S.S ; Tue, 28/2/23.

noise $+n(t)$

Signal $x(t) \longrightarrow \boxed{\text{System}} \longrightarrow y(t) = x(t) + h(t)$

System

$h(t)$

Convolution property.

- Signal :-
  - May be continuous or discrete S.
  - May be energy or power Sig
  -

→ Signal have some operations such as

- scaling
  - * Time scaling
  - * Amplitude scaling.

$x(t) \xrightarrow[T.S]{} x(\alpha t).$

where $|\alpha| \in (-\infty, \infty)$

We can compress or expand a signal with time scaling.

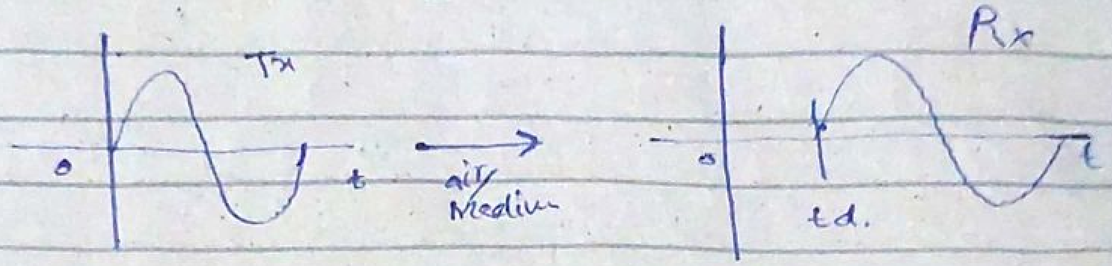
$x(t) \xrightarrow[A.S]{} \alpha \cdot x(t).$

where $|\alpha| \in (-\infty, 1) \cup (1, \infty).$

$\alpha \in (-1, 0) \cup (0, 1).$

(2) * We should shift first and then scale it.

* Time shifting:-



It is due to delay cause by covering distance. this delay is as:

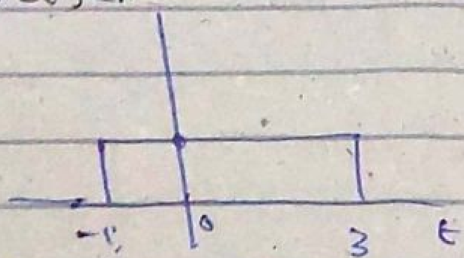
as $t = \frac{S}{V} = \frac{d}{c}$.

$t_d = \frac{d^{ist}}{c}$ (speed of light)

$x(t) \xrightarrow[\text{T. shift}]{} x(t + t_d)$.

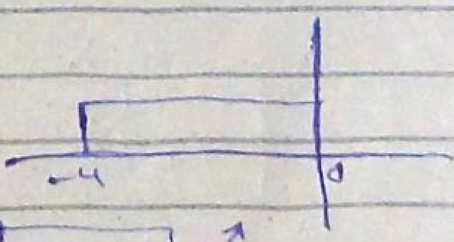
∵ If td is +ve it is advance
∵ elif td is -ve it is delayed

Exercise:-



$\longrightarrow x(t+3) = ?$

$t+3 = 0$
$t = -3$
$t+3 = -1 \Rightarrow \boxed{t = -4}$
$t+3 = 3 \Rightarrow t = 0$



it will advanced by (3)

$x(t) \longrightarrow x(2t+3)$.

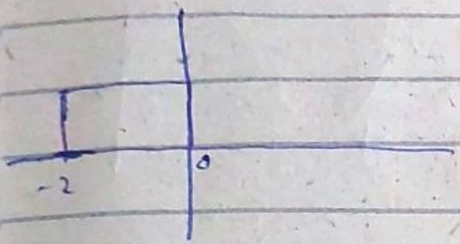
$2t+3 = -1$

$\cancel{2}t = -4$

$\boxed{t = -2}$

$2t = 0$

$t = 0$



it is compressed
and shifted.

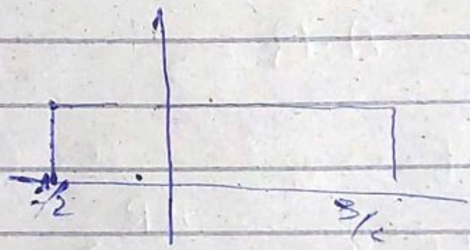
$x(t) = x(2t)$.

$2t = -1$

$t = -1/2$

$2t = 3$

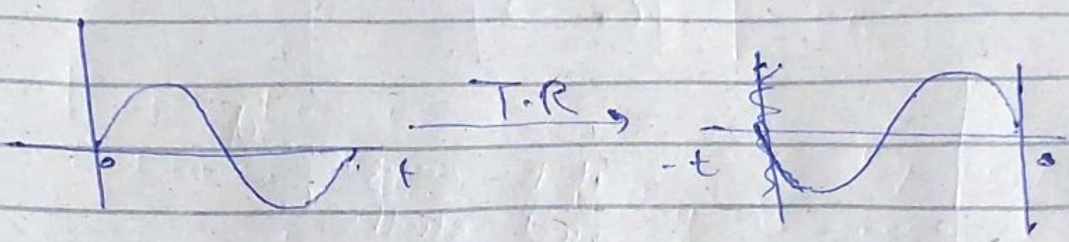
$t = 3/2$



④

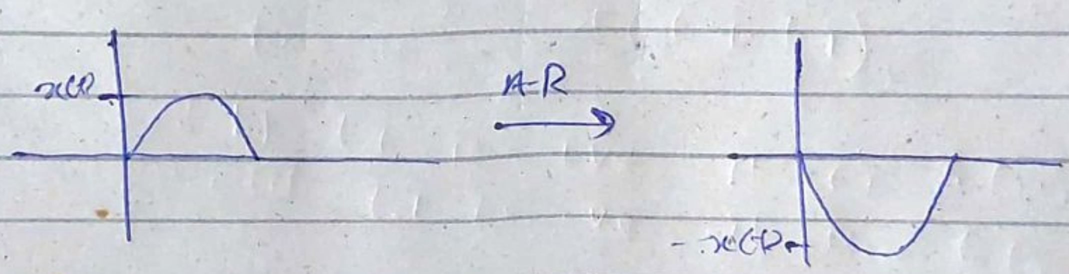
* Time Reversal:-

$x(t) \xrightarrow{T.R} x(-t).$



* Amplitude Reversal:-

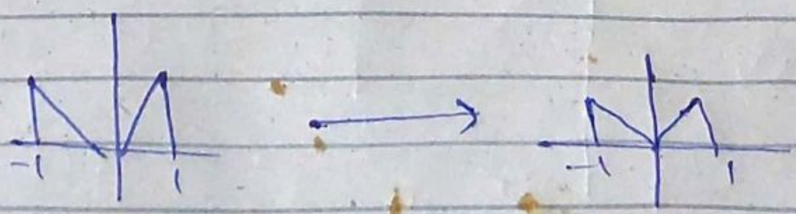
$x(t) \xrightarrow{A.R} -x(t).$



Even & Odd Signals.

* $x(t) = x(-t)$

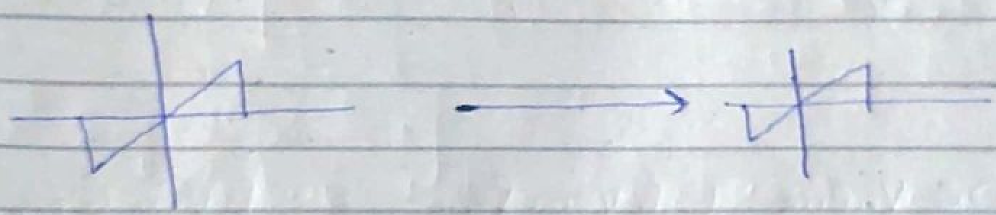
It is said to be even sig.



5

* $x(-t) = \cos(-t) = \cos(-t)$.
  * It is even signal.

