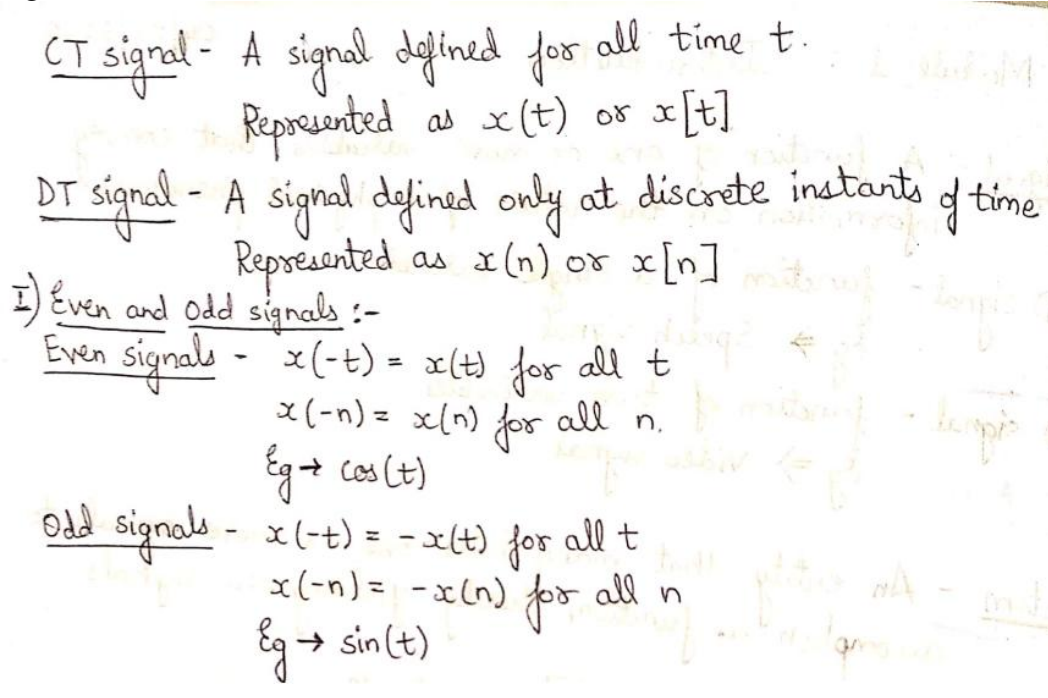
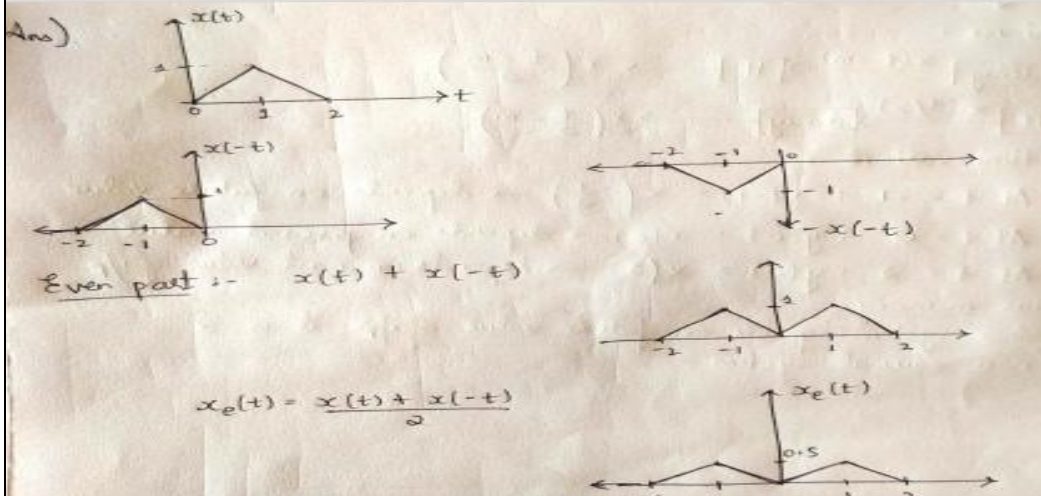


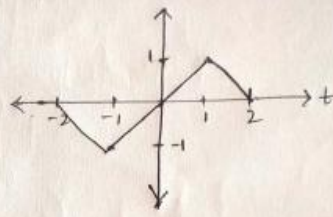
Internal Assessment Test - I

Sub:	<b>SIGNALS AND DIGITAL SIGNAL PROCESSING</b>						Code:	21EE63	
Date:	3/06/24	Duration:	90 mins	Max Marks:	50	Sem:	5th	Branch:	EEE

