Assignment - 1

1) **Define signal**: Signal is anything that is visible, audible, observable or measurable with the help of some machine.

Example: Audio, light, ~~Raro~~ radio etc.

2) **Types of signals**:

A 1) One dimensional signal : Example ⇒ Speech, audio

2) Multidimentional signal : Example ⇒ Image

- 2-D signal
- 3D signal

B) One channel & Multichannel signals : Example

ECG

C) Continuous & Discrete Signals

D) Analog & Digital signals

E) Real & complex signals

F) Even & odd signals

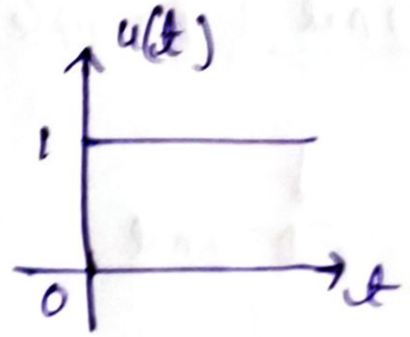
(c) Deterministic & Random signals :

3) What does following signal signifies

i) Step signal :

• Unit step signal denoted by $u(t)$.

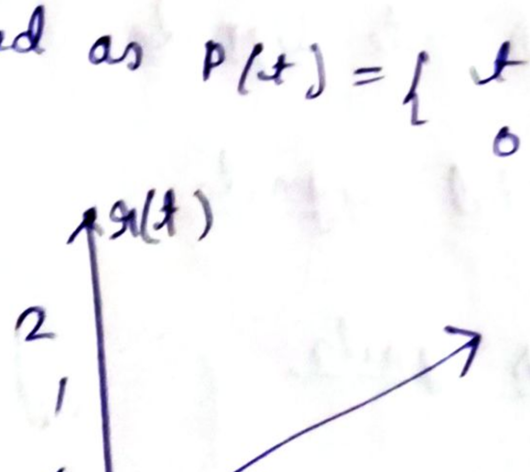
It is defined as $u(t) = \begin{cases} 1 & t \geq 0 \\ 0 & t < 0 \end{cases}$.



ii) Ramp Signal :

Ramp signal is denoted by $r(t)$ and it is defined as $r(t) = \begin{cases} t & t \geq 0 \\ 0 & t < 0 \end{cases}$.

(iii)



$\int u(t) = \int 1 = t = r(t)$

$u(t) = \frac{d\,r(t)}{dt}$

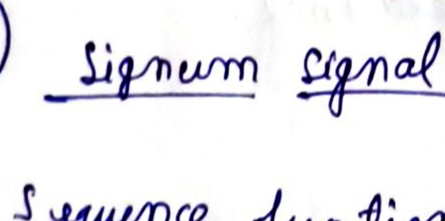
iii) <u>Impulse signal</u> :

Impulse signal is denoted by $\delta(t)$. and It is defined as $\delta(t) = \begin{cases} 1 & t = 0 \\ 0 & t \neq 0 \end{cases}$.

$$\int_{-\infty}^{\infty} d(t)\, dt = u(t)$$
$$d(t) = \frac{du(t)}{dt}$$

iv) <u>Sync signal</u> :

It is defined as $Sync(t)$ and it is defined as ~~sync~~. sinc.

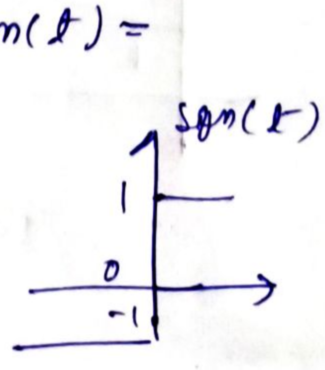


$$t = \frac{\sin \pi t}{\pi t}.$$
$$= 0 \text{ for } t = \pm 1, \pm 2, \pm 3.$$

v) <u>Signum signal</u> :

Sequence function is denoted as sign(t).

It is defined as $sgn(t) = \begin{cases} 1 & t > 0 \\ 0 & t = 0 \\ & t < 0 \end{cases}$



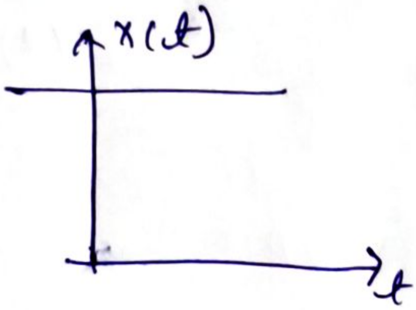
3)

vi) <u>Exponential signal</u> :

It is in the form of $x(t) = e^{t}$.

The shape of exponential can be defined by α

<u>case 1</u> : If $\alpha = 0 \rightarrow x(t) = e^{0} = 1$.

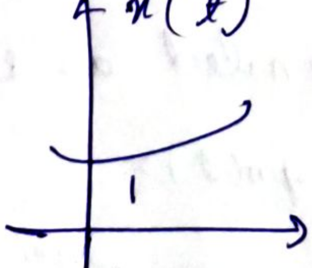


<u>case 2</u> : If $\alpha < 0$ i.e -ve than $x(t) = e^{-\alpha t}$.

