CMR INSTITUTE OF TECHNOLOGY

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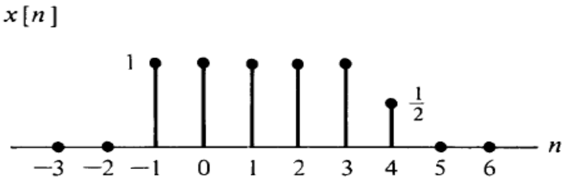
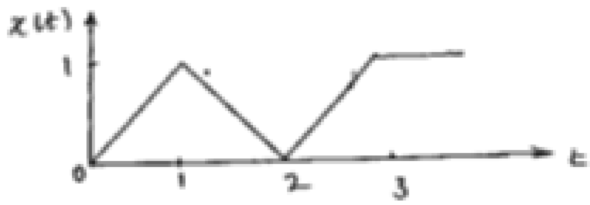
Internal Assesment Test - I

Sub:	**SIGNALS AND SYSTEMS**							Code:	17EE54
Date:	09/09/19	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	CO2	L2
4	(a) Show that the product of two even signals or two odd signals results in another even signal, while the product of an even signal and odd signal is an odd signal. (b) Show that if $x[n]$ is an odd signal then $\sum_{n=-\infty}^{\infty} x[n]=0$.	10	CO2	L2
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[t]=H{x(t)}=$[x(t)]^2$	10	CO3	L3
6	Performs the following operations on given signals (i)x(-2(t+1)) (ii)x($\frac{t}{2}+1$) 	10	CO2	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.

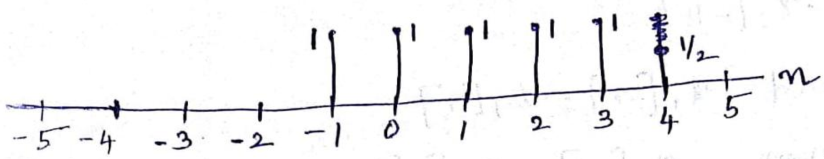
1.2.4 Deterministic and Random Signals.

1.2.5 Energy and Power Signals.

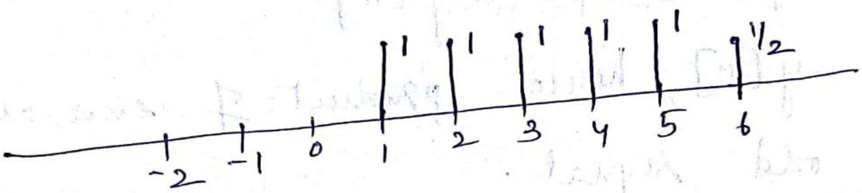
2.

(3)

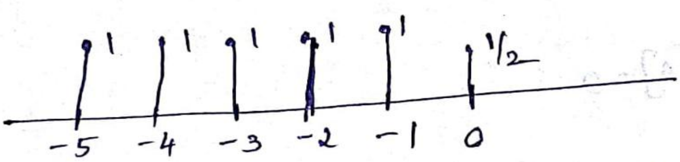
$x[n]$



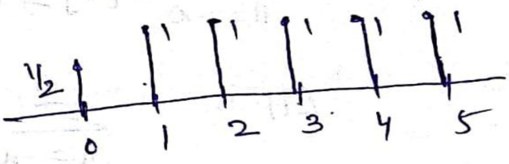
(i) $x[n-2]$ shifted 2 places to the right (delay)



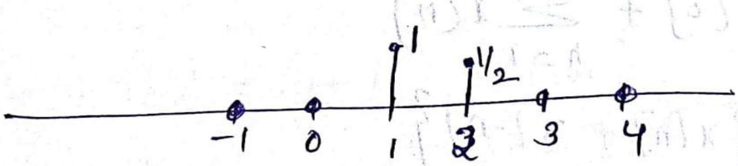
(ii) $x[4-n] = x[-n+4]$ advancing and reflection



$x[-n+4)$



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



3.

$x[n] = (1/2)^n u[n]$

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

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 $n = -m$

$$E = \sum_{m=\infty}^{0} 4^{-m} = \sum_{m=0}^{\infty} (1/4)^m = \frac{1}{1-1/4} = \frac{4}{3} J$$

4.

(5) (a) Consider $y[n] = x_1[n] \cdot x_2[n]$

$y[-n] = x_1[-n] \cdot x_2[-n]$

Given $x_1[n]$ is odd $x_1[-n] = -x_1[n]$

$x_2[n]$ is even $x_2[-n] = x_2[n]$

$y[-n] = -x_1[n] \times x_2[n] = -y[n]$

$y[-n] = -y[n]$, hence product of even and odd signal is odd signal.

