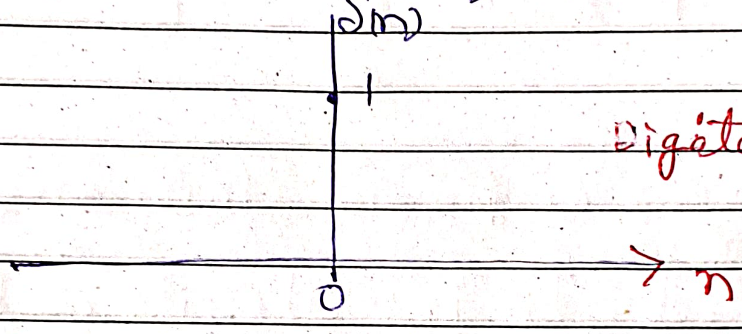
Standard Discrete Time Signal.

1) Digital Impulse signal or Unit sample sequence :-

Mathematically it is defined as

$$\delta(n) = \begin{cases} 1, & n = 0 \\ 0; & n \neq 0 \end{cases}$$

The Unit sample sequence is zero every where except at $n = 0$ where its value is unity.

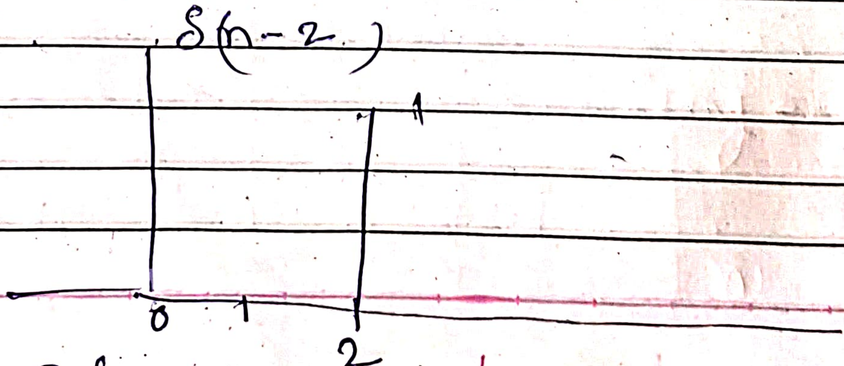


Digital impulse signal

The shifted unit impulse function $\delta(n-k)$ is defined as

$$\delta(n-k) \begin{cases} 1; & n = k \\ 0; & n \neq 0 \end{cases}$$

$$\delta(n-2) \begin{cases} 1 & n = 2 \\ 0 & n \neq 0 \end{cases}$$

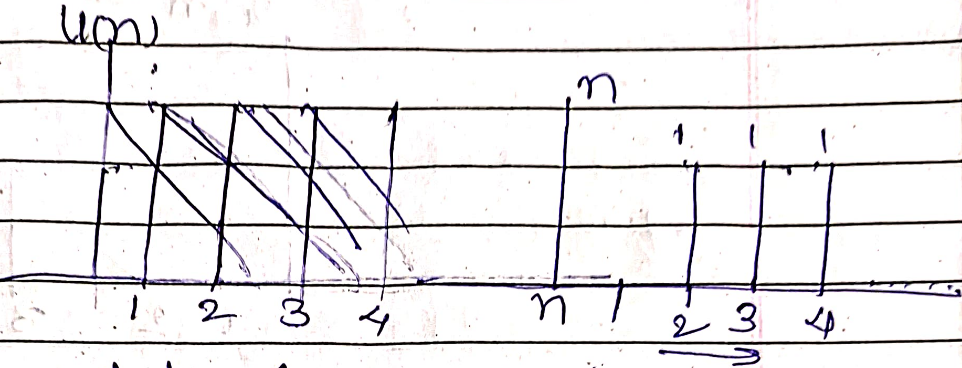


$\delta(n-2) \rightarrow$ delayed version $\delta(n)$

(2) Unit Step Singnal

Mathematically it is defined as

$$u(n) \begin{cases} 1 ; n \geq 0 \\ 0 : n < 0 \end{cases}$$

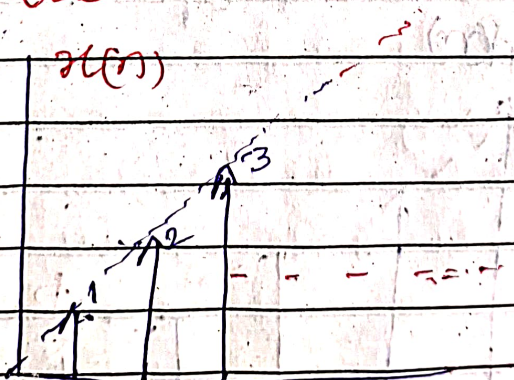


u(n-2) - ~~defined version u(n)~~ delayed version.