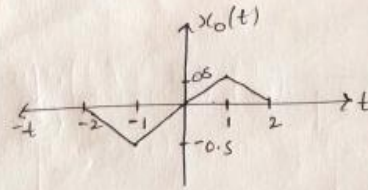
Answer Any FIVE FULL Questions

		Marks	OBE	
			CO	RBT
1	<p>Define the term Signal. Distinguish between (i) Continuous time and Discrete time signals (ii) Even and Odd signals.</p> <p>The fundamental quantity of representing some information is called a signal.</p>  <p><u>CT signal</u> - A signal defined for all time <math>t</math>. Represented as <math>x(t)</math> or <math>x[t]</math></p> <p><u>DT signal</u> - A signal defined only at discrete instants of time Represented as <math>x(n)</math> or <math>x[n]</math></p> <p>I) <u>Even and Odd signals</u> :-</p> <p><u>Even signals</u> - <math>x(-t) = x(t)</math> for all <math>t</math> <math>x(-n) = x(n)</math> for all <math>n</math>. Eg <math>\rightarrow \cos(t)</math></p> <p><u>Odd signals</u> - <math>x(-t) = -x(t)</math> for all <math>t</math> <math>x(-n) = -x(n)</math> for all <math>n</math> Eg <math>\rightarrow \sin(t)</math></p>	10	CO1	L2
2	<p>Sketch even and odd parts of the signal</p>  <p><math>x(t)</math></p> <p>Ans)</p> <p>Even part :- <math>x_e(t) = \frac{x(t) + x(-t)}{2}</math></p>	10	CO1	L3

Odd part :-  $x(t) + [-x(-t)]$



$$x_o(t) = \frac{x(t) + [-x(-t)]}{2}$$



3 Distinguish between power and energy signals. Categorize each of the following signals as Periodic and Non-periodic signals and find the corresponding Period.

10

CO1

L3

(a).  $x(t) = \cos 2t + \sin 2t$  (b).  $x[n] = \cos(n\pi/5) + \sin(n\pi/3)$

Ans i)  $x(t) = \cos 2t + \sin 2t$

$\omega_1 = 2$	$\omega_2 = 3$
$2\pi f_1 = 2$	$2\pi f_2 = 3$
$f_1 = \frac{2}{2\pi} = \frac{1}{\pi}$	$f_2 = \frac{3}{2\pi}$
$T_1 = \frac{1}{f_1} = \pi$	$T_2 = \frac{1}{f_2} = \frac{2\pi}{3}$

$\frac{T_1}{T_2} = \frac{\pi \times 3}{2\pi} = \frac{3}{2} \Rightarrow$  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)  $x(n) = \cos\left(\frac{n\pi}{5}\right) \sin\left(\frac{n\pi}{3}\right)$

$$= \frac{\sin\left(\frac{n\pi}{3} + \frac{n\pi}{5}\right) + \sin\left(\frac{n\pi}{3} - \frac{n\pi}{5}\right)}{2}$$

$$x(n) = \frac{1}{2} \left[ \sin\left(\frac{8\pi}{15}\right) + \sin\left(\frac{2\pi}{15}\right) \right]$$

Ans i)  $x(t) = \cos 2t + \sin 3t$

$\omega_1 = 2$

$2\pi f_1 = 2$

$f_1 = \frac{2}{2\pi} = \frac{1}{\pi}$

$T_1 = \frac{1}{f_1} = \pi$

$\omega_2 = 3$

$2\pi f_2 = 3$

$f_2 = \frac{3}{2\pi}$

$T_2 = \frac{1}{f_2} = \frac{2\pi}{3}$

$\frac{T_1}{T_2} = \frac{\pi \times 3}{2\pi} = \frac{3}{2} \Rightarrow$  a rational number

So  $x(t)$  is a periodic signal

Fundamental period :-  $2T_1 = 3T_2 = T$

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ii)  $x(n) = \cos\left(\frac{n\pi}{5}\right) \sin\left(\frac{n\pi}{3}\right)$

$= \frac{\sin\left(\frac{n\pi}{3} + \frac{n\pi}{5}\right) + \sin\left(\frac{n\pi}{3} - \frac{n\pi}{5}\right)}{2}$

