CMR INSTITUTE OF TECHNOLOGY

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Internal Assessment Test - I

Sub:	SIGNALS AND SYSTEMS							Code:	18EE54
Date:	7/11/22	Duration:	90 mins	Max Marks:	50	Sem:	5th	Branch:	EEE

Answer Any FIVE FULL Questions

		Marks	OBE CO	OBE RBT
1	Define the term Signal.Distinguish between (i) Continous time and Discrete time signals (ii) Even and Odd signals.	10	CO1	L2

The fundamental quantity of representing some information is called a signal.

CT signal - A signal defined for all time t.
Represented as $x(t)$ or $x[t]$

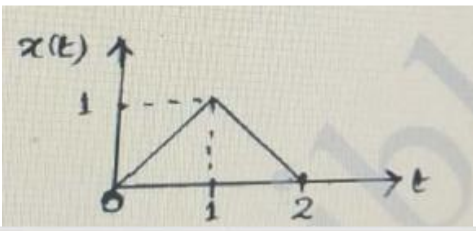
DT signal - A signal defined only at discrete instants of time
Represented as $x(n)$ or $x[n]$

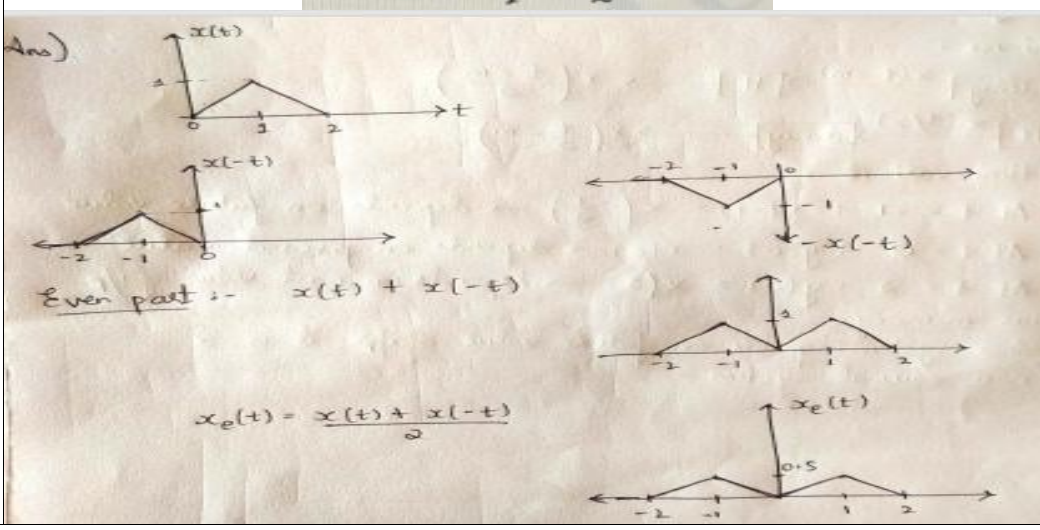
I) Even and Odd signals :-

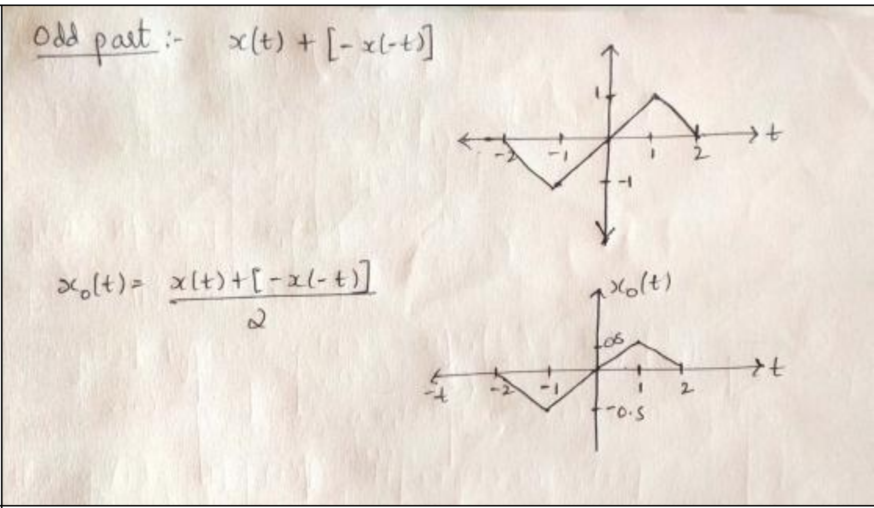
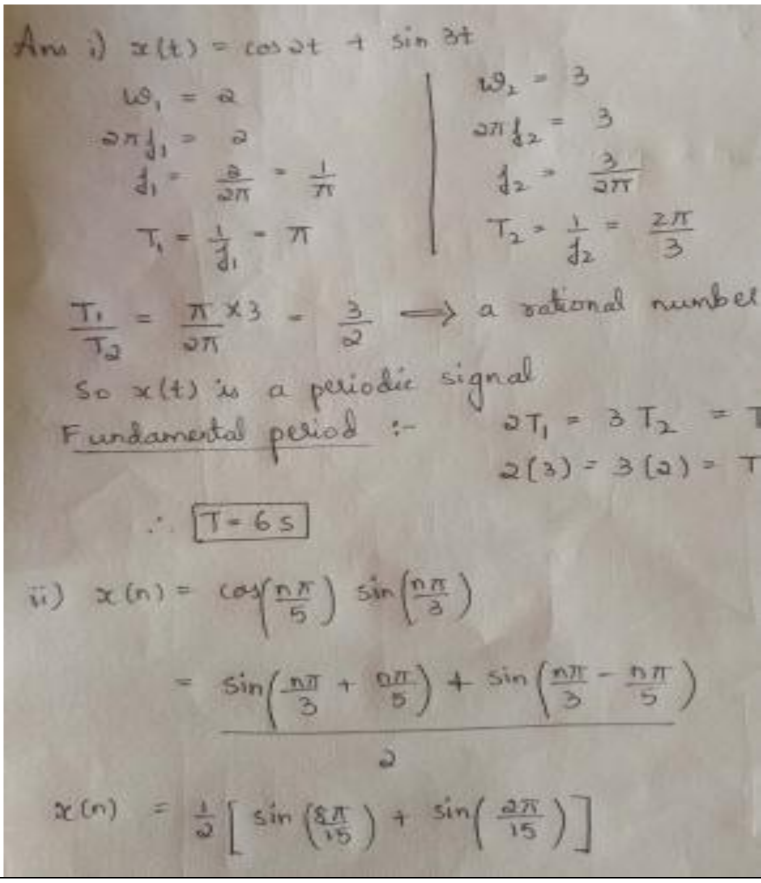
Even signals - $x(-t) = x(t)$ for all t
$x(-n) = x(n)$ for all n.
Eg → $\cos(t)$

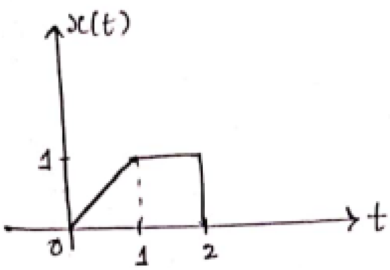
Odd signals - $x(-t) = -x(t)$ for all t
$x(-n) = -x(n)$ for all n
Eg → $\sin(t)$