(b) $\sum_{n=-\infty}^{\infty} x[n] = 0$

L.H.S $\sum_{n=-\infty}^{\infty} x[n] = 0$

$= \sum_{n=-\infty}^{-1} x[n] + x[0] + \sum_{n=1}^{\infty} x[n]$

$= \sum_{n=1}^{\infty} x[-n] + x[0] + \sum_{n=1}^{\infty} x[n]$

$= x[0] + \sum_{n=1}^{\infty} \{x[n] + x[-n]\}$

for odd $x[0] = 0$ $x[-n] = -x[n]$

Sub in equation

$= 0 + 0 = \underline{\underline{0}}$

5.

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

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

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

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

$\therefore$ System is linear

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

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

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

$\therefore$ 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 $|x(t)| \leq B_x$,

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

$\therefore$ system is unstable.

(a) Linearity

$$H\{x_1(t)\} = [x_1(t)]^2$$
$$H\{x_2(t)\} = [x_2(t)]^2$$
$$a H\{x_1(t)\} + b H\{x_2(t)\} = a(x_1(t))^2 + b(x_2(t))^2 \quad (1)$$
$$H\{a x_1(t) + b x_2(t)\} = [a x_1(t) + b x_2(t)]^2 \quad (2)$$

(1) $\neq$ (2) Not linear.

(b) Time-invariance

$$y(t-t_0) = (x(t-t_0))^2$$
$$T\{x(t-t_0)\} = (x(t-t_0))^2$$

Time-invariant.

(c) Memory

$y(t) = (x(t))^2$ depends only on the present value, Memoryless

(d) Causality

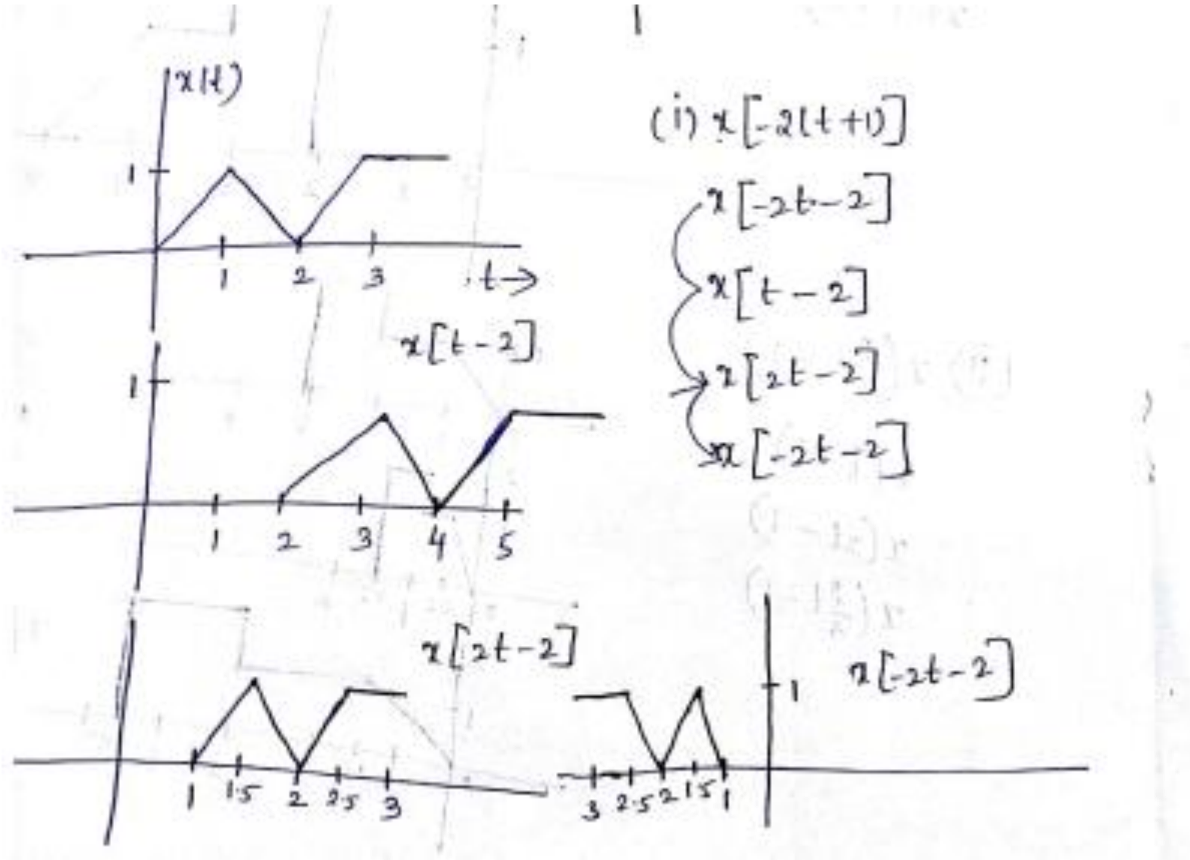
Does not depend on future value, so Causal.

(e) Stability $0 < |x(t)| < \infty$ $\quad 0 < |(x(t))^2| < \infty$.

Stable.

6.

a.



b.

(ii) $x\left[\frac{t}{2}+1\right]$ first perform $x[t+1]$

one place to left.

then $x\left[\frac{t}{2}+1\right]$ expand by 2.