SNS COLLEGE OF TECHNOLOGY

An Autonomous Institution

Coimbatore-35

Accredited by NBA – AICTE and Accredited by NAAC – UGC with 'A+' Grade

Approved by AICTE, New Delhi & Affiliated to Anna University, Chennai

DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

19ECT202 – SIGNALS AND SYSTEMS

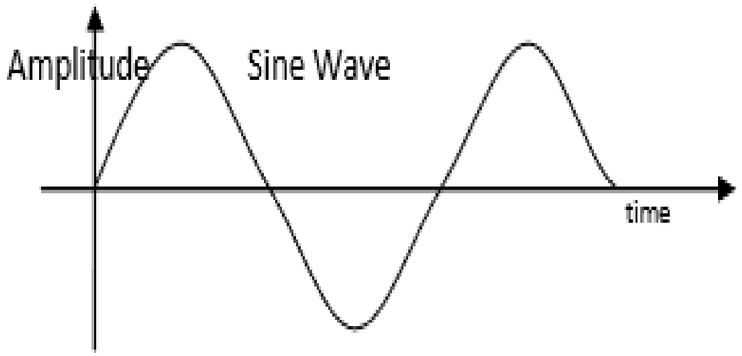
II YEAR/ III SEMESTER

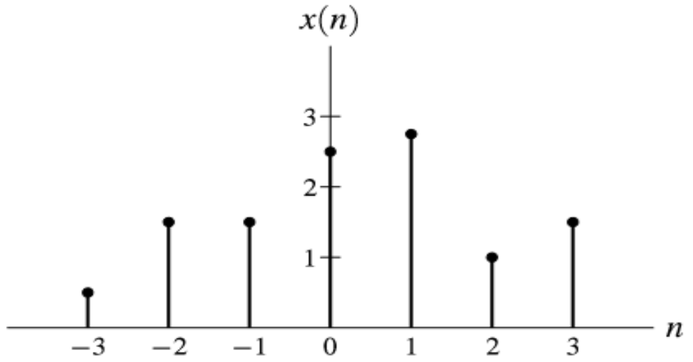
UNIT 1 – CLASSIFICATION OF SIGNALS AND SYSTEMS

TOPIC 2 – STANDARD SIGNALS

STANDARD SIGNALS

- Standard signals are represented in both continuous time signals and discrete-time signals
- **Continuous time signal:** The variable of time is continuous. A speech signal as a function of time is a continuous-time signal
- **Discrete time signal:** The variable of time is discrete





STANDARD SIGNALS

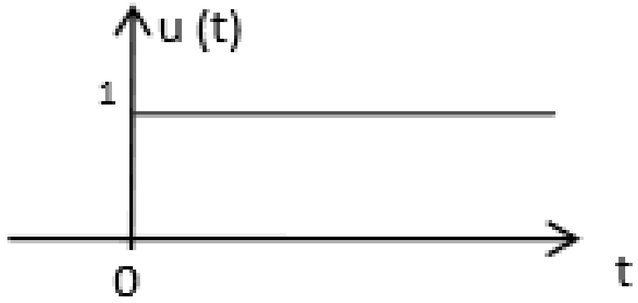
- Unit Step Signal
- Unit Impulse Signal
- Unit Ramp Signal
- Complex Exponential Signal
- Sinusoidal Signal