3) Unit ramp Signal
Mathematically it is defined as

$$r(n) = \begin{cases} n ; n \geq 0 \\ 0 \quad n < 0 \end{cases}$$

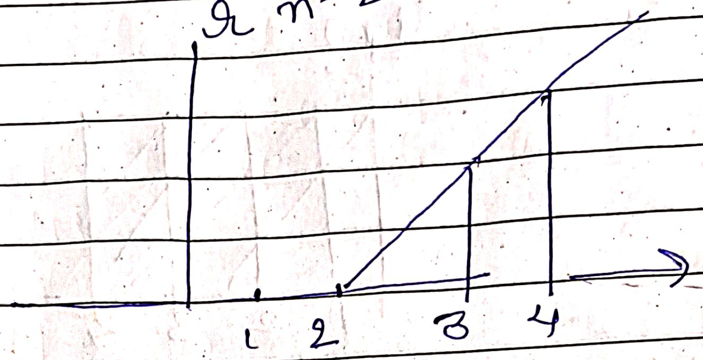
It start at n=0 and increases linearity with n



The shifted discrete time unit Ramp signal r(n-k) is defined as.

$$r(n-k) = \begin{cases} n-k & n \geq k \\ 0 & n < k \end{cases}$$

$$r(n-2) = \begin{cases} n-2; & n \geq 2 \\ 0; & n < 2 \end{cases}$$



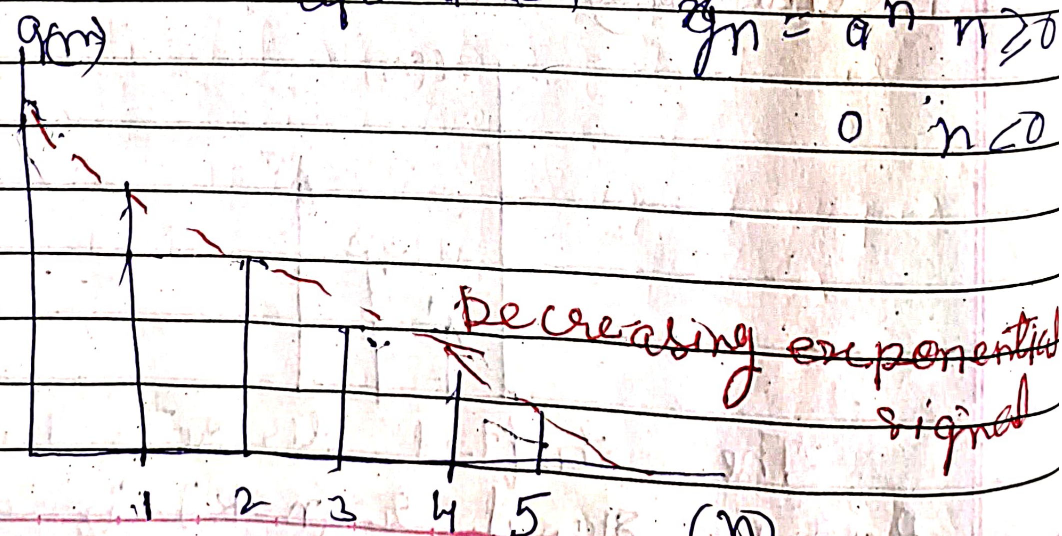
Exponential signal ⇒ (Real Exponential Sequence