The shape x called decaying exponential.

<u>Case 3</u> : If $\alpha > 0$ i.e +ve then $x(t) = e^{\alpha t}$.

The shape is called raising appearence.



$$\iint u(t)\,dt - \int r(t)\,dt = \int t\,dt = \frac{t^2}{2} = \text{Parabolic signal}$$

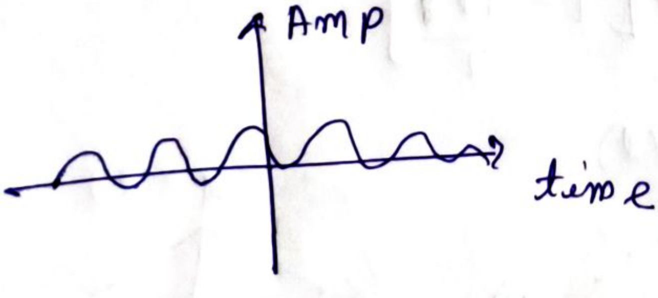
$$\Rightarrow u(t) = \frac{d^2 x(t)}{dt^2}$$

$$\Rightarrow r(t) = \frac{dx(t)}{dt}$$

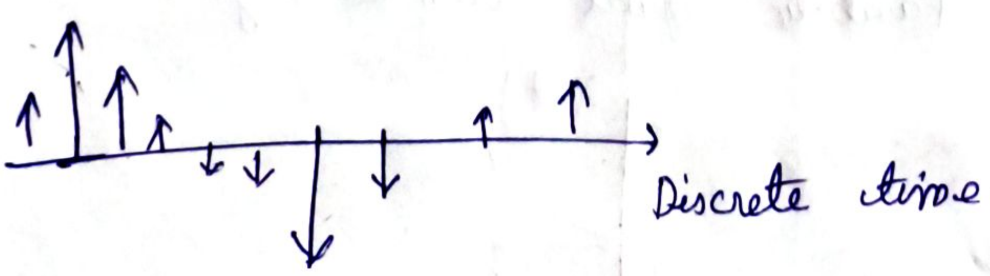
5) Following signals defination

i) Continuous & Discrete Time signals :

A signal is said to be continuous when it is defined for all instants of time.



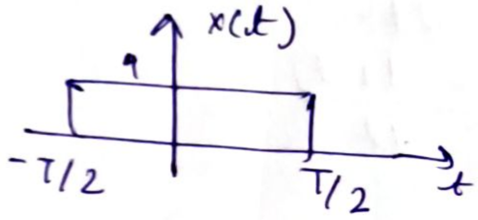
A signal is said to be discrete when it is defined at only discrete instants of time.

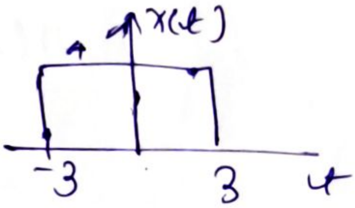


vii) <u>Rectangular Signal</u> :

Let it be denoted as $X(t)$ and it is defined as

$X(t) = A \, rect[\frac{t}{T}]$



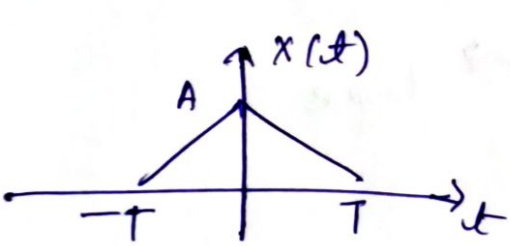


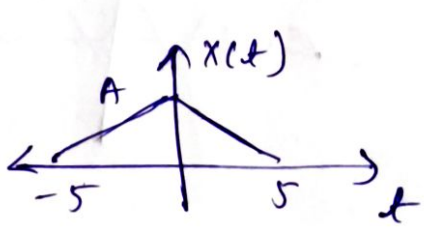
$4 \, rect[\frac{t}{6}]$

viii) <u>Triangular Signal</u>

Let it be denoted as $x(t)$

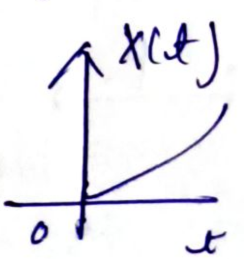
$x(t) = A[1 - \frac{|t|}{T}]$





ix) <u>Parabolic Signal</u> :

Parabolic signal can be defined as $X(t) = \{ \frac{P}{2} t^2$
$0 \quad t<0$



Even & odd signals :

A signal is said to be even when it satisfy the condition $x(t) = x(-t)$

Example : t^2, t^4 ... cost etc.

Let $x(t) = t^2$

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

$\therefore$ t^2 is even function.

A signal is said to be odd when it satisfies the condition $x(t) = -x(-t)$

Example : t, t^3 ... And sint.