* $x(-t) = -x(-t)$.
  $x(t) = \sin(-t) = -\sin t$
  * it is add function



↳ signal are made up of both add and even parts. i.e.

$$x(t) = x_e(t) + x_o(t). \quad -(1)$$

as fibbin fourier series show.

$$x(t) = \sum_n C_n [\cos n\omega t + \sin n\omega t]$$

$$x(-t) = x_e(t) - x_o(t). \quad -(2)$$

Adding (1) and (2) we get

$$x(t) + x(-t) = 2x_e(t) + 0$$

$$\boxed{x_e(t) = \frac{1}{2}[x(t) + x(-t)]}$$

Now Subtraction ① and ② we get

$$\boxed{x_o(t) = \frac{1}{2}\left[x(t) - x(-t)\right]}$$

* properties:

① x

② DC Value + Even fun = Even Signal

③ DC Val. + odd funcli = odd Sig

④ Even $\times$ Even = Even Sig

⑤ odd $\times$ odd = Even Sig

⑥ odd $\times$ Even = odd Signal

⑦ $\frac{1}{\text{Even}}$ = Even Sn

⑧ $\frac{1}{\text{odd}}$ = odd Signal.

⑨ $\frac{d}{dt}$ Even = odd Sign

⑩ $\frac{d}{dt}$ odd = Even Sign.

⑪ $\int$ Even dt = odd

⑫ $\int$ odd dt = Even

Example

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

$x_e(t) = ?$, $x_o(t) = ?$

$$x_e(t) = \frac{1}{2}\left[x(t) + x(-t)\right]$$

$$= \frac{1}{2}\left[\cos t + \cancel{\sin t} + \cancel{\cos t \sin t} + \cos t - \cancel{\sin t} - \cancel{\cos t \sin t}\right]$$

$$= \frac{1}{\cancel{2}}\left[\cancel{2}\cos t\right]$$

$$= \cos t.$$

$$x_o(t) = \frac{1}{2}\left[x(t) - x(-t)\right]$$

$$= \frac{1}{2}\left[\cancel{\cos t} + \sin t + \cos t \sin t - \cancel{\cos t} + \sin t + \cos t \sin t\right]$$

$$= \frac{1}{\cancel{2}}\left[\cancel{2}\left(\sin t + \cos t \sin t\right)\right]$$

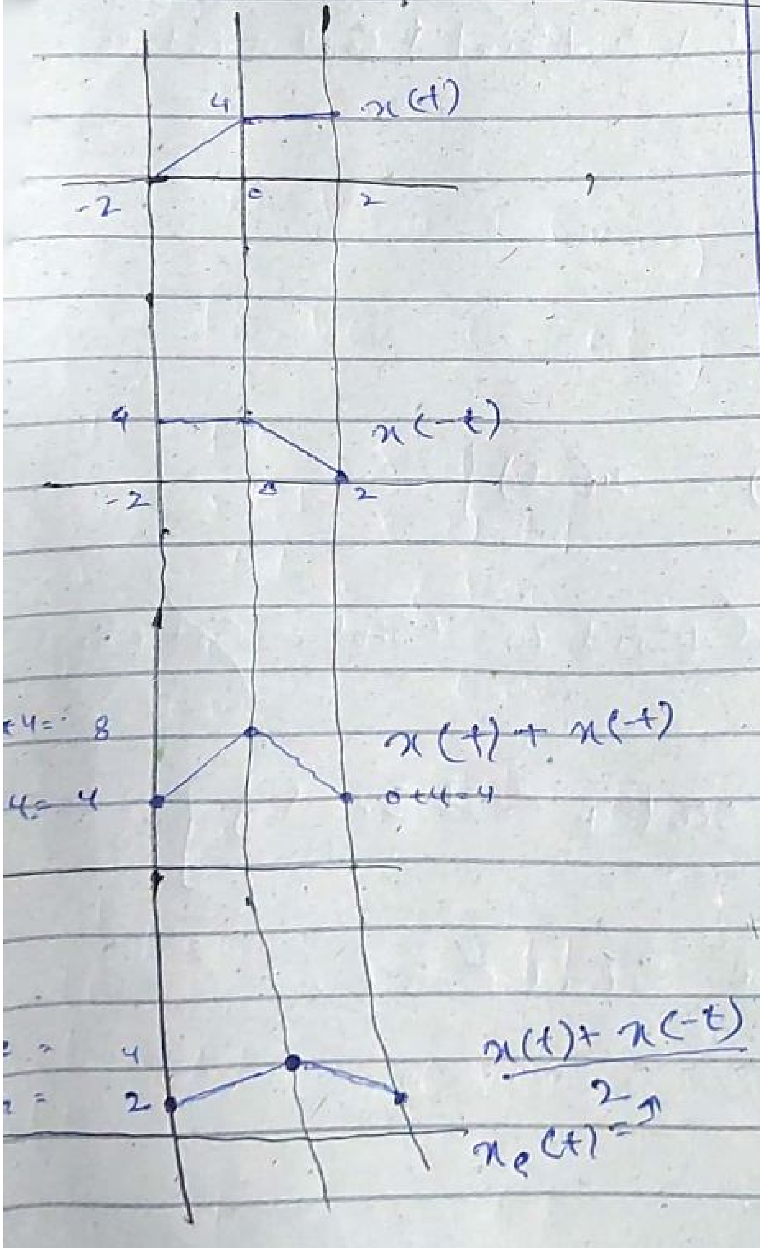
$$= \sin t + \sin t \cos t.$$

$x(t) \longrightarrow x(2t+3)$

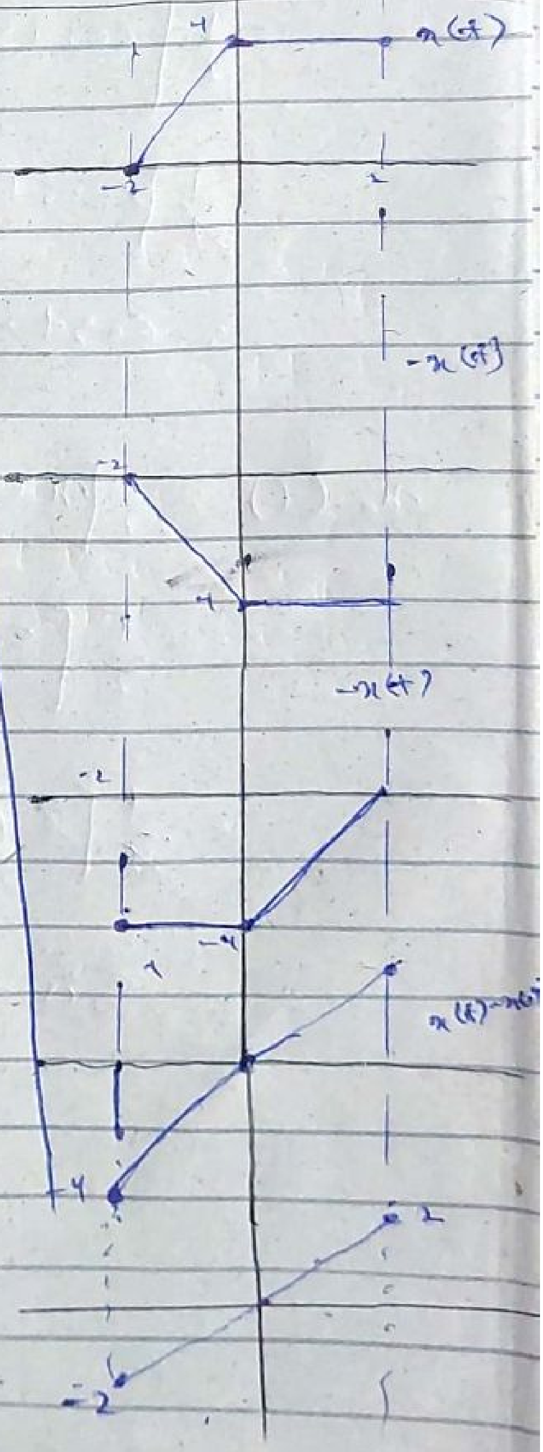
i) $x(t+3)$
ii) $x(2t+3)$

i) $x(2t)$
ii) $x(2(t+1.5))$
iii) $x(2t+3)$.

