Signal

A signal describes a time varying physical phenomenon which is intended to convey information. (or) Signal is a function of time or any other variable of interest. (or) Signal is a function of one or more independent variables, which contain some information. Signals may be of continuous time or discrete time signals.

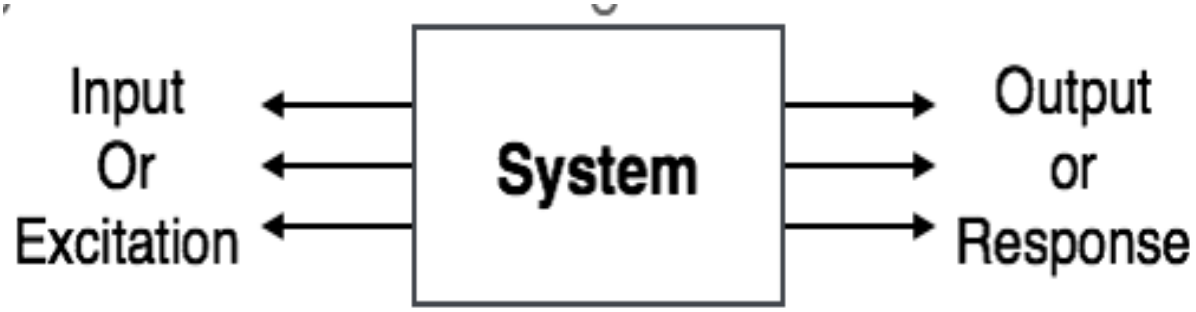
Example: voice signal, video signal, signals on telephone wires, EEG, ECG etc.

System:

System is a device or combination of devices, which can operate on signals and produces corresponding response. Input to a system is called as excitation and output from it is called as response. (or) System is a combination of sub units which will interact with each other to achieve a common interest.

For one or more inputs, the system can have one or more outputs.

Example: Communication System



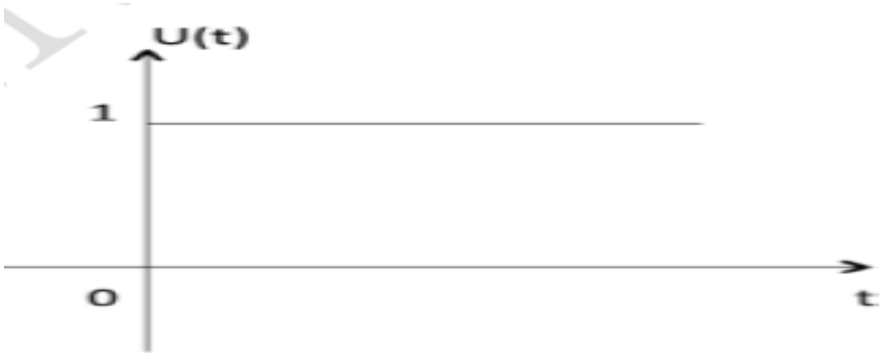
Elementary Signals or Basic Signals:

Unit Step Function

Unit step function is denoted by u(t). It is defined as u(t) = 1 when $t \geq 0$ and

0 when $t < 0$.

- It is used as best test signal.
- Area under unit step function is unity.