Mathematically it is defined as

$$g(n) = \begin{cases} a^n & n \geq 0 \\ 0 & n < 0 \end{cases}$$

(i) case if $0 < a < 1$

$$g(n) = \begin{cases} a^n & n \geq 0 \\ 0 & n < 0 \end{cases}$$



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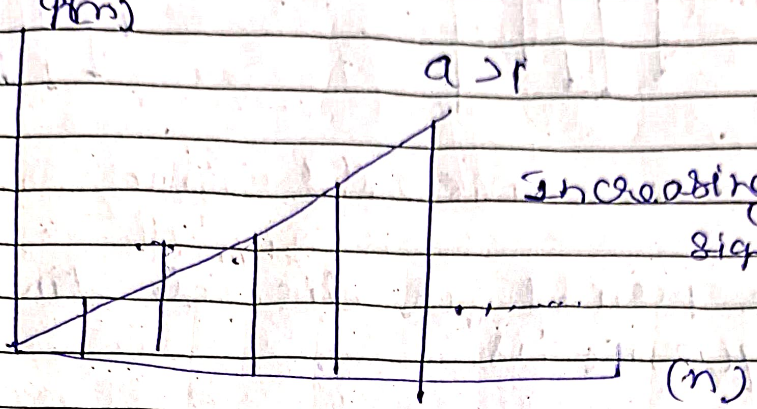
(2) case. $a \geq 1$



Increasing Exponential signal.

Discret Sinusoidal signal.

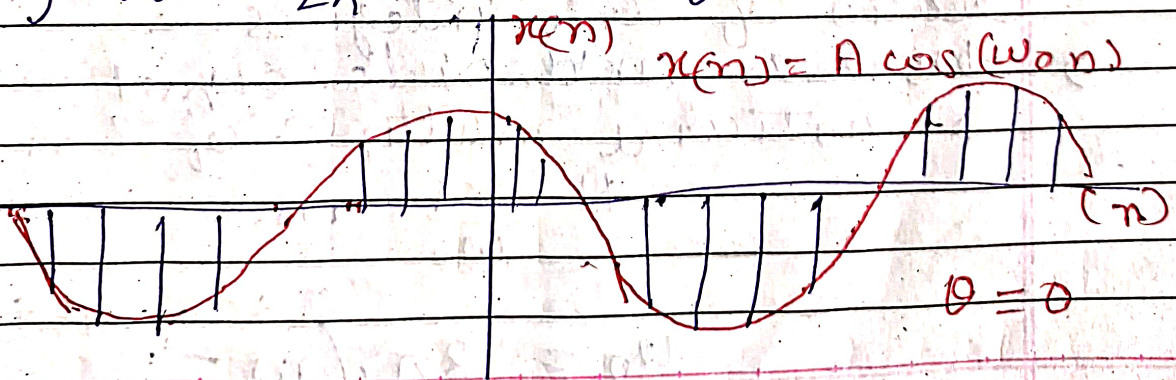
Mathematical Expression

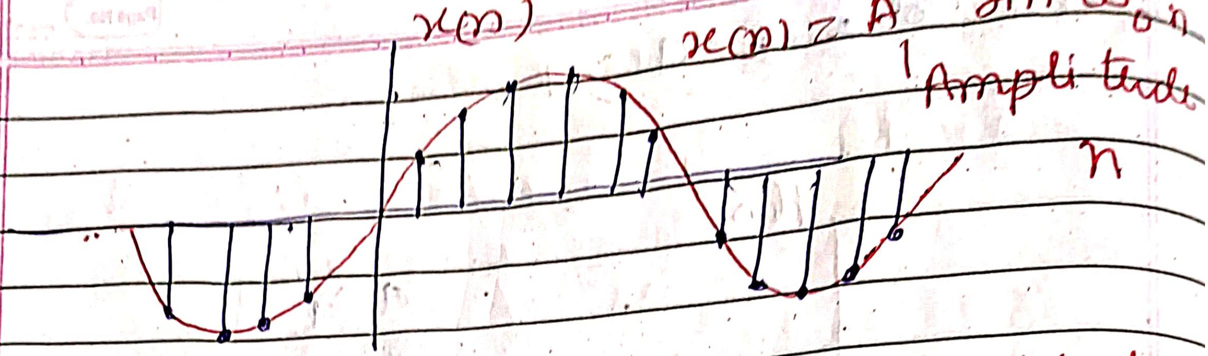
$$x(n) = A \sin(\omega_0 n + \theta) \quad -\infty < n < +\infty$$
$$= A \cos(\omega_0 n + \theta) \quad -\infty < n < +\infty$$

where, ω_0 Angular frequency in radians/sample.

θ = phase angle in radian (Phase shift)

$f_0 = \frac{\omega_0}{2\pi}$ frequency in cycles/sample





Discrete Time Sinusoidal Signal

The period for discrete time sinusoid sequence is

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

$\forall m \Rightarrow$ Integers

All continous time sinusoidal signal $\Rightarrow$ Periodic in nature.

