30-08-22

* Discrete-time Energy Signal —

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

* Discrete-time Power Signal —

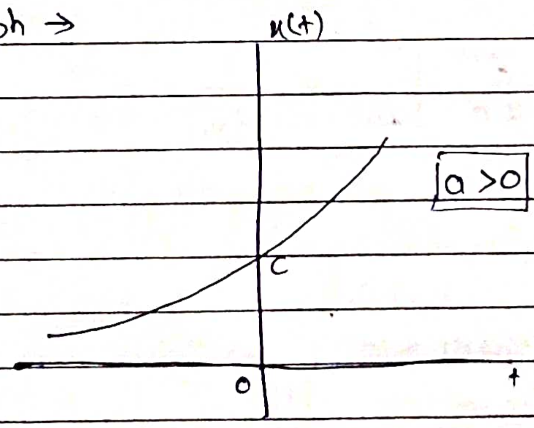
$$P = \lim_{N\to\infty} \frac{1}{2N+1} \sum_{n=-N}^{N} |x[n]|^2$$

* Real Exponential Signals —

$$x(t) = c\,e^{at}$$

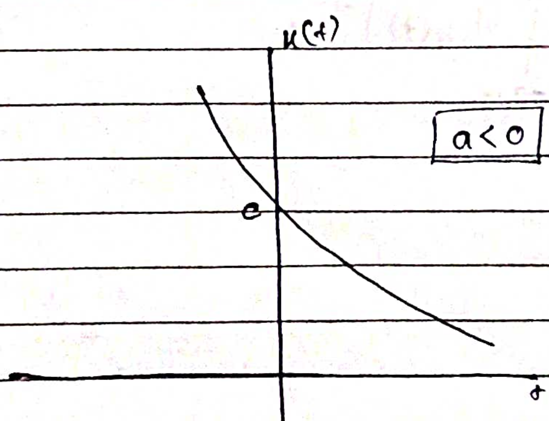
where $c, a \rightarrow$ real parameters

Graph →



$\boxed{a > 0}$

→ Grow Exponential Signal



$\boxed{a < 0}$

→ Decay Exponential Signal

* Discrete - time Real Exponential Signal -

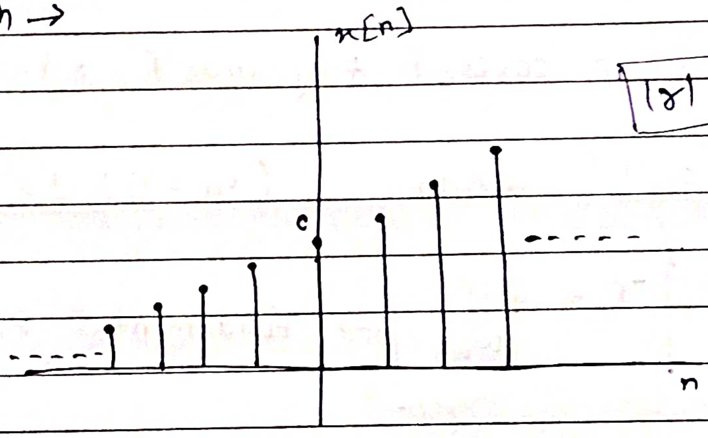
$$x[n] = c\gamma^n$$

where $c, \gamma \rightarrow$ real parameters

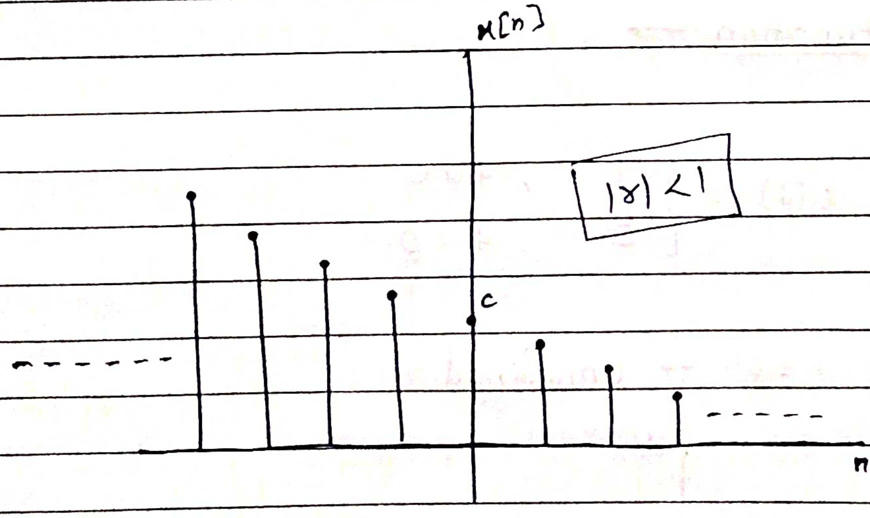
Or, $x[n] = c\,e^{\alpha n}$

where, $\gamma = e^{\alpha}$

Graph →



$\boxed{|\gamma| > 1}$ → Grow ES



$\boxed{|\gamma| < 1}$ → Decay ES

e.g. → FP of ES $x(t) = e^{j\omega_0 t}$

$$\Rightarrow \quad x(t+T) = e^{j\omega_0(t+T)} = e^{j\omega_0 t} \cdot e^{j\omega_0 T}$$