odd part

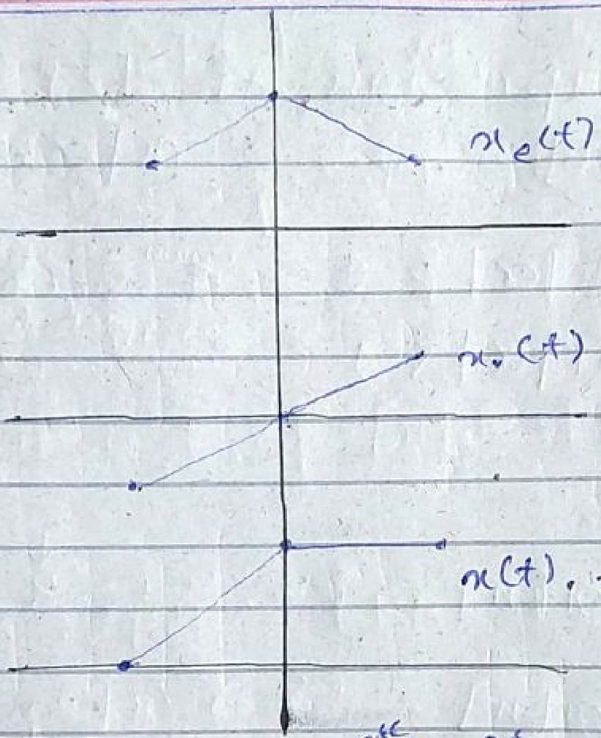


Even part



$\frac{x(t)-x(-t)}{2}$

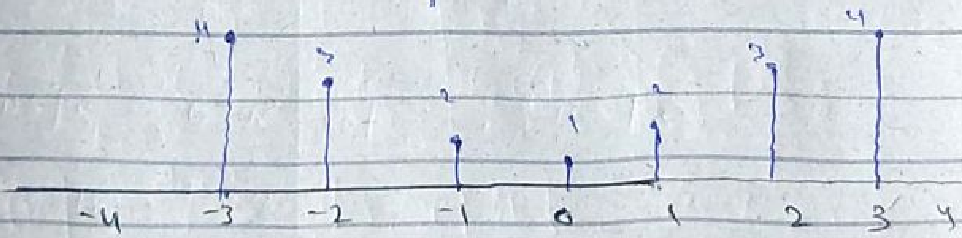
S.S Wed, 1-3-23.



$x(t) = x_e(t) + x_o(t)$.

Time shifts of DTS (discrete time signal)

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

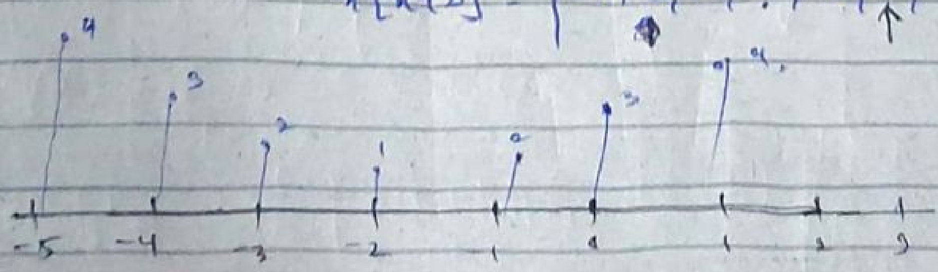


$x[n+k]$ i.e $x[n+2]$

$x[n] \longrightarrow x[n+k]$

$\quad \hookrightarrow x[n+2]$

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



Time Compression of DTS:

$$x[n] \xrightarrow[T.C]{} x[\alpha n].$$

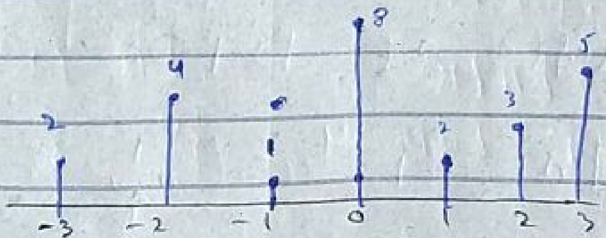
If $|\alpha| > 1$ ← Down sampling / Decimation

elif $|\alpha| < 1$ ← interpolation / up sampling.

Example:-

$$x[n] = \{2, 4, 1, \underset{\uparrow}{8}, 2, 3, 5\}.$$

$$x[n] \xrightarrow{T.C} x[2n].$$



$x[2n]$: for $n=0$, $x[2n] = x[0] = 8$

$n=-1$, $x[-2] = 4$

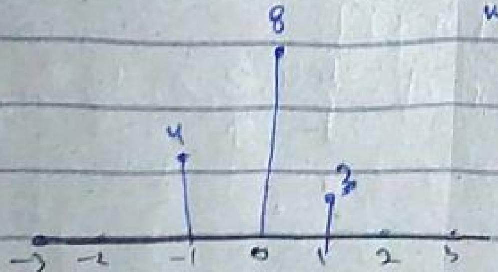
$n=2$, $x[4] = 0$

$n=1$, $x[2] = 2$

$n=-2$, $x[-4] = 0$

$n=3$, $x[6] = 0$

$n=-3$, $x[-6] = 0$

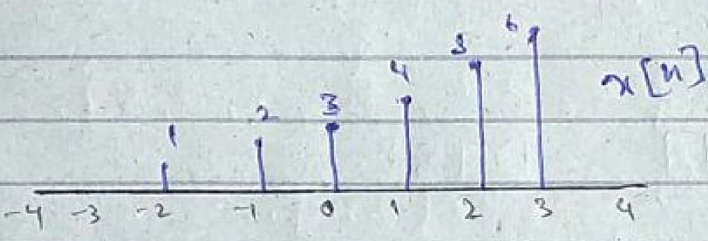


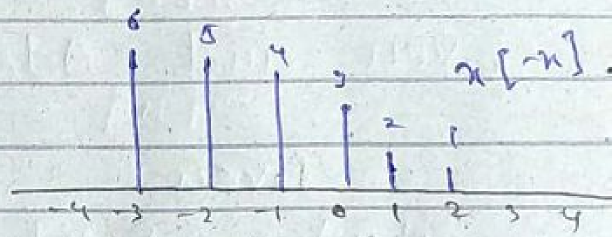
Time Reversal of DTS:

$$x[n] \xrightarrow[T.R]{} x[-n].$$

$$x[n] = \{1, 2, \underset{\uparrow}{3}, 4, 5, 6\}$$

$$x[-n] = \{6, 5, 4, \underset{\uparrow}{3}, 2, 1\}$$





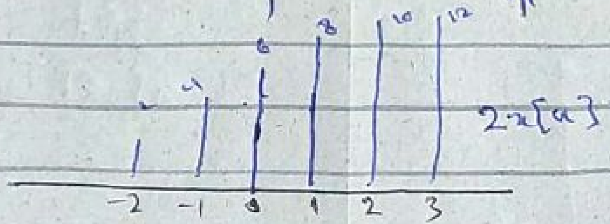
Amplitud Scaling of DTS:-

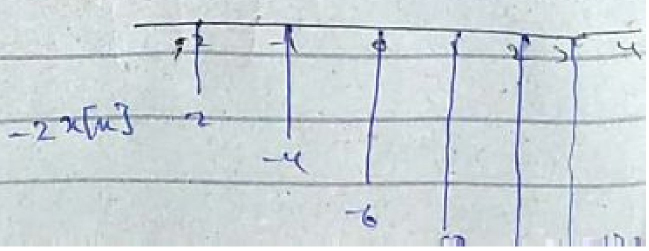
$$x[n] \xrightarrow{A.S} b \cdot x[n].$$

above exp. $\rightarrow 2x[n].$

$\rightarrow -2x[n]$

$$2x[n] = \{2, 4, \underset{\uparrow}{6}, 8, 10, 12\}.$$





Addition in DTS:

$$x_1[n] = \{1, 2, \underset{\uparrow}{3}, 4, 5, 6\}$$

$$x_2[n] = \{5, 6, 7, \underset{\uparrow}{8}, 9, 10\}.$$

$$y[n] = x_1[n] + x_2[n] = \{5, 7, 9, 11, 13, 15, 6\}.$$

Even and odd DTS:

Even	odd.
$x[n] = x[-n].$	$x[n] = -x[-n].$
$\therefore x[n] = \{4, 2, \underset{\uparrow}{0}, 2, 4\}$	$\therefore x[n] = \{-4, -2, \underset{\uparrow}{0}, 2, 4\}$

Lec#

SS. 8 March 23.