UNIT STEP SIGNAL

Continuous Time Signal

u (t) = 1 for t ≥ 0

= 0 for t < 0

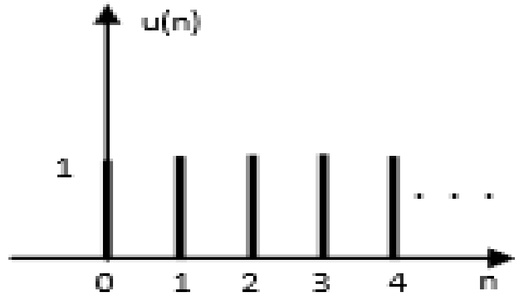


Unit step signal

Discrete Time Signal

u (n) = 1 for n ≥ 0

= 0 for n < 0



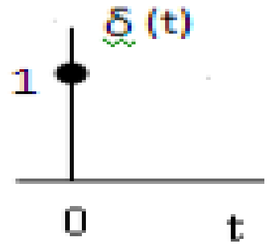
Unit step signal

UNIT IMPULSE SIGNAL

Continuous Time Signal

$\delta(t) = 1$ for $t = 0$

$= 0$ for $t \neq 0$

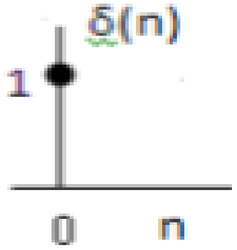


Unit Impulse signal

Discrete Time Signal

$\delta(n) = 1$ for $n = 0$

$= 0$ for $n \neq 0$

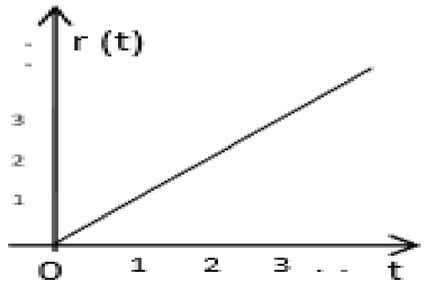


Unit Impulse signal

UNIT RAMP SIGNAL

Continuous Time Signal

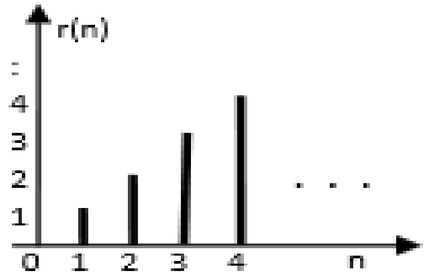
$$r(t) = t \text{ for } t \geq 0$$
$$= 0 \text{ for } t < 0$$