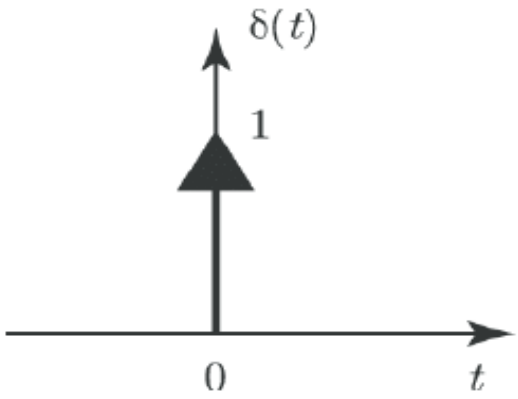


Unit Impulse Function

Impulse function is denoted by δ(t). It is defined as

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

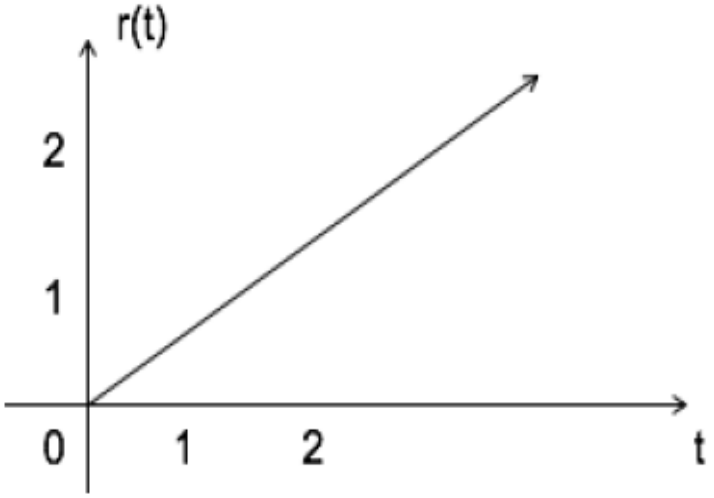
$$\delta(t) = \frac{du(t)}{dt}$$



Ramp Signal

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

Area under unit ramp is unity.

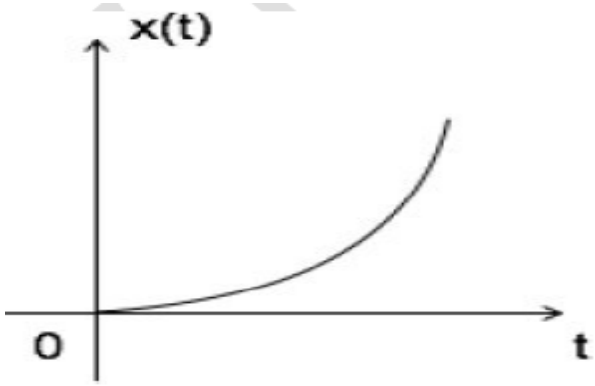


$$\int u(t) = \int 1 = t = r(t)$$

$$u(t) = \frac{dr(t)}{dt}$$

Parabolic Signal

Parabolic signal is defined as x(t)=$\begin{Bmatrix} \frac{t^2}{2}, t \geq 0 \\ o, t < 0 \end{Bmatrix}$



$$\iint u(t)dt = \int r(t)dt = \int tdt = \frac{t^2}{2} = parabolicsignal$$

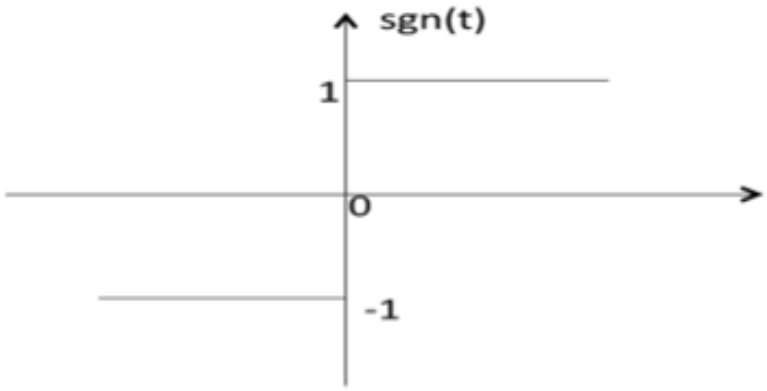
$$\Rightarrow u(t) = \frac{d^2x(t)}{dt^2}$$

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

Signum Function

Signum function is denoted as sgn(t). It is defined as sgn(t) =$\begin{Bmatrix} 1, t > 0 \\ 0, t = 0 \\ -1, t < 0 \end{Bmatrix}$

sgn(t) = 2u(t) – 1

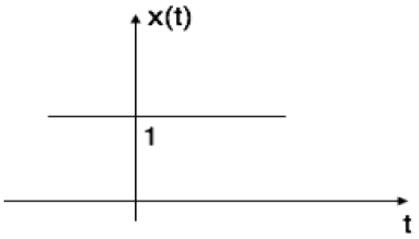


Exponential Signal

Exponential signal is in the form of x(t) =$e^{\alpha t}$

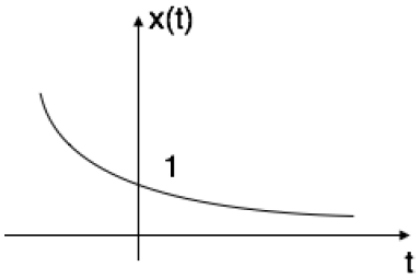
The shape of exponential can be defined by α

Casei: if α= 0→x(t) = e^{0}= 1



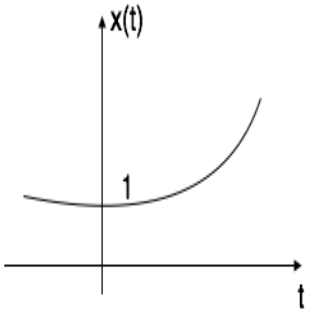
Caseii:if α< 0i.e.-vethenx(t) =$e^{-\alpha t}$

. The shape is called decaying exponential.