Periodic and Aperiodic Signals:

$x(t) = x(t + nT_0)$.

$\because -\infty \leq n \leq \infty$

$x[n] = x[n + mN]$

$\because -\infty \leq m \leq \infty$

Compose of many signal

$x(t) = x_1(t) + x_2(t)$: Composite signal.

$x(t) = A_0 e^{j\omega_0 t}$: Non-Composite signal.

$x(t + T_0) = x(t)$.

$= A_0 e^{j\omega_0 (t + t_0)}$.

$\cancel{A_0 e^{j\omega_0 t}} = \cancel{A_0 e^{j\omega_0 t}} e^{j\omega_0 t_0}$

$e^{j\omega_0 t_0} = 1$ —— (i)

$e^{jx} = \cos x + j \sin x$

let $x = 2\pi k$

$e^{2\pi k j} = \cos 2\pi k + j \sin 2\pi K$.

for $k = 1$

$e^{2\pi j} = \cos 2\pi + j \sin 2\pi$

$= 1$ —— (ii)

from (i) and (2)

$\omega_0 t_0 = 2\pi \Rightarrow \boxed{T_0 = 2\pi / \omega_0}$

fundamental period

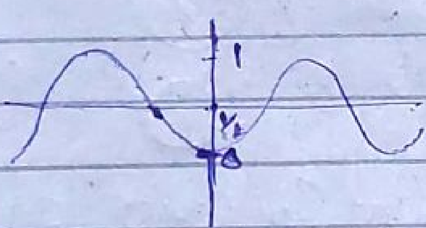
$x(t) = \sin^2 4t$, $T_0 = ?$

as $\sin^2\theta = \frac{1-\cos 2\theta}{2}$

$\sin^2 4t = \frac{1}{2} - \frac{\cos 8t}{2}$

↑ dc-value

this is a signal and as



Now as $T_0 = \frac{2\pi}{\omega_0}$

$T_1 = \frac{\cancel{2\pi}}{\cancel{8\pi}} = \frac{1}{4}$ sec

---

$x(t) = \sin 6\pi t + \cos 8\pi t$. $t_0 = ?$

Sol:- let $x(t) = x_1(t) + x_2(t)$

$t_1 = \frac{2\pi}{6\pi} = \frac{1}{3}$ sec | $t_2 = \frac{2}{8}$ sec

$f_1 = 3$ Hz | $f_2 = \frac{8}{2}$ Hz.

Now to find T_0

$$\boxed{T_0 = \frac{t_1}{t_2} = LCM(t_1, t_2)}$$

$$T_0 = \frac{t_1}{t_2} = \frac{LCM(1,2)}{HCF(3,5)} = \frac{2}{1}$$

$\boxed{T_0 = 2 \text{ sec}}$, $\boxed{f_0 = 0.5 \text{ Hz}}$.

15.

$x_1(t) = \sin 2\pi t$

$x_2(t) = x_1(t+2)$ $\quad t_2 = ?$

$x_2(t) = \sin 2\pi(t+2)$

$= \sin(2\pi t + 4\pi)$ $\quad \because A\sin(\omega_0 t + \phi)$

$T_2 = \frac{2\pi}{\omega_0} = \frac{2\pi}{2\pi} = 1$

hence, no effect on time shifting occur.

$* \quad x_3(t) = x(2t)$

$x_3(t) = \sin 4\pi t$

$T_0 = \frac{2\pi}{4\pi} = \frac{1}{2}$ sec

hence affected when time scaling occur.

$* \quad x_4(t) = x_1(-t)$

$x_4(t) = \sin 2\pi(-t) = -2\sin 2\pi t$

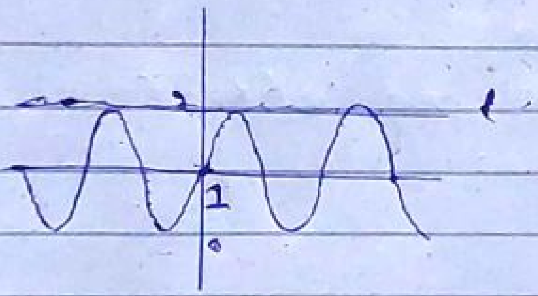
$T_0 = \frac{2\pi}{2\pi} = 1$ sec.

* $x_5(t) = \sin(2\pi t + 45°)$

$T_0 = 1$ sec.

* $x_6(t) = 1 + x_1(t)$

$= 1 + \sin 2\pi t$



* $x_7(t)$
* $x_8(t)$
* $x_9(t) = x^2(t)$

$= \sin^2 2\pi t$

$= \frac{1}{2} - \frac{\cos 4\pi t}{2}$

$t = \frac{2\pi}{4\pi} = \frac{1}{2}$ sec

$f_0 = 2$ Hz.

Periodic of DTS:

$$x[n] = x[n \pm kN]$$

$$x[n] = x_1[n] + x_2[n].$$

Fundamental period of DTS:

$$N = \frac{N_1}{N_2}$$

If (N == Rational) Periodic
elif (N == IrRational) Aperiodic

↳ It is impossible event for DTS.

$$x[n] = A_0 e^{j\omega_0 n}$$

$$x[n \pm kN] = A_0 e^{j\omega_0 (n \pm kN)}$$

$$\cancel{A_0 e^{j\omega_0 N}} = \cancel{A_0 e^{j\omega_0 n}} e^{j\omega_0 N} \quad \because \text{if } k = 1$$

$$e^{j\omega_0 N} = 1$$

$$e^{j\omega_0 N} = e^{j\pi 2k} = 1$$

$$\omega_0 N = 2\pi k$$

$$\frac{2\pi}{\omega_0} = \frac{N}{k}$$

1) $x[n] = e^{j2n}$

Soln $\omega_0 = 2$

$$\frac{\cancel{2}\pi}{\cancel{2}} =$$

π ∴ IR

2) $x[n] = \cos \frac{3\pi}{4} n.$

$\omega_0 = 3\pi/4$

$$\frac{2\pi}{\cancel{3\pi}/4} = \frac{8}{3} = \frac{N}{k}$$

$$N = \frac{8K}{3}$$

for $K = 3$
$N = 8$
↳ No

3) $x[n] = \cos\frac{3\pi}{4}n + \sin\frac{5\pi}{7}n$.

Sol^n $k = ?$

$\omega_1 = \frac{3\pi}{4}$ $\qquad$ $\omega_2 = \frac{5\pi}{7}$

$\frac{2\pi}{3\pi}4 = \frac{8}{3}$ $\qquad$ $\frac{2\pi}{5\pi}7 = \frac{14}{5}$

$N_1 = 8$; if $k=3$ $\qquad$ $N_2 = 14$; if $k=5$

$N = LCM(N_1, N_2) = LCM(8, 14)$
$= 56$.

Discrete Time Energy Signal:

$\boxed{x(t) = \int_{-\infty}^{\infty} p(t)^2 \, dt}$

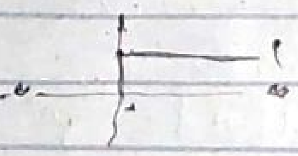
$x[n]$

$$E_x = \sum_{n=-\infty}^{\infty} |x[n]|^2$$

$x[n] = \{1, 2, 3, 4, 5\}$

$E_x = 1^2 + 2^2 + 3^2 + 4^2 + 5^2 = 55$ joule.