		Marks	CO	RBT
2	Sketch even and odd parts of the signal	10	CO1	L3

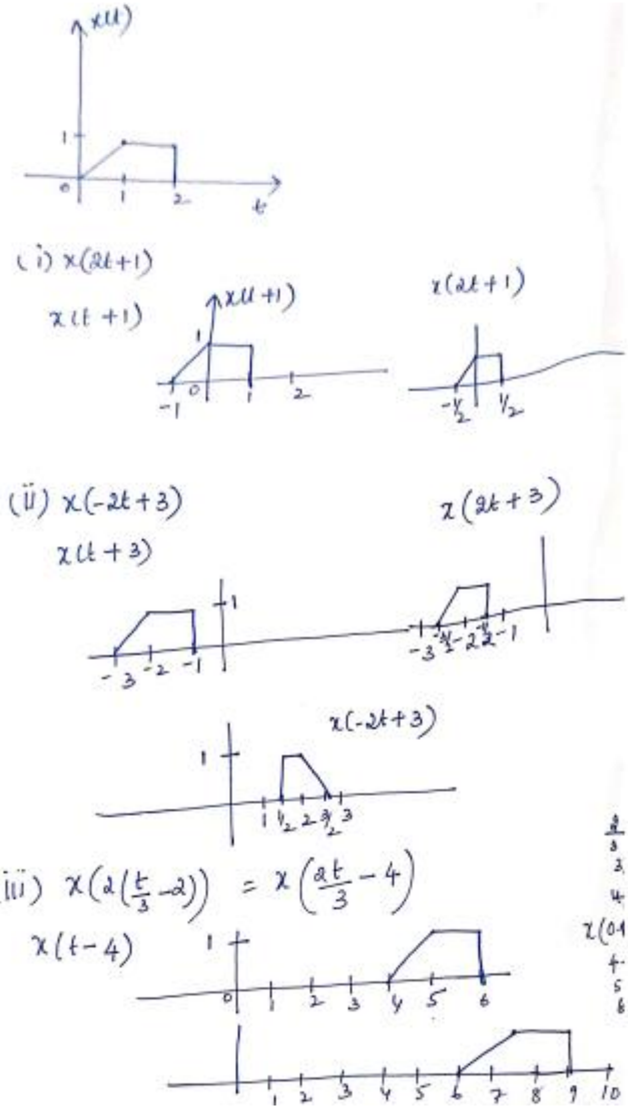




	 			
3	Distinguish between power and energy signals. Categorize each of the following signals as Periodica nd Non-periodic signals and find the corresponding Period. (a). $x(t) = cos2t + sin2t$ (b). $x[n] = \cos(n\pi/5)+\sin(n\pi/3)$  Ans i) $x(t) = \cos 2t + \sin 3t$ $\omega_1 = 2$, $2\pi f_1 = 2$, $f_1 = \frac{2}{2\pi} = \frac{1}{\pi}$, $T_1 = \frac{1}{f_1} = \pi$ $\omega_2 = 3$, $2\pi f_2 = 3$, $f_2 = \frac{3}{2\pi}$, $T_2 = \frac{1}{f_2} = \frac{2\pi}{3}$ $\frac{T_1}{T_2} = \frac{\pi \times 3}{2\pi} = \frac{3}{2}$ ⟹ a rational number So x(t) is a periodic signal Fundamental period :- $2T_1 = 3T_2 = T$ $2(3) = 3(2) = T$ ∴ $T = 6s$ ii) $x(n) = \cos\left(\frac{n\pi}{5}\right)\sin\left(\frac{n\pi}{3}\right)$ $= \frac{\sin\left(\frac{n\pi}{3}+\frac{n\pi}{5}\right)+\sin\left(\frac{n\pi}{3}-\frac{n\pi}{5}\right)}{2}$ $x(n) = \frac{1}{2}\left[\sin\left(\frac{8\pi}{15}\right)+\sin\left(\frac{2\pi}{15}\right)\right]$	10	CO1	L3

