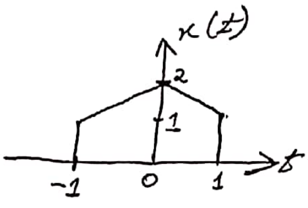
Name:- Zubayer Ahmed Ridhan Laskar, Roll :- 20071000 7062

Subject: Basics of Signal Systems, Semester:- 3^{rd}

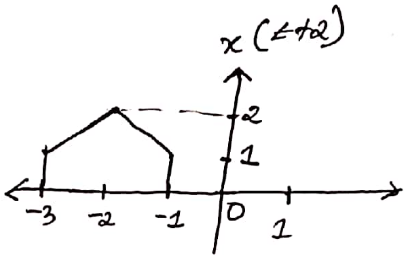
Date :- 27/10/2021

CIF - 1

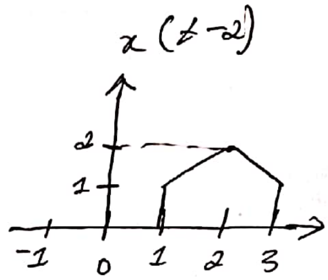
1. Soln:-



$x(t)$



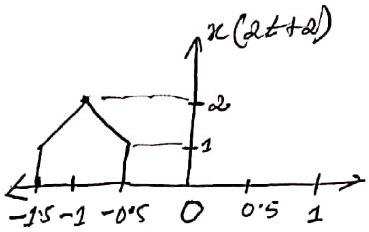
$x(t+2)$



$x(t-2)$

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

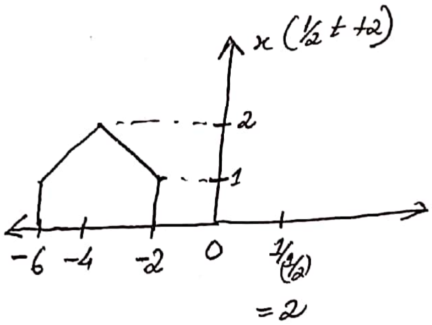
$x(t) \rightarrow x(t+2) \rightarrow x(2t+2)$



[dividing t by 2]

(ii) For $x(\frac{1}{2}t+2)$

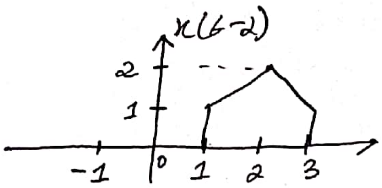
$x(t) \rightarrow x(t+2) \rightarrow x(\frac{1}{2}t+2)$



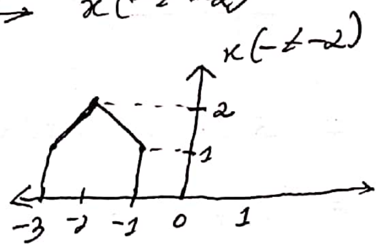
[dividing t by 1/2]

(iii) For $x(-t-2)$

$x(t) \longrightarrow x(t-2) \longrightarrow x(-t-2)$

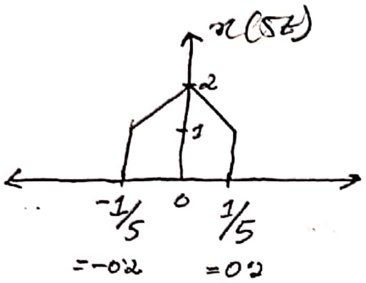


$\rightarrow$

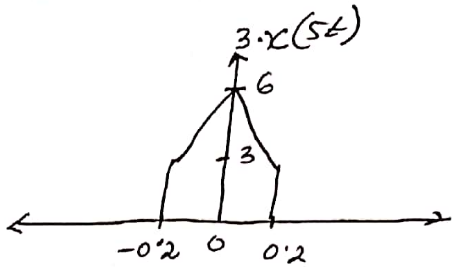


1. (iv) Solⁿ: for $3 \cdot x(5t)$

$$x(t) \rightarrow x(5t) \longrightarrow 3 \cdot x(5t).$$



$\longrightarrow$



2) (i) Solⁿ: Given,

$$x(t) = \cos t + \sin t + \cos t \sin t$$

Now,

$$x(-t) = \cos(-t) + \sin(-t) + \cos(-t)\sin(-t)$$

$$= \cos t - \sin t + \cos t(-\sin t)$$

$$= \cos t - \sin t - \cos t \sin t$$

$$\therefore x_{even}(t) = \frac{x(t) + x(-t)}{2}$$

$$= \frac{\cos t + \cancel{\sin t} + \cancel{\cos t \sin t} + \cos t - \cancel{\sin t} - \cancel{\cos t \sin t}}{2}$$

$$= \frac{2\cos t}{2}$$

$$= \cos t$$

$$\& \ x_{odd}(t) = \frac{x(t) - x(-t)}{2}$$

$$= \frac{\cancel{\cos t} + \sin t + \cos t \sin t - \cancel{\cos t} + \sin t + \cos t \sin t}{2}$$