Unit ramp signal

Discrete Time Signal

$$r(n) = n \text{ for } n \geq 0$$
$$= 0 \text{ for } n < 0$$

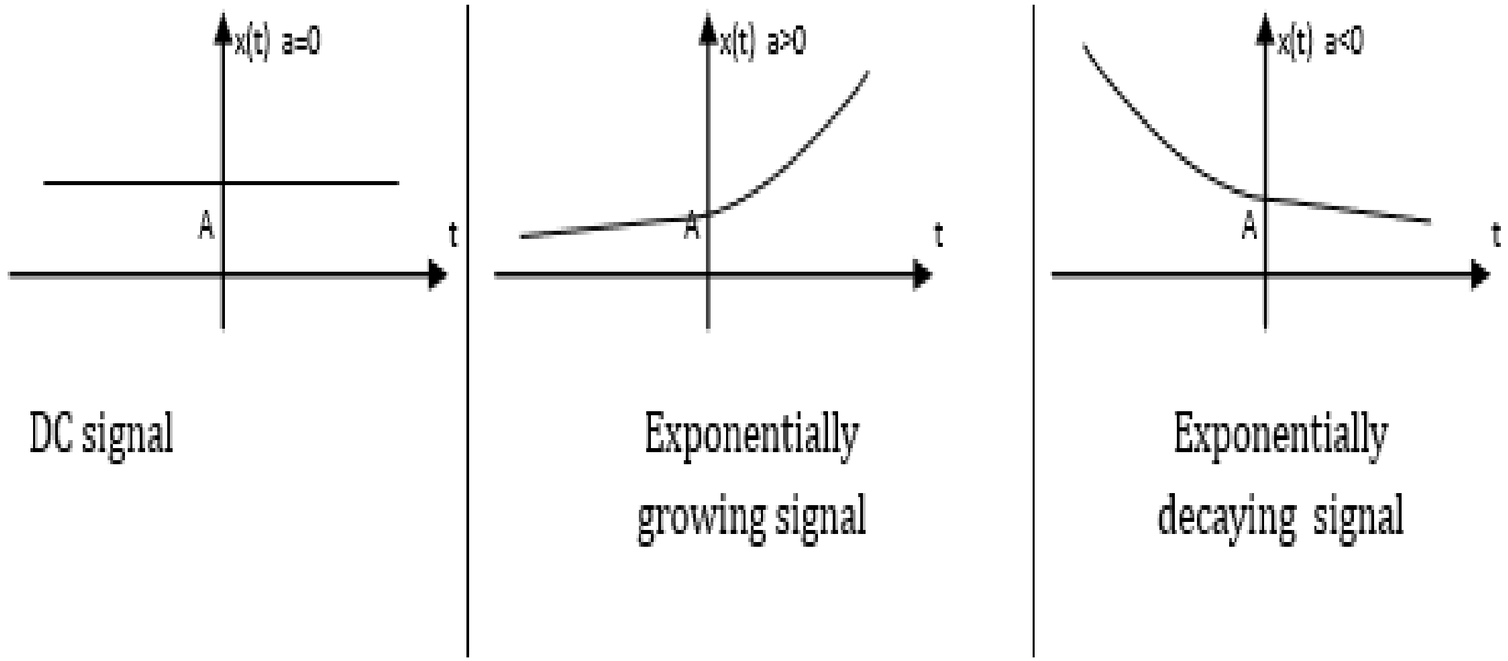


Unit Ramp signal

EXPONENTIAL SIGNAL

Real Exponential Signal is defined as $x(t) = Ae^{at}$

Where A is the amplitude



DC signal

Exponentially growing signal

Exponentially decaying signal

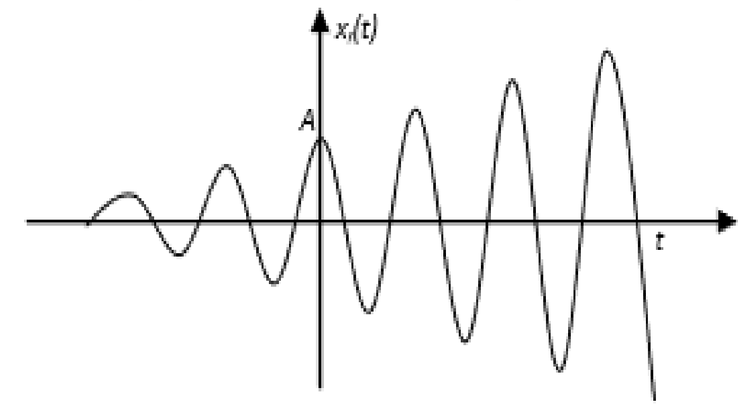
CT EXPONENTIAL SIGNAL

Complex Exponential signal is defined as $x(t) = Ae^{st}$

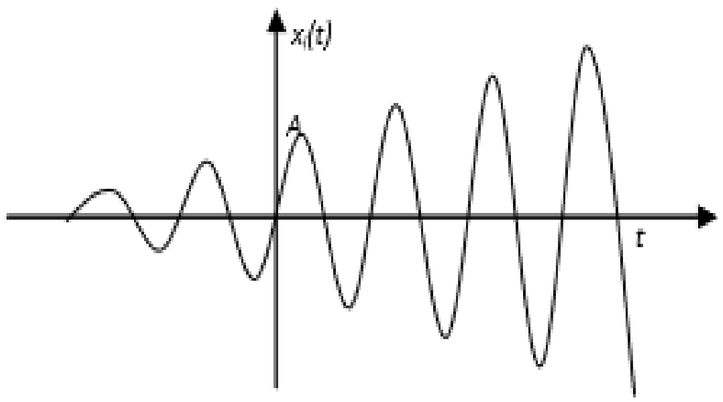
Where A is amplitude, s is complex variable and $\mathbf{s = \sigma + j\Omega}$

$$\mathbf{x(t) = Ae^{st} = Ae^{(\sigma+j\Omega)t} = Ae^{\sigma t}\, e^{j\Omega t} = Ae^{\sigma t}(\cos\Omega t + j\sin\Omega t)}$$

where $x_r(t) = Ae^{\sigma t}\cos\Omega t$ *and* $x_i(t) = Ae^{\sigma t}\sin\Omega t$