<table>
<tr><td></td><td>Ans i) $x(t) = \cos 2t + \sin 3t$
$\omega_1 = 2$
$2\pi f_1 = 2$
$f_1 = \frac{2}{2\pi} = \frac{1}{\pi}$
$T_1 = \frac{1}{f_1} = \pi$
$\omega_2 = 3$
$2\pi f_2 = 3$
$f_2 = \frac{3}{2\pi}$
$T_2 = \frac{1}{f_2} = \frac{2\pi}{3}$
$\frac{T_1}{T_2} = \frac{\pi \times 3}{2\pi} = \frac{3}{2} \Longrightarrow$ a rational number
So $x(t)$ is a periodic signal
Fundamental period :- $2T_1 = 3T_2 = T$
$2(3) = 3(2) = T$
$\therefore$ $T = 6s$
ii) $x(n) = \cos\left(\frac{n\pi}{5}\right)\sin\left(\frac{n\pi}{3}\right)$
$= \frac{\sin\left(\frac{n\pi}{3} + \frac{n\pi}{5}\right) + \sin\left(\frac{n\pi}{3} - \frac{n\pi}{5}\right)}{2}$
$x(n) = \frac{1}{2}\left[\sin\left(\frac{8\pi}{15}\right) + \sin\left(\frac{2\pi}{15}\right)\right]$
$\omega_1 = \frac{8n\pi}{15}$
$2\pi f_1 = \frac{8n\pi}{15}$
$f_1 = \frac{8n\pi}{15 \times 2\pi}$
$f_1 = \frac{4n}{15}$
$T_1 = \frac{1}{f_1} = \frac{15}{4n}$
$\omega_2 = \frac{2n\pi}{15}$
$2\pi f_2 = \frac{2n\pi}{15}$
$f_2 = \frac{2n\pi}{15 \times 2\pi}$
$f_2 = \frac{n}{15}$
$T_2 = \frac{1}{f_2} = \frac{15}{n}$
$\frac{T_1}{T_2} = \frac{15}{4n} \times \frac{n}{15} = \frac{1}{4} \Longrightarrow$ rational
$\therefore$ $x(n)$ is a periodic signal
$T = 4T_1 = T_2$
$T = 4(1)$
$T = 4s$ is the fundamental period</td><td></td><td></td><td></td></tr>
<tr><td>4</td><td>Sktech and label for each of the following for the given signal x(t)


(i)x(2t+1) (ii) x(-2t+3) (iii)$x(2(\frac{t}{3} - 2))$</td><td>10</td><td>CO1</td><td>L3</td></tr>
</table>

				
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. $y[t]=H\{x(t)\}=[x(t)]^2$ 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 : $T\{x(t-t_o)\} = \frac{d}{dt}x(t-t_o)$ $y(t-t_o) = \frac{d}{dt}x(t-t_o)$	10	CO1	L3

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

∴ 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 $|x(t)| \leq B_x$,

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

∴ system is unstable.

(a) Linearity

$H\{x_1(t)\} = [x_1(t)]^2$

$H\{x_2(t)\} = [x_2(t)]^2$

$aH\{x_1(t)\} + bH\{x_2(t)\} = a(x_1(t))^2 + b(x_2(t))^2$ — ①

$H\{ax_1(t) + bx_2(t)\} = [ax_1(t) + bx_2(t)]^2$ — ②

① ≠ 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 $0 < |x(t)| < \infty$ $0 < |(x(t))^2| < \infty$.

Stable.

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Explain the operations performed on dependent and independent varaiables

Basic Signal Operations Performed on Dependent Variables

In this transformation, only the quadrature axis values are modified i.e magnitude of the signal changes, with no effects on the horizontal axis values or periodicity of signals like.

1. Amplitude scaling of signals.
2. Addition of signals.
3. Multiplication of signals.
4. Differentiation of signals.
5. Integration of signals.

Basic Signal Operations Performed on Dependent Variables

This is exactly the opposite of the above mentioned case, here the periodicity of the signal is varied by modifying the horizontal axis values, while the amplitude or the strength remains constant. These are:-

1. Time scaling of signals

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	2. Reflection of signals 3. Time-shifting of signals.			

CI **CCI** **HOD**