Let $x(t) = \sin t$.

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

$\therefore$ sin t is odd function.

iii) Energy and power signals :

A signal is said to be energy signal when it has finite energy

Energy $E = \int_{-\infty}^{\infty} x^2(t)\, dt$.

A signal is said to be power signal when it has finite ~~___~~ power

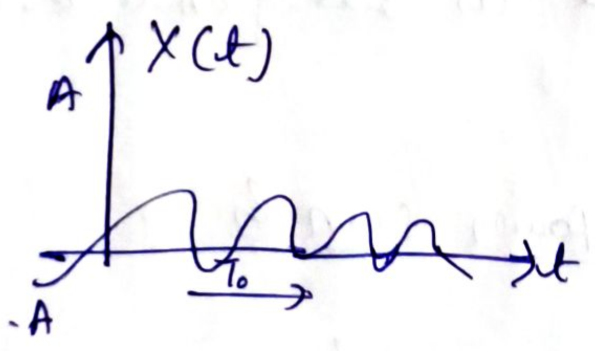
$$\text{power } P = \lim_{T \to \infty} \frac{1}{2T} \int_{-T}^{T} x^2(t)\, dt$$

iv) <u>Perodic and Aperiodic Signals</u> :

A signal is said to be perodic if it satisfies the condition $x(t) = x(t+T)$ or $x(n) = x(n+N)$

T = Fundamental time period.

$1/T = f =$ fundament frequency.

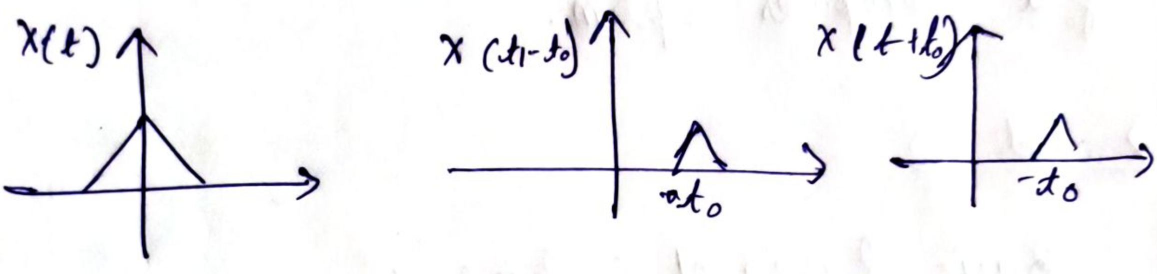


Time Shifting :

i) $x(t \pm t_0)$ is time shifted version of signal $x(t)$

$x(t + t_0) \rightarrow$ negative shift.

$x(t - t_0) \rightarrow$ positive shift.



Time Scaling :

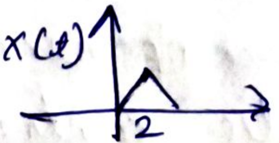
$x(At)$ is time scaled version of the signal $x(t)$ .. where A .. is always positive

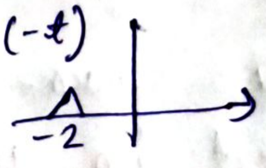
$|A| > 1 \rightarrow$ compression of the signal

$|A| < 1 \rightarrow$ Expression of the signal.

Time Reversal :

$x(-t)$ is the time powersal of the signal $x(t)$





Module II

1) System : A group of components or ~~of~~ subsystems that integrate & function together in order to achieve specific ~~need~~ goal.

EX : A disk subsystem is a component/part of a computer system.

2) and 3).

Basic types of systems :

i) Linear or non-linear systems :

A system is linear if it satisfies the following property, where signals $x_1(t)$ and $x_2(t)$ output $y_1(t)$ and $y_2(t)$, respectively

$$T[a_1 x_1(t) + a_2 x_2(t)] = a_1 T[x_1(t)] + a_2 T[x_2(t)] = a_1 y_1(t) + a_2 y_2(t).$$

Linear systems are typically much simpler than their non-linear components. They are ...matic control theory, signal macceuing and telecommunication. Specifically wireless communication can be modeled by Linear systems.

ii) <u>Time varient and time-invarient Systems</u>:

A system is time-varient if its input and output relationship vaues with time. The equations that define these classes are as follows.

when $y(n,t) = T[x(n-t)]$ = input change

and $(y-nt)$ = output change

$y(n-t) = y(n-t)$ for time - invarient Systems.

$y(n,t) \neq y(n-t)$ time -varient system.

iii) <u>Static & Dynamic system</u>:

Static systems are memory less Systems

An example eqn $y[t] = 2^x [t]$

Dynamic system might have follows eqn

$$y[t] = 2 \cdot x[t-1].$$

iv) casual and non-casual :

Similar to the disfunction between static & dynamic systems a casual system is one that depends on only present & past inputs. so $y[t] = 2 \cdot x[t-1]$ still described a casual system. A non-casual system depends on future inputs $y[t] = x[t+1]$. a non-casual system.