$x(n) = \frac{1}{2} \left[ \sin\left(\frac{8n\pi}{15}\right) + \sin\left(\frac{2n\pi}{15}\right) \right]$

$\omega_1 = \frac{8n\pi}{15}$

$2\pi f_1 = \frac{8n\pi}{15}$

$f_1 = \frac{8n}{15 \times 2\pi}$

$f_1 = \frac{4n}{15}$

$T_1 = \frac{1}{f_1} = \frac{15}{4n}$

$\omega_2 = \frac{2n\pi}{15}$

$2\pi f_2 = \frac{2n\pi}{15}$

$f_2 = \frac{2n}{15 \times 2\pi}$

$f_2 = \frac{n}{15}$

$T_2 = \frac{1}{f_2} = \frac{15}{n}$

$\frac{T_1}{T_2} = \frac{15}{4n} \times \frac{n}{15} = \frac{1}{4} \Rightarrow$  rational

$\therefore x(n)$  is a periodic signal

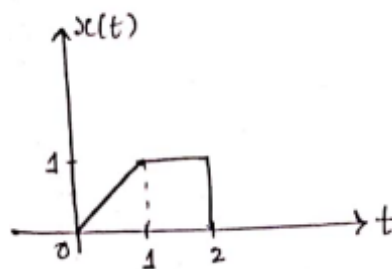
$T = 4T_1 = T_2$

$T = 4(1)$

$T = 4s$  is the fundamental period.

4 Sketch and label each of the following for the given signal  $x(t)$

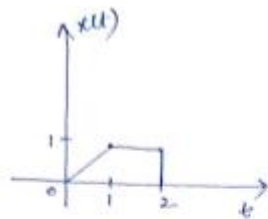
10 CO1 L3



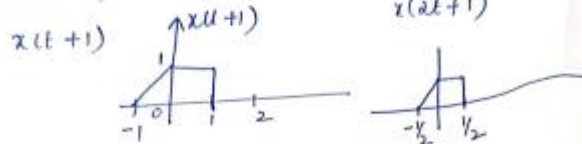
(i)  $x(2t+1)$

(ii)  $x(-2t+3)$

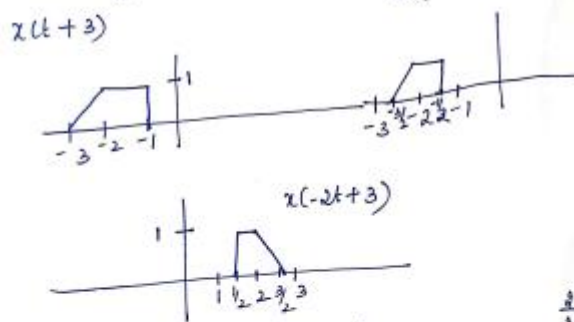
(iii)  $x\left(2\left(\frac{t}{3} - 2\right)\right)$



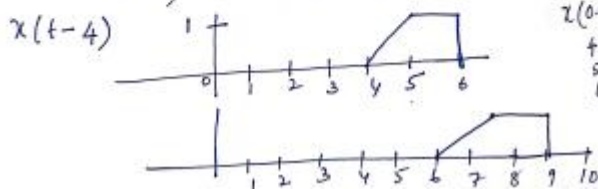
(i)  $x(2t+1)$



(ii)  $x(-2t+3)$



(iii)  $x(2(\frac{t}{3}-2)) = x(\frac{2t}{3}-4)$



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

10 CO1 L3

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

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

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

∴ System is linear

(ii) Time-invariance :  $T\{x(t-t_0)\} = \frac{d}{dt}x(t-t_0)$

$y(t-t_0) = \frac{d}{dt}x(t-t_0)$



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

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

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

$\therefore$  system is unstable.

② Linearity

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

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

$$aH\{x_1(t)\} + bH\{x_2(t)\} = a[x_1(t)]^2 + b[x_2(t)]^2 \text{ --- (1)}$$

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

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

③ Time-invariance

$$y(t-t_0) = (x(t-t_0))^2$$

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

} Time-invariant.

④ Memory

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

⑤ Causality

Does not depend on future value, so Causal.

⑥ Stability  $0 < |x(t)| < \infty$   $0 < (x(t))^2 < \infty$   
Stable.

6 Explain the operations performed on dependent and independent variables

10

CO1

L2

## 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

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

**CCI**

**HOD**