Caseiii:if α> 0i.e.+vethen x(t)=$e^{\alpha t}$

. The shape is called raising exponential.

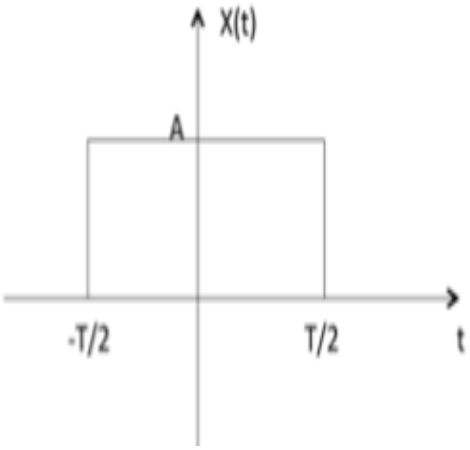


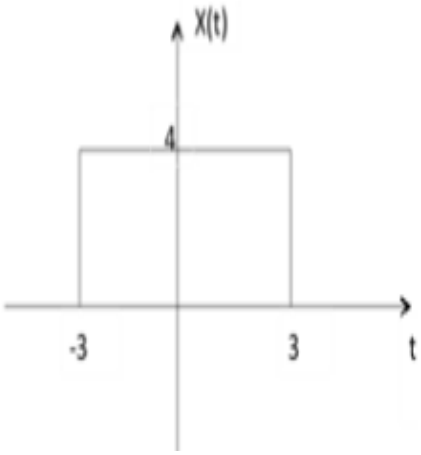
Rectangular Signal

Let it be denoted as x(t) and it is defined as

$$x(t) = A\,rect\left[\frac{r}{T}\right]$$

$$ex: 4\,rect\left[\frac{r}{6}\right]$$

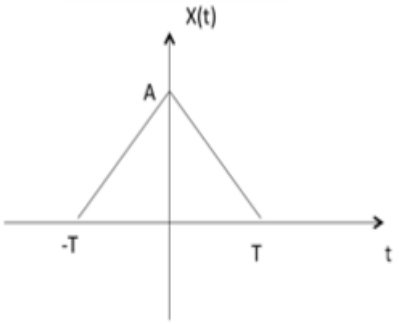




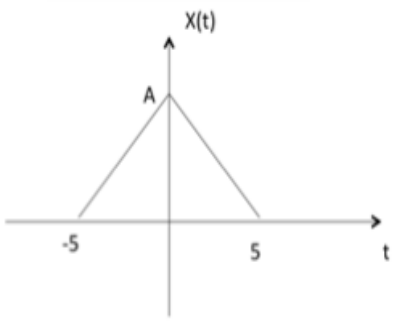
Triangular Signal

Let it be denoted as x(t)

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

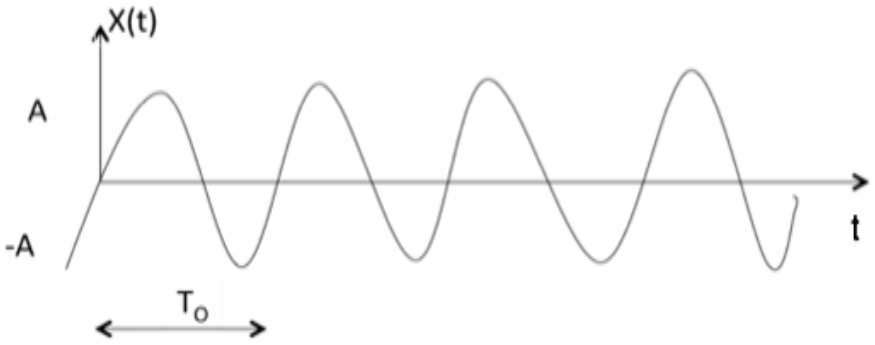


$$\text{ex: } x(t) = A\left[1 - \frac{|t|}{5}\right]$$



Sinusoidal Signal

Sinusoidalsignalisin theformof x(t)=Acos($w0\pm\phi$)orAsin($w0\pm\phi$)



Where T0 = $2\pi/w0$