DT-sinusoidal signal it may be or not be periodic.

$\Rightarrow$ it depends upon the value of ω_0

Discrete time signal,

$\Rightarrow$ Discrete sinusoidal signal periodic f_0 is rational number (that is ratio of two integers.

$\Rightarrow$ Discrete sinusoidal signal $\Rightarrow$ periodic $\Rightarrow$ rational multiple of 2π

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

$$\omega_0 = 2\pi \left(\frac{m}{N}\right) \rightarrow \text{integer}$$

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Complex exponential signal:-

⇒ The mathematical expression for discrete time complex exponential signal is Mathematically

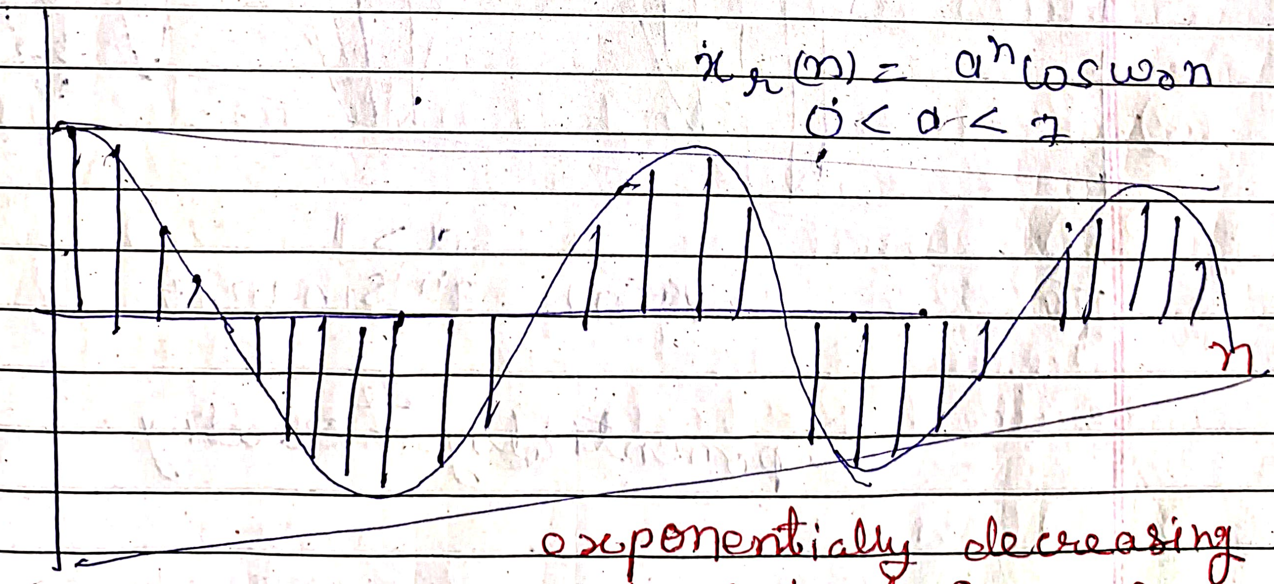
$$x(n) = a^n e^{j(\omega_0 n + \theta)}$$