1) $x[n] = \left(\frac{1}{3}\right)^n u[n]$



Sol: $E_x = 1 + \frac{1}{9} + \left(\frac{1}{9}\right)^2 + \dots$

this is a geometric series with $a_1 = 1$, $r = \frac{1}{9}$.

$$S_\infty = \frac{a_0}{1-r} = \frac{1}{1-1/9} = \frac{9}{8}$$

$x[n] = \{ 1+j, 1-j, -2, 2 \}$, $E_x = ?$

$c = a + bi$. $|c| = \sqrt{a^2+b^2}$. $|c|^2 = a^2+b^2$

$c_1 = 1+j \Rightarrow |c_1|^2 = 2$

$|c_2|^2 = 2$

$(-2)^2 +$

$E_x = |c_1|^2 + |c_2|^2 + (-2)^2 + (2)^2$

$= 2 + 2 + 4 + 4 = 12$

* Conjugate Symmetric Signal:

$a+bi \longrightarrow a-bi$

$\rightarrow x(t) = x^*(-t)$

$x(t) = a(t) + b(t)j$

$x(-t) = a(-t) + b(-t)j$

$x^*(-t) = a(-t) - b(-t)j$

for $x(t) = x(-t)^*$

$a(t) = a(-t)$ → a must be even.

and $b(t) = -b(-t)$ → b must be odd.

for example. $x(t) = t^2 + j\,\text{Sin}t$.

* Conjugate Anti-Symmetric Signal:

$x(t) = -x(-t)^*$

$x(t) = a(t) + b(t)j$

$x(-t) = a(-t) + b(-t)j$

$x^*(-t) = a(-t) - b(-t)j$

له بانی بلخه پاڅه
د نوروز د سیر باده

$$-x^*(-t) = -a(-t) + j\,b(-t)$$

for $x(t) = -x(-t)^*$

$$a(t) = -a(-t) \rightarrow \text{odd}$$

$$b(t) = b(-t) \longrightarrow \text{even}$$

* Assignment

$$x(t) = x_{ss}(t) + x_{CAS}(t).$$

*

Half wave symmetric signal:-

$$x(t) = x(t \pm T/2);$$

for $x(t) = -x(-t)^*$

$a(t) = -a(-t) \rightarrow$ odd

$b(t) = b(-t) \rightarrow$ even.

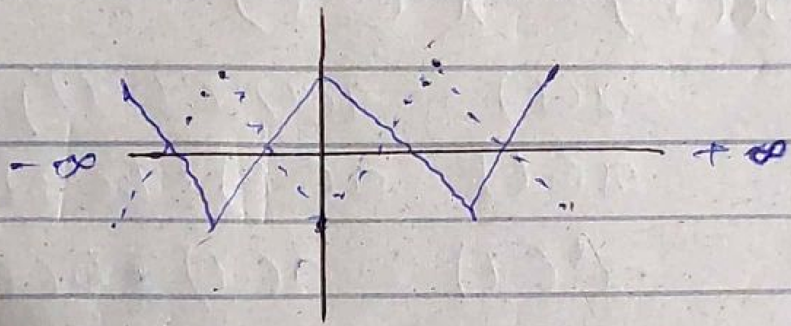
* Assignment

$x(t) = x_{cs}(t) + x_{cAs}(t)$.

*

Half wave symmetric Signal:-

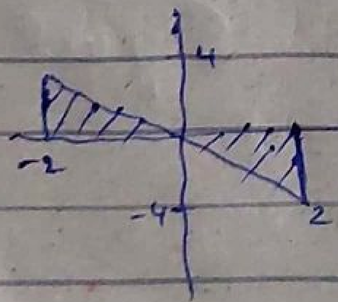
$x(t) = -x(t \pm T/2)$;



Area a CT Signal:-

$x(t)$;

$A_x = \int_{t_1}^{t_2} x(t)\,dt$.



$A_x = \int_{t_1}^{0} x(t)\,dt + \int_{0}^{t_2} x(t)\,dt$

$= \frac{2 \times 4}{2} + \left(\frac{2(-4)}{2}\right) = 4 - 4 = 0$

Average value of CT Signals.

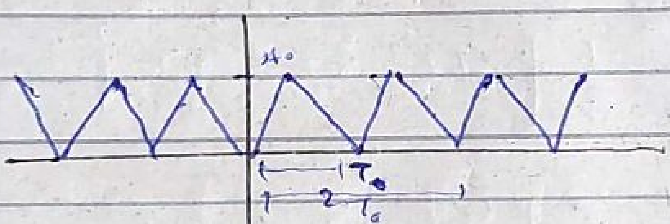
$$\text{Average} = \frac{\text{total Area}}{\text{total time.}}$$

$$= \frac{1}{T}\int_{t_0}^{t_1} x(t)\,dt$$

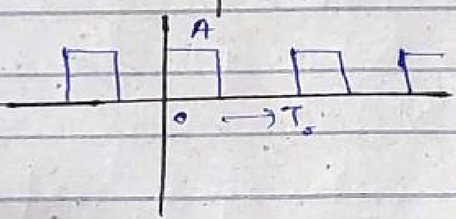
↳ if signal is periodic

$$= \lim_{T\to\infty} \frac{1}{T}\int_{-T/2}^{T/2} x(t)\,dt$$

↳ if signal is Aperiodic.



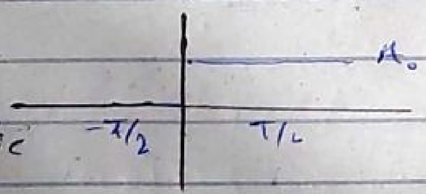
Periodic



$$\frac{1}{T}\int_0^{T_0/2} A\,dt$$

$$= \frac{A}{2}$$

Aperiodic

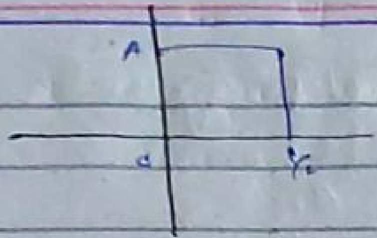


$$\lim_{T\to\infty} \frac{1}{T}\left\{\int_{-T/2}^{0} 0\,dt + \int_0^{T/2} A\,dt\right\}$$

$$\lim_{T\to\infty} \frac{1}{T}\left[\frac{A}{2}\times T\right]$$

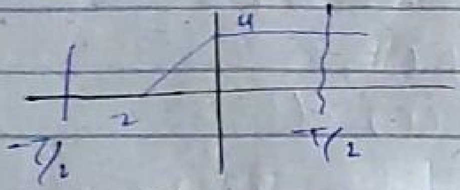
$$= \frac{A}{2}$$

2.1



$$Av = \lim_{T\to\infty} \frac{1}{T}\int_0^{T/2} x(t)\,dt$$

$$= \lim_{T\to\infty}$$



$$\text{Avg} = \lim_{T\to\infty} \frac{1}{T}\left[\int_{-2}^{0} (2t+4)\,dt + \int_0^{T/2} 4\,dt\right]$$

mx + c

$$= \lim_{T\to\infty} \frac{1}{T}\left[\frac{\cancel{2}t^2}{\cancel{2}} + 4t\Big|_{-2T}^{0} + \int 4t\Big|_0^{T/2}\right]$$

$$= \lim_{T\to\infty} \frac{1}{T}\left[4T^2 - 8T\right] + \left[-4T/2\right]$$

$$= \lim_{T\to\infty} \frac{1}{T}\left[4T^2 - 8T - \frac{\cancel{4}^{2}T}{\cancel{2}}\right]$$

$$= \lim_{T\to\infty} \frac{\cancel{T}}{\cancel{T}}\left[4T - 8 - 2\right]$$

$$= \infty.$$

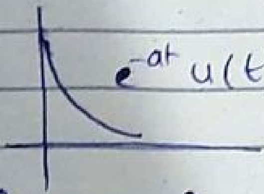
28 March, 23.

* Energy & Power CTS:

$P = IV = V^2/R = I^2R$.

$P = W/t$ $W = P \times T$, $E = P \times t$

$x(t) = e^{-at}u(t)$ $(a>0)$ $u(t)$ is unit step fn.