Exponentially growing Cosinusoidal signal



Exponentially growing sinusoidal signal

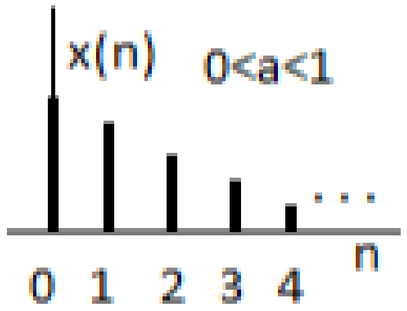
DT EXPONENTIAL SIGNAL

Real Exponential Signal is defined as $x(n) = a^n$ for $n \geq 0$

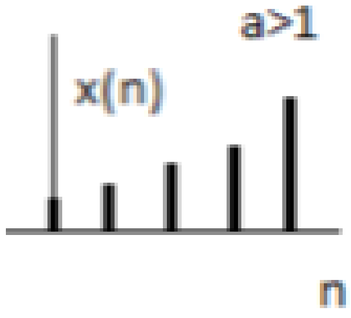
Complex Exponential signal is defined as

$$x(n) = a^n e^{j(\omega on)} = a^n (\cos\omega_o n + j\sin\omega_o n)$$

Where $x_r(n) = a^n \cos\omega_o n$ and $x_i(n) = a^n \sin\omega_o n$



Decreasing exponential signal



Increasing exponential signal

CT SINUSOIDAL SIGNAL

Cosinusoidal signal is defined as

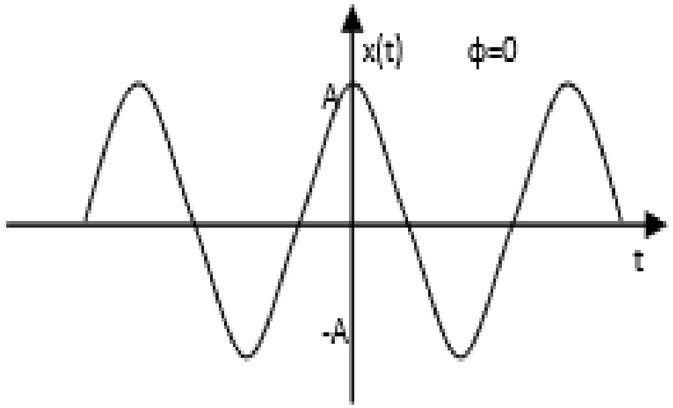
$$x(t) = A\cos(\Omega t + \Phi)$$

Sinusoidal signal is defined as

$$x(t) = A\sin(\Omega t + \Phi)$$

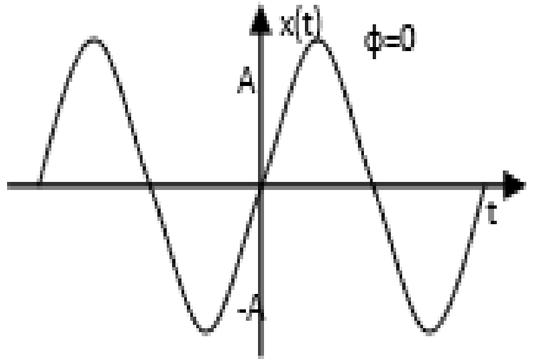
Cosinusoidal signal

$$when\ \phi = 0, x(t) = A\cos(\Omega t)$$



Sinusoidal signal

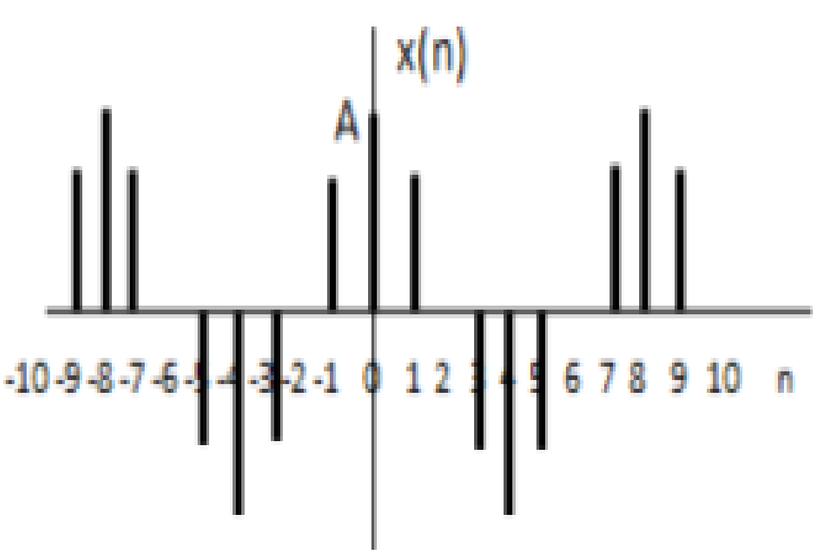
$$when\ \phi = 0, x(t) = A\sin(\Omega t)$$



DT SINUSOIDAL SIGNAL

Cosinusoidal signal is defined as

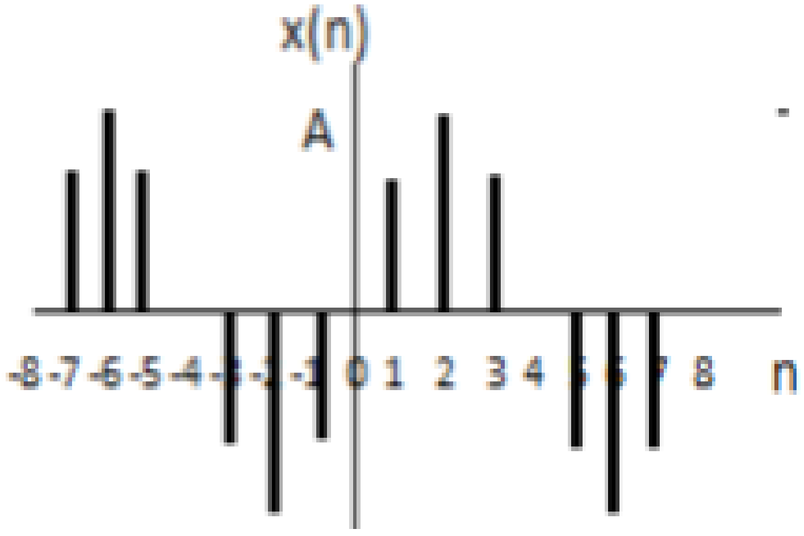
$$x(n) = A\cos(\omega n)$$



Cosinusoidal signal

Sinusoidal signal is defined as

$$x(n) = A\sin(\omega n)$$



Sinusoidal signal

RELATIONSHIP BETWEEN UNIT STEP & RAMP SIGNAL