$$= a^n[\cos(\omega_0 n + \theta) + j\sin(\omega_0 n + \theta)]$$

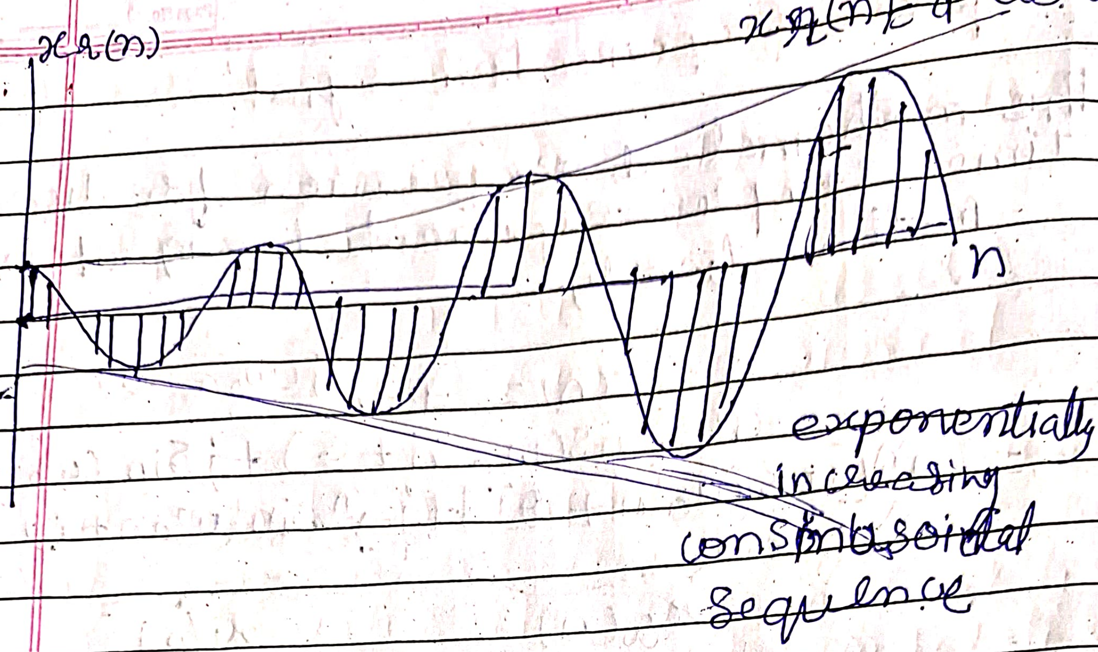
$$= \underbrace{a^n[\cos(\omega_0 n + \theta)]}_{x_R(n)} + j\underbrace{a^n \sin(\omega_0 n + \theta)}_{x_i(n)}$$

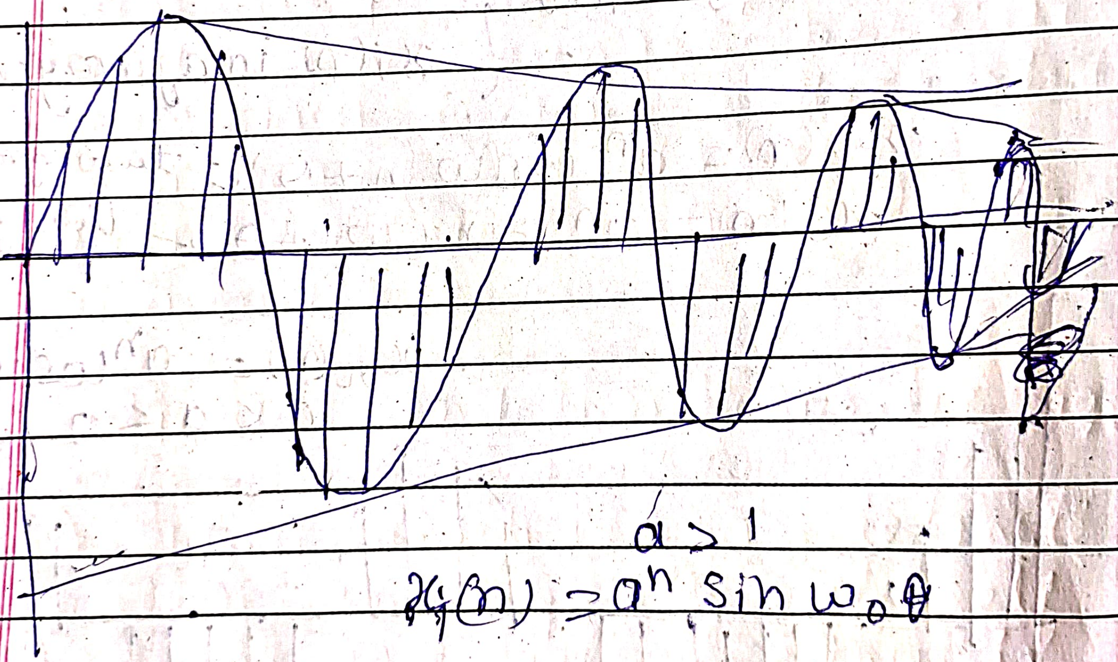
$x_R(n) + j\,x_i(n)$ { $x_R(n)$ Real part → $x(n)$; $x_i(n)$ imaginary part $x(n)$ }

$x_R(n) = a^n \cos(\omega_0 n + \theta)$ — two graph
$x_i(n) = a^n \sin(\omega_0 + \theta)$ — two graph



exponentially decreasing cosinusoidal sequence.





$a > 1$

$x_I(n) = a^n \sin w_0 n$

exponentially ~~in~~ decreasing