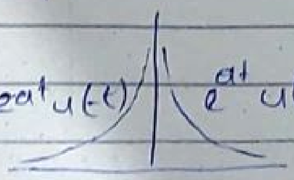
$e^{-at}u(t)$. Time limited so find energy

$$E_x = \int_{-\infty}^{\infty} |x(t)|^2 dt \qquad \boxed{u^2(t) = 1}$$

$$E_x = \int_0^{\infty} e^{-2at} dt = \left.\frac{e^{-2at}}{-2a}\right|_0^{\infty}$$

$= \frac{1}{2a}$ joules. $\boxed{x_1 = \frac{1}{2a} + \frac{1}{2a} = \frac{1}{a}}$

→ After time reversal $x(-t)$ on any fn, the value of power & energy remains the same



$e^{at}u(-t)$ $e^{-at}u(t)$. $= \frac{1}{2a}$

→ if $P = 0$, it is energy signal.

→ $P = \infty$ not energy nor power

→ $P =$ finite, Power signal, aperiodic signal

→ $P < \infty$

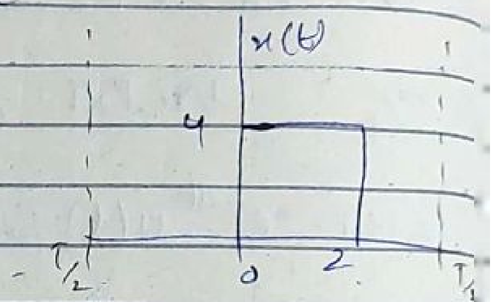
For aperiodic signal, Power is

$$P = \lim_{T \to \infty} \frac{1}{T} \int_{-T/2}^{T/2} |x(t)|^2 dt$$

↳ It is a span

For periodic signal, Power is

$$P = \frac{1}{T_0}\int_{-T_0/2}^{T_0/2} |x(t)|^2 \, dt$$



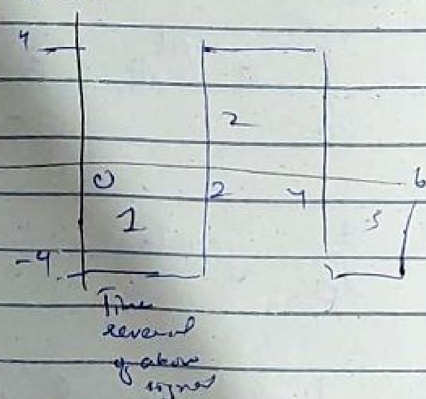
$$\lim_{T\to\infty} \frac{1}{T}\int_{-\infty}^{\infty} |x(t)|^2 \, dt$$

$$\lim_{T\to\infty} \frac{1}{T}\int_{0}^{2} 4^2 \, dt$$

$$= \frac{16}{T} \times 2 = \frac{32}{T} = 0 \text{ watt}$$

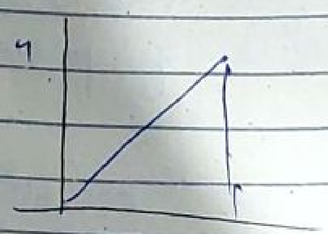
$\rightarrow E = \int_{-\infty}^{\infty} |x(t)|^2 dt = 16t \Big|_0^2 = 32$

$E = 32 \times 3$
$= 96 \text{ J}$



$$E_x = \int_0^2 |x(t)|^2 dt$$

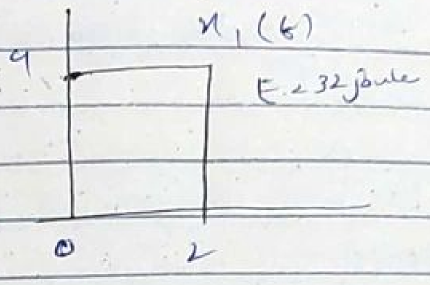
$$= \int_0^2 4t^2 dt$$



$\rightarrow$ Aperiodic signal power is always $\underline{\underline{0}}$.

→ Time reversed

$x(-t) = 32$ joule (Energy).



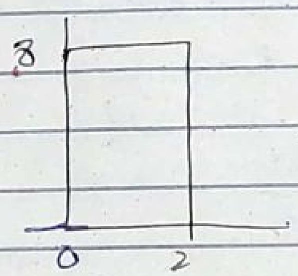
→ Time shifting

$x_1(t-6)$, delayed by 6.

so energy remain the same

→ Amplitude scaling

$2(x_1(t))$. = now energy changes



if periodic

$y(t) = 2j\,x(2t-1)$,

→ So after compression, Power still remain same.

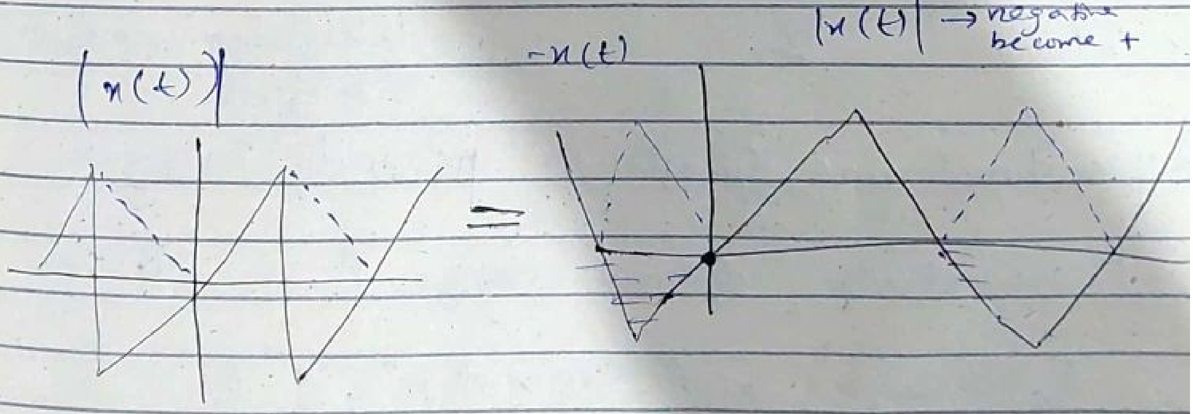
$x(t) \to x(2t)$ compressed

Power remain same

→ average remain same

$= 0+2j = \sqrt{0^2+2^2} = \cancel{4}\,2 = 2^2 = 4$

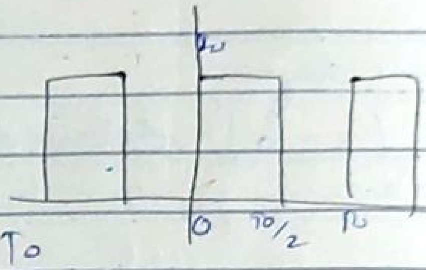
→ After compression, Energy ~~remain~~ changes.



→ ~~diff~~ Mode of different signal can create similar signal

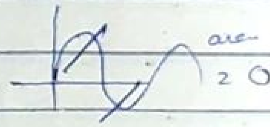
→ Periodic signal → Find power

Periodic signal so find power



$$= \frac{1}{T_0}\int_0^{T_0/2} A_0^2 \, dt = \frac{A_0^2}{T_0} \times \frac{T_0}{2}$$

$$\text{Power} = \frac{A_0^2}{2}$$



$x_1(t) = A_0 \sin \omega t$ → Area under the curve = 0.

