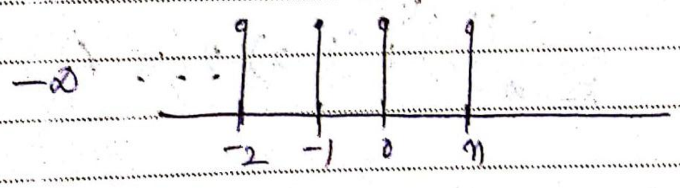
$$\begin{aligned} y[n] &= \sum_{K=-\infty}^{\infty} \beta^k u[k] \left(\alpha^{n-k}\right) u[n-k] \\ &= \alpha^n \sum_{K=-\infty}^{\infty} \beta^k \alpha^{-k} u[k]\, u[n-k] \\ &= \alpha^n \sum_{K=-\infty}^{\infty} (\beta/\alpha)^K u[k]\, u[n-k] \end{aligned}$$

$u[k]$

$u[n-k] = u[-k+n]$

first $u[k+n]$

$u[-k+n]$



when $n<0$, no overlapping between $u[k]$ and $u[n-k]$

when $n \geq 0$ overlapping is from 0 to n

$$y[n] = \alpha^n \sum_{k=0}^{n} (\alpha/\beta)^k = \alpha^n \left[\frac{1-(\alpha/\beta)^{n+1}}{1-\alpha/\beta} \right]$$

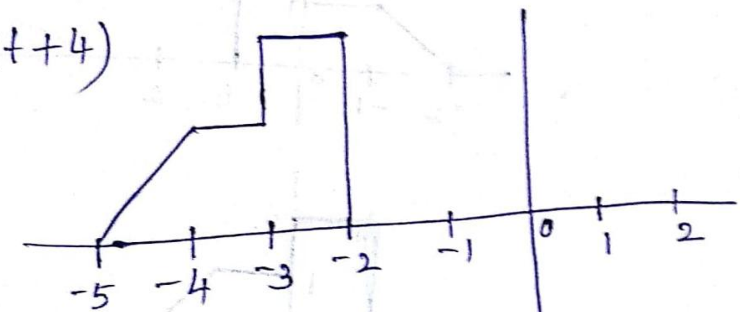
$$y[n] = 0 \qquad n<0$$

$$= \alpha^n \left[\frac{1-(\alpha/\beta)^{n+1}}{1-(\alpha/\beta)} \right]$$

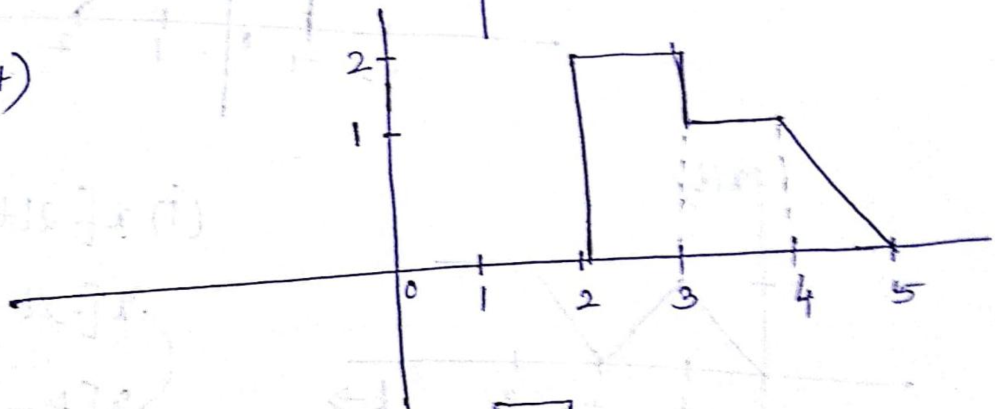
7.

(i) $x(4-t) = x(-t+4)$

$x(t+4)$



$x(-t+4)$

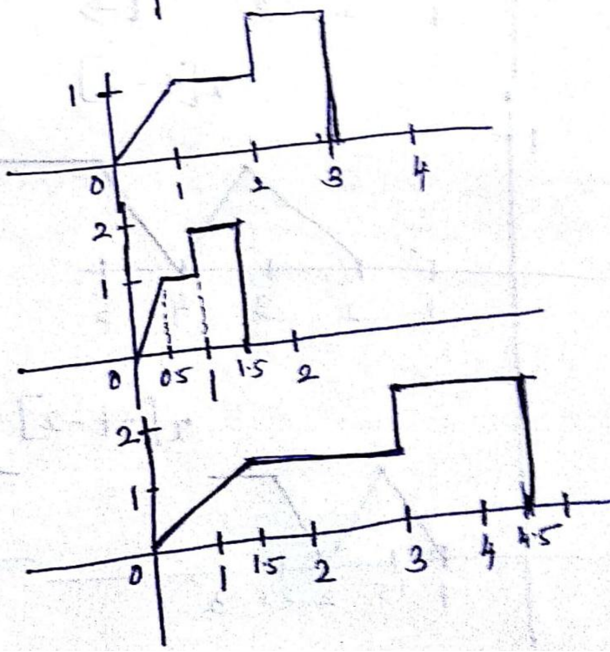


(ii) $x\left(\frac{2}{3}t-1\right)$

$x(t-1)$

$x(2t-1)$

$x\left(\frac{2}{3}t-1\right)$



$1\cdot5\times3=1\cdot5$

$1\times3=3$

$1\cdot5\times3=4\cdot5$

$x\left(\frac{2}{3}t-1\right)$