8th Oct, 18

# LECTURE#3:-

## CONTINUOUS & DISCRETE SYSTEMS:-

**EXAMPLE #1:-**

Memory / Without Memory System?

1) $y(t) = x(2t)$

Sol:-

$t = 0$

$y(0) = x(0)$ pr. ip

$t = -1$

$y(-1) = x(-2)$ past i/p

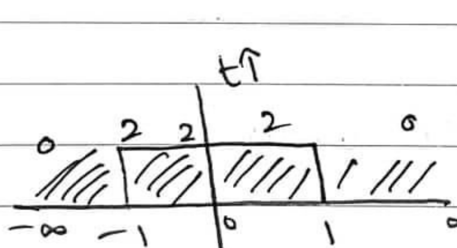
$t = 1$

$y(1) = x(2)$ future i/p

Hence, it is system with memory i-e, Dynamic system.

2) $y(t) = \int_{-\infty}^{t} x(\tau)\, d\tau$

Sol:-




Slowly start from $-\infty$ and reaches to t.

if $t = -1$ then $-\infty$ to $-1$ the area is 0

$t = 1$ then net area depends on previous values and so on.

So it is system with memory i-e; Dynamic system.

3) $y[n] = x[-n]$

<u>Sol:-</u>

$y[n] = x[-n]$

$n = 0$

$y[0] = x[0]$ present o/p → present i/p

~~past i/p → +~~

$n = 1$

$y[1] = x[-1]$ pr. o/p → past i/p

Hence the system is Dynamic.

4) $y[n] = x[n+1]$

<u>Sol:-</u>

$n = 0$

$y[0] = x[1]$ pr. o/p → future i/p.

Hence the system is Dynamic.

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<u>EXAMPLE # 2:-</u>

Causal or Non-Causal ?

1) $y(t) = x(3t)$.

<u>Sol:-</u>

$t = 0$

$y(0) = x(0)$

$t = 1$

$y(1) = x(3)$

pr o/p → future i/p

Hence the system is non-causal.

2) $y(t) = \begin{cases} x(3t) & t < 0 \\ x(t-1) & t \geq 0 \end{cases}$

Sol:

$t < 0$

$y(t) = x(3t)$

$t = -1$

$y(-1) = x(-3)$

past i/p

$t \geq 0$

$t = 0$ $\quad y(0) = x(-1)$ past i/p

$t = 1$ $\quad y(1) = x(0)$ past i/p

Hence the system is causal.

3) $y[n] = x[n] + x[n-1]$

Sol:

$n = 0$

$y[0] = x[0] + x[-1]$

pr o/p → pr. i/p + past i/p

$n = 1$

$y[1] = x[1] + x[0]$

pr o/p → pr i/p + past i/p

$n = -1$

$y[-1] = x[-1] + x[-2]$

pr o/p → pr i/p + past i/p

Hence, the system is causal.

EXAMPLE #3:-

Time Variant or Time Invariant?

1) $y(t) = x(\cos t)$

Sol:-

$$x(t) \rightarrow \boxed{SYS} \rightarrow y(t) = x(\cos t)$$

$$y(t) \xrightarrow{t_0} \boxed{sys} \rightarrow y(t-t_0) = x\{\cos(t-t_0)\}$$

$$x(t) \xrightarrow{t_0} x(t-t_0) \rightarrow \boxed{SYS} \rightarrow x[\cos t - t_0]$$

Hence, the system is Time variant.

2) $y[n] = x[2n]$

Sol:

$$x[n] \rightarrow \boxed{SYS} \rightarrow y[n] = x[2n]$$

$$y[n] \xrightarrow{n_0} y[n-n_0] = x[2(n-n_0)]$$

$x[n] \xrightarrow{n_0} x[n-n_0] \rightarrow \boxed{sys} \rightarrow y[n] = x[2n-n_0]$

Hence, the system is time variant.

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EXAMPLE # 4:-

Linear or Non-Linear ?

1) $y(t) = e^3 x(t)$

Sol:-

a) Law of Aditivity (LOA):-

$x_1(t) \rightarrow sys \rightarrow y_1(t) = e^3 x_1(t)$

$x_2(t) \rightarrow sys \rightarrow y_2(t) = e^3 x_2(t)$

$$y_1(t) + y_2(t) = e^3 x_1(t) + e^3 x_2(t) \Rightarrow e^3[x_1(t) + x_2(t$$

$$y'(t) = x_1(t) + x_2(t) \Rightarrow e^3[x_1(t) + x_2(t)]$$

b) Law of Homogenity (LOH):-

$$x(t) \rightarrow sys \rightarrow y(t) \rightarrow 'k' \rightarrow k\,y(t) = k.e^3.x(t)$$

$$kx(t) \rightarrow sys \rightarrow k \cdot e^3 . x(t)$$

Both results are same so, the system is linear sys.

$\longleftrightarrow$

2) $y[n] = x[2n]$

Sol:

a) LOA:

$x_1[n] \rightarrow sys \rightarrow y_1[n] = x_1[2n]$

$x_2[n] \rightarrow sys \rightarrow y_2[n] = x_2[2n]$

$y_1[n] + y_2[n] = x_1[2n] + x_2[2n]$

$y'[n] = x_1[n] + x_2[n] \Rightarrow x_1[2n] + x_2[2n]$

b) LOH:

$x[n] \rightarrow sys \rightarrow y[n] \rightarrow 'k' \rightarrow k\,y[n] = k\,x[2n]$

$k\,x[n] \rightarrow sys \rightarrow k\,x[2n]$

Hence the system is linear.

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EXAMPLE # 5:-

Invertible or Non-Invertible?

$y(t) = \sin t \cdot x(t)$

Sol:-

| $x(t)$ | $y(t) = \sin t \cdot x(t)$ |
|---|---|
| 0 | $y(t) = \sin(t) \cdot (0) \Rightarrow 0$ |
| 1 | $y(t) = \sin t = 1$ (let) |
| 2 | $y(t) = 2\sin t = 2 \times 1/2 \Rightarrow 1$ |
| $\delta(t)$ | $y(t) = \sin t \cdot \delta(t)$ <br> $= 0$ |

Hence, the system is Non-Investible.

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EXAMPLE # 6:-

Stable or Not stable ?

1) $y(t) = \frac{x(t)}{t}$

Sol:-

$$x(t) \rightarrow sys \rightarrow y(t) = \frac{x(t)}{t}$$

i/p

$$x(t) = 2 \longrightarrow sys \rightarrow y'(t) = \frac{2}{t} \Rightarrow y(t) \rightarrow \infty$$

dc value (bounded)

unbounded.

Hence the system is Unstable.

2) $y[n] = \cos n \cdot x[n]$.

Sol:-

$$x[n] = \text{finite}$$

$$\Rightarrow y[n] = \cos n \cdot (\text{finite})$$

-1 to +1

$$\Rightarrow y[n] = -\text{finite to } +\text{finite}.$$

Hence, the system is stable.

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