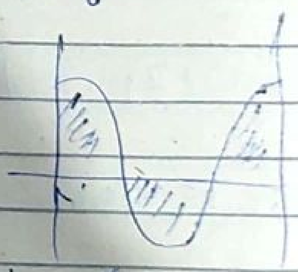
Periodic signal so find P.

$$= \frac{1}{T_0}\int_{-T_0/2 \text{ or } 0}^{T_0/2 \text{ or } T_0} A_0^2 \sin^2 \omega_0 t \, dt = \frac{A_0^2}{T_0}\int_0^{T_0} \frac{1 - \cos 2\omega_0 t}{2} \, dt$$

$$= \frac{A_0^2}{2}\left[\frac{1}{2} + \cancel{\frac{X}{0}} \times T_0\right]$$

T_0 → product

$$= \frac{A_0^2}{2T_0} \times T_0 = \frac{A_0^2}{2} \text{ (same for cos)}$$



intersecting so area = 0
so integration = 0

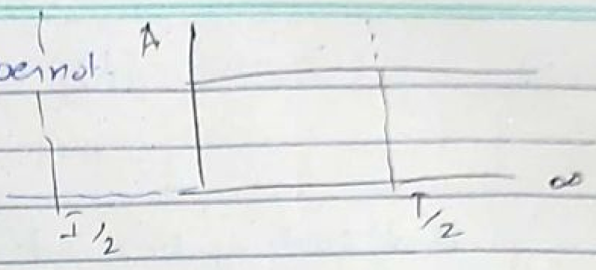
→ We donot use limit in periodic & vice versa.

→ Phase change doesnot change P.

$$A_0 \cos(\omega_0 t) = A_0 \sin(\omega_0 t + \pi/2)$$

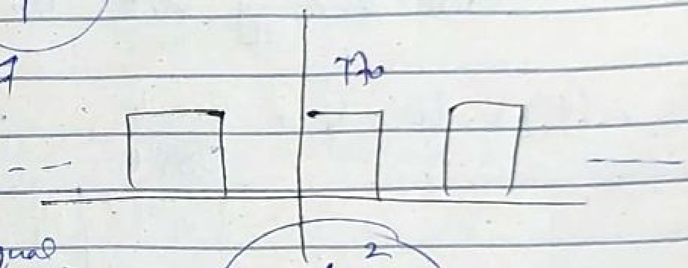
Power = Power

→ not energy cz it doesnot converge to 0.



$$P = \lim_{T\to\infty} \frac{1}{T}\int_0^{T/2} A_0^2 \, dt$$

$$= \lim_{T\to\infty} \frac{A_0^2}{T} \times \frac{T}{2} = \frac{A_0^2}{T}$$ (Power of aperiodic signal)



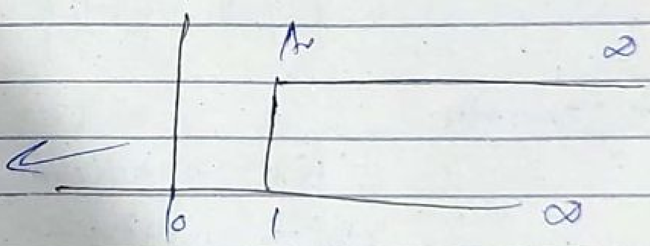
→ bcz half of power exist half doesnot exist

equal

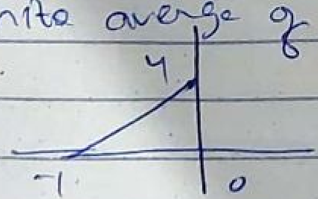
$$P = \frac{A_0^2}{2}$$

$$RMS = \sqrt{\frac{A_0^2}{2}}$$

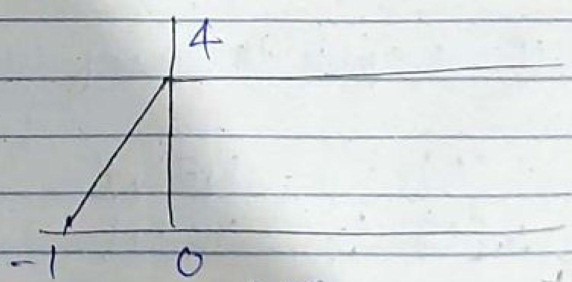
$$P = \frac{A_0^2}{2}$$



→ infinite average of



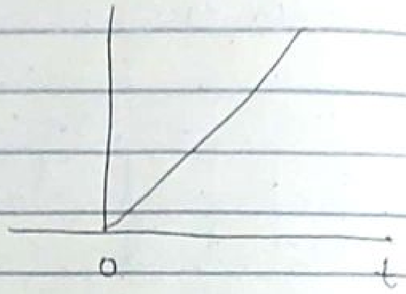
is 0.



Aperiodic Power so limit formula.

So Power = $\frac{A_0^2}{2}$

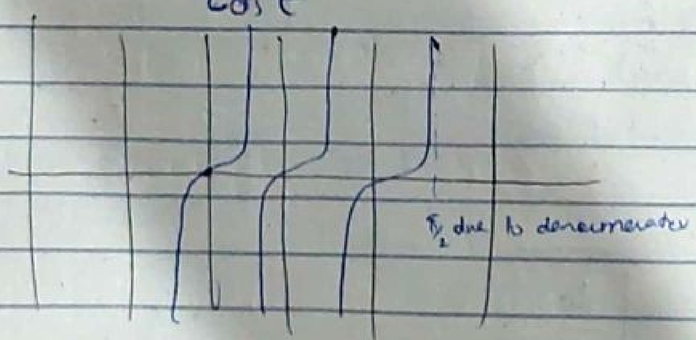
$x(t) = t\,u(t)$. $u(t)$ mean limit is 0 to t



→ cannot find energy bcz not time limited.
→ cannot find average

Not energy not Power signal.

$x(t) = \tan t = \frac{\sin t}{\cos t}$



→ periodic.

we find power of Periodic but we cannot find P & E due to infinite amplitude

→ If amplitude → infinite → not energy not Power

$x(t) = t^2$ NENP.
$x(t) = 1/t$ NENP

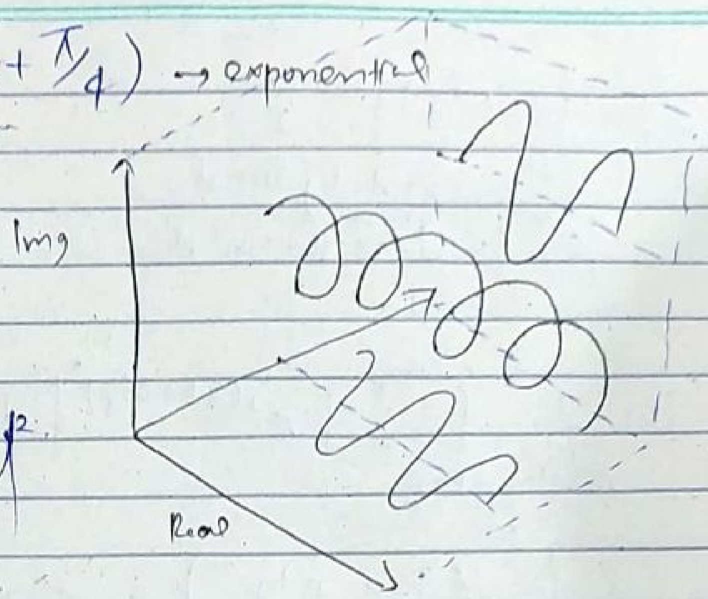
$x(t) = e^{j(2t+\pi/4)}$ → exponential

pow

$e^{jx} = \cos x + j \sin x$

$$P = \frac{1}{T_0}\int_{-T_0/2}^{T_0/2} \left| e^{j(2t+\pi/4)} \right|^2$$

H.W find power



orthognal signal

29th March, 23.

$\rightarrow \left| e^{j(2t+\pi/4)} \right| = 1.$

$e^{jx} = \cos x + j \sin x.$

$|e^{jx}| = \sqrt{\cos^2 x + \sin^2 x}$

$= 1.$

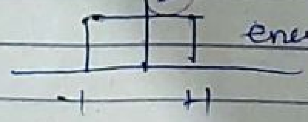
$$P = \frac{1}{T_0} \int_{-T_0/2}^{T_0/2} \left| e^{j(2t+\pi/4)} \right|^2 dt$$

$$= \frac{1}{T_0}\left(\frac{T_0}{2} + \frac{T_0}{2}\right) = \frac{1}{T_0} \times T_0 = 1$$

$\rightarrow$ Power of exp fn is always $\underline{1}$.