when $e^{j\omega_0 T} = 1$,

$$x(t+T) = x(t)$$

and $e^{j\omega_0 T} = \cos\omega_0 T + j\sin\omega_0 T = 1$

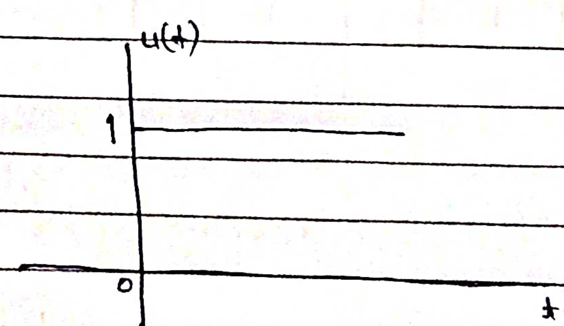
i.e., $\omega_0 T = 2\pi m \quad (m = \pm 1, \pm 2, \pm 3, \ldots)$

$$\boxed{T = \frac{2\pi}{|\omega_0|}}$$ → Fundamental Period

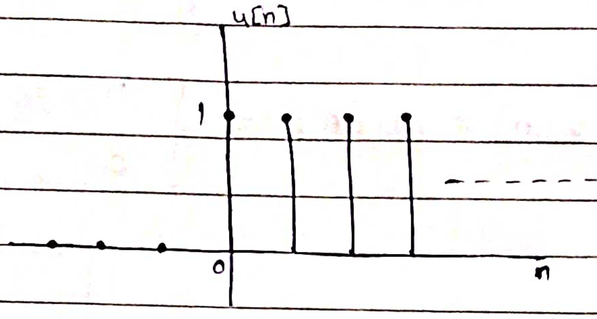
* Unit - Step Function —

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

at $t = 0$ → undefined



$$u[n] = \begin{cases} 1 & , n \geq 0 \\ 0 & , n < 0 \end{cases}$$

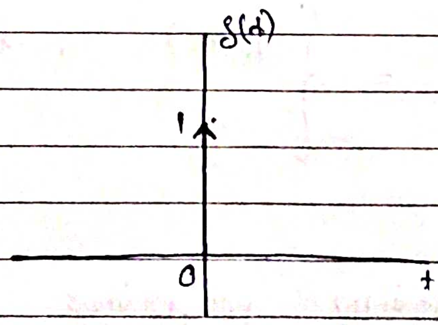


* Unit Impulse –

Dirac - Delta Function –

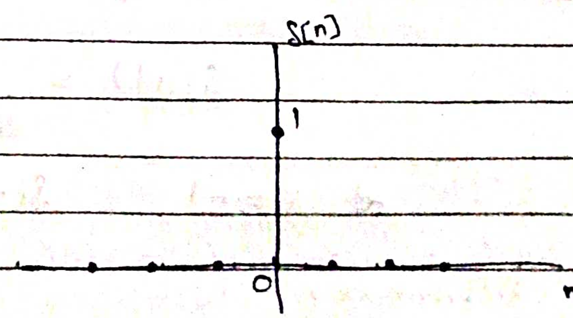
$$\delta(t) = 0 \quad \text{for} \quad t \neq 0$$

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



$$\delta[n] = 0 \quad \text{for} \quad n \neq 0$$

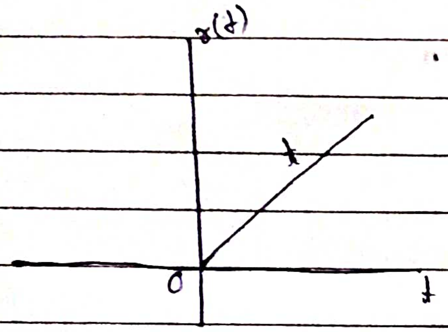
$$= \sum_{n=-\infty}^{\infty} \delta[n] = 1$$

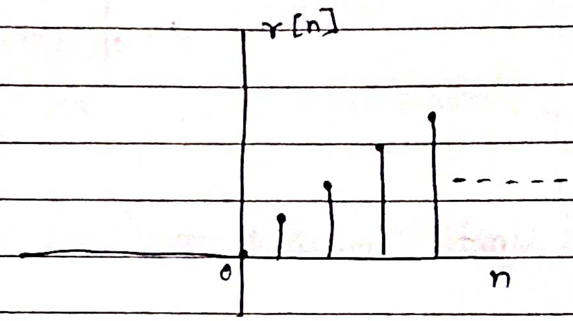


* Unit - Ramp -

$$r(t) = t\,u(t) = \begin{cases} t & , \; t \ge 0 \\ 0 & , \; t < 0 \end{cases}$$

$$r[n] = n\,u[n] = \begin{cases} n & , \; n \ge 0 \\ 0 & , \; n < 0 \end{cases}$$





* Properties of continuous time Unit Impulse -

① (i) $$\int_{-\infty}^{\infty} x(t)\,\delta(t)\,dt = x(0)$$

(ii) $$\int_{t_1}^{t_2} x(t)\,\delta(t - t_0)\,dt = \begin{cases} x(t_0) & , \; t_1 < t_0 < t_2 \\ 0 & , \; \text{otherwise} \end{cases}$$

(i) & (ii) are shifting properties

② Scaling Property -

$$\delta(at) = \frac{1}{|a|}\,\delta(t)$$

at $a = -1$, $\delta(-t) = \delta(t)$ → even signal