Unit ramp :-

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

Unit Step :-

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

Diff r(t) w.r to t

$$\frac{d}{dt} r(t) = \begin{cases} 1, & t \geq 0 \\ 0, & t < 0 \end{cases}$$

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

$$d\,r(t) = u(t)\,dt$$

$$r(t) = \int u(t)\,dt$$

RELATIONSHIP BETWEEN UNIT STEP & IMPULSE SIGNAL

Unit step : $u(t) = \begin{cases} 1, & t \geq 0 \\ 0, & t < 0 \end{cases}$

Unit Impulse : $\delta(t) = \begin{cases} 1, & t = 0 \\ 0, & t \neq 0 \end{cases}$

Diff $u(t)$ w.r to t

$\frac{d}{dt}\, u(t) = \begin{cases} 1, & t = 0 \\ 0, & t \neq 0 \end{cases}$

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

$d\, u(t) = \delta(t)\, dt$

$$u(t) = \int \delta(t)\, dt$$

ASSESSMENT

1. List the classification of standard signals.
2. What is unit step function?
3. Standard signals are also called as ----------
4. Define unit ramp signal
5. Unit Impulse signal is denoted as ----------
6. Standard signals can be represented in both ---------- and ----------
7. The relationship between Unit Step and Unit Ramp signal is ----------
8. What is meant by Sinusoidal signal.

THANK YOU