$\rightarrow$ amplitude

$x(t) = 2 \, rect\left(\frac{t}{2}\right)$ Rectangular width is 2



energy signal $= \int_{-\infty}^{\infty} \left|2 rect\left(\frac{t}{2}\right)\right|^2 dt$

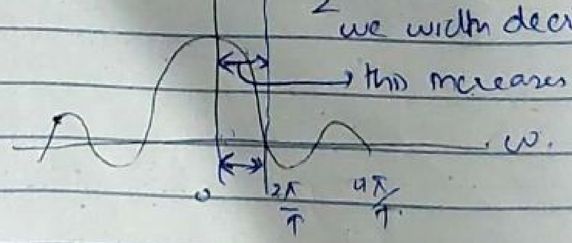
$= \int_{-1}^{+1} 4 \, dt = 8$ joule

$\rightarrow$ Rect is very imp if we see it in frequency do

$rect \; t/T \Leftrightarrow T \; sinc \; \frac{\omega T}{2}$ (frequency domain)

we width decreases

$\rightarrow$ this increases

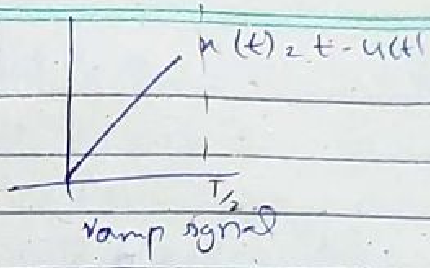


Band width $= \frac{2\pi}{T}$

$\omega = \pm \frac{2n\pi}{T}$

always find P so we know that if is power signal or energy

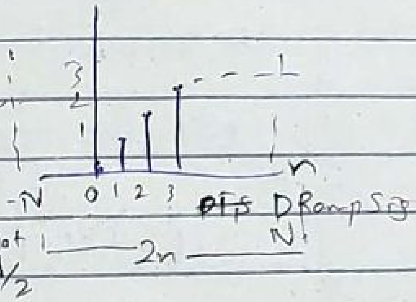
$x[n] = \text{ramp } n$



lets find power

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

(2n+1) → because 0 is always included



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

$\lim_{N \to \infty} \frac{1}{\cancel{2N+1}} \frac{N(N+1)(\cancel{2N+1})}{6}$

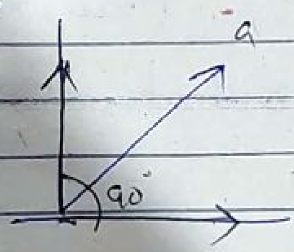
$\lim_{N \to \infty} \frac{N(N+1)}{6}$ → infinite so nor energy nor power

$= \infty$

ORTHOGNAL SIGNAL

$a.b = |a||b| \cos \theta = 0$

$\int_0^T x_1(t).x_2(t)dt = 0$



$e^{jx} = \cos x + j \sin x$ (orthognal independant of each other)

Properties-

1) $\int_0^T \sin(\omega_0 mt + \phi_1) \cdot \sin(n\omega_0 t + \phi_2)dt$

if $m \neq n$ then above eq $= 0$

15 20 → 19 (6) 49

2, $\int_0^T \sin(m\omega_0 t + \phi)\cos(n\omega_0 t + \phi)\,dt$

if $m = n$ then eq = 0

3, DC value sin $(\omega_0 t + \phi)$

$\int_0^{T} 2\sin(\omega_0 t + \phi)\,dt = 0$

bcz sin +ive & -ive cancel.

(4). $\int_{-\infty}^{\infty} \int_0^T x_1(t)\, x_2(t)\, dt = 0$

Ex: $y(t) = 2\sin(3\omega_0 t + 45^\circ) + 4\sin(4\omega_0 t + 35^\circ)$

orthognal so independent & find power of both individually, then add them & vise versa

$P_1 = \frac{A_0^2}{2} = \frac{2^2}{2} = \frac{4}{2} = 2$

$2 + 8 = 10$ watt

$P_2 = \frac{4^2}{2} = \frac{16}{2} = 8$

Ex: $x(t) = 2\cos(2\omega_0 t + 45^\circ) + 3\sin(2\omega_0 t + 45)$,

To find ⊥, multiply both.

$\frac{2^2}{2} + \frac{3^2}{2} = 2 + 4.5 = 6.5$ watt

EX: $x(t) = 2\sin 3t + 3\cos(3t + \pi/3)$

$m = n$ $\phi_1 \neq \phi_2$

$2\sin 3t + 3\sin\left(3t + \frac{\pi}{3} + \frac{\pi}{2}\right)$

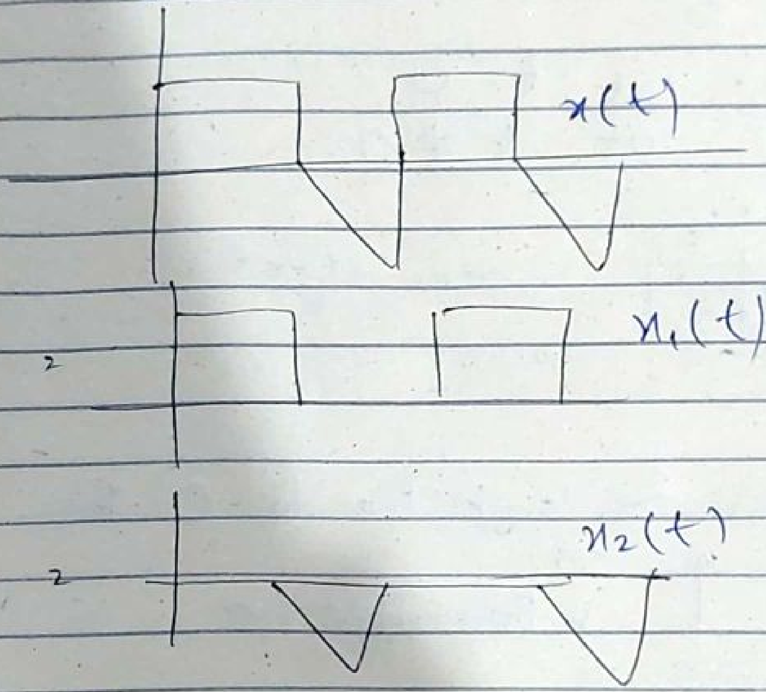
$$\boxed{A_1\sin(\omega_0 t + \phi_1) + A_2\sin(\omega_0 t + \phi_2) = A_0\sin(\omega_0 t + \phi)}$$

Both are not ortho so A_0 is the mutual value of both signal

Here $A_0 = \sqrt{A_1^2 + A_2^2 + 2A_1A_2 + \cos(\phi_1 - \phi_2)}$

$= \sqrt{2^2 + 3^2 + 2\times 2\times 3\cos(0 - 5\pi/6)}$

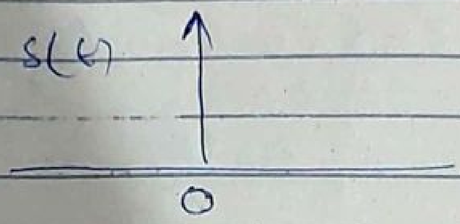
$= \sqrt{'' \quad '' \quad '' \cos(\theta}$.



$x(t) = x_1(t) + x_2(t)$.

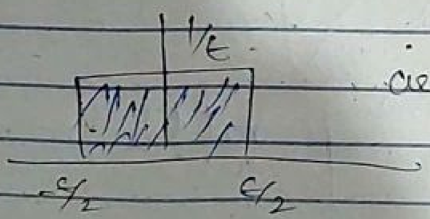
$P_x = P_1 + P_2$.

UNIT IMPUSE FN



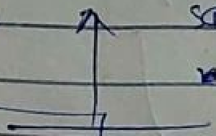
$\delta(t) = \infty$ at $t = 0$

$= 0$ at $t \neq 0$



area $= \frac{1}{\epsilon} \times \epsilon = 1$

If we decrease ε length ~~than~~ to 0 then height $= \infty$.



so

Bandwight $= \infty$.

$$\boxed{\int_{-\infty}^{\infty} \delta(t)\,dt} = 1$$

area