$$= \sin t + \cos t \sin t$$

$$= \sin t(1 + \cos t)$$

3. (ii) Sol^n:- Given, $x(n) = \{-2, 1, \underset{\uparrow}{2}, -1, 3\}$

Now, $x(-n) = \{3, -1, \underset{\uparrow}{2}, 1, -2\}$

$\therefore x_{even}(n) = \dfrac{x(n) + x(-n)}{2}$

$= \frac{1}{2}[1, 0, 4, 0, 1]$

$= [0.5, 0, 2, 0, 0.5]$

$= \{0, \underset{\uparrow}{2}, 0\}$

& $x_{odd}(n) = \dfrac{x(n) - x(-n)}{2}$

$= \frac{1}{2}[-5, 2, 0, -2, 5]$

$= [-2.5, 1, 0, -1, 2.5]$

$= \{1, \underset{\uparrow}{0}, -1\}$

2) Sol^n: Given, $x(n) = 2e^{i3\pi n}$

Now, Energy of the signal, $E = \sum_{n=-\infty}^{\infty} [x(n)]^2$

$= \sum_{n=-\infty}^{\infty} [2e^{i3\pi n}]^2$

$= \infty$

Scanned with CamScanner

And, Power of the signal, $P = \frac{1}{2T}\sum_{n=-T}^{T}[x(t)]^2$

$$= \frac{1}{2T}\sum_{n=-T}^{T}[2e^{i3\pi n}]^2$$

$$= \frac{1}{2}\sum_{n=-T}^{T}(2e^{i3\pi n})$$

which is finite, i.e.

$P < \infty$

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

4. (i) Soln:- Given,

$$x(t) = \cos(\tfrac{1}{3}T) + \sin(\tfrac{1}{4}T)$$

Now, Let, $x_1(t) = \cos(\tfrac{1}{3}T)$ & $x_2(t) = \sin(\tfrac{1}{4}T)$

Now, $w_1 = \frac{1}{3}$ & $w_2 = \frac{1}{4}$

$\therefore 2\pi f_1 = \frac{1}{3}$

$\Rightarrow f_1 = \frac{1}{6\pi}$

Or, $T_1 = 6\pi$ seconds.

$\therefore 2\pi f_2 = \frac{1}{4}$

$\Rightarrow f_2 = \frac{1}{8\pi}$

i.e. $T_2 = 8\pi$ seconds.

Now, $\frac{T_1}{T_2} = \frac{6\pi}{8\pi} = \frac{6}{8} = \frac{3}{4}$ = rational.

Hence, $x(t)$ is periodic

4. (ii). Solⁿ:- Given,

$$x(t) = u(t) - u(t-10)$$

Let, $x_1(t) = u(t)$ & $x_2(t) = u(t-10)$

Now, $u(t) = \begin{cases} 1, & t \geq 0 \\ 0, & t < 0 \end{cases}$

i.e. $u(t)$ is not periodic.

$u(t-10) = \begin{cases} 1, & t \geq 10 \\ 0, & t < 10 \end{cases}$

i.e. $u(t-10)$ is not periodic.

Hence,

$x(t) = u(t) - u(t-10)$ is not periodic.

5) Solⁿ:- Given,

$$x(t) = \frac{d^3y(t)}{dt^3} + 4 \cdot \frac{d^2y(t)}{dt^2} + 5 \frac{dy(t)}{dt} + 2y^2(t)$$

(a) for,

$$x(-1) = \frac{d^3y(-1)}{dt^3} + 4 \cdot \frac{d^2y(-1)}{dt^2} + 5 \cdot \frac{dy(-1)}{dt} + 2y^2(-1)$$

$$x(0) = \frac{d^3y(0)}{dt^3} + 4 \cdot \frac{d^2y(0)}{dt^2} + 5 \cdot \frac{dy(0)}{dt} + 2y^2(0)$$

$$x(1) = \frac{d^3y(1)}{dt^3} + 4 \cdot \frac{d^2y(1)}{dt^2} + 5 \cdot \frac{dy(1)}{dt} + 2y^2(1)$$

As the present o/ps depend only on present i/ps

∴ The system is <u>static</u>.

(b) ∵ The coefficients of $x(t)$ are independent of time (t),

∴ The system is <u>linear</u>.

(c) As at any instant of time (t), the present o/p depends only on the present i/p and doesn't need future i/p.

∴ The system is <u>casual</u>.

(d) Here let $y(t) = \frac{d^3y(t)}{dt^3} + 4 \cdot \frac{d^2y(t)}{dt^2} + 5 \cdot \frac{dy(t)}{dt} + 2y^2(t)$

∴ $y(t, T) = y(t-T)$

∴ The system is <u>time-invariant</u>.

—+—