I/P —— [DT System] —— O/P

$\delta[n]$ $h[n]$

Excitation Response

$u[n]$ $\delta[n]$

# The response of a system when impulse function is applied to the system, the system is known as impulse response of the system.

⇒ This system is used to determine the output without input.

1. Finite Impulse Response (FIR)
2. Infinite Impulse Response (IIR)

# $y[n] = x[n] - 2x[n-1] + x[n-3]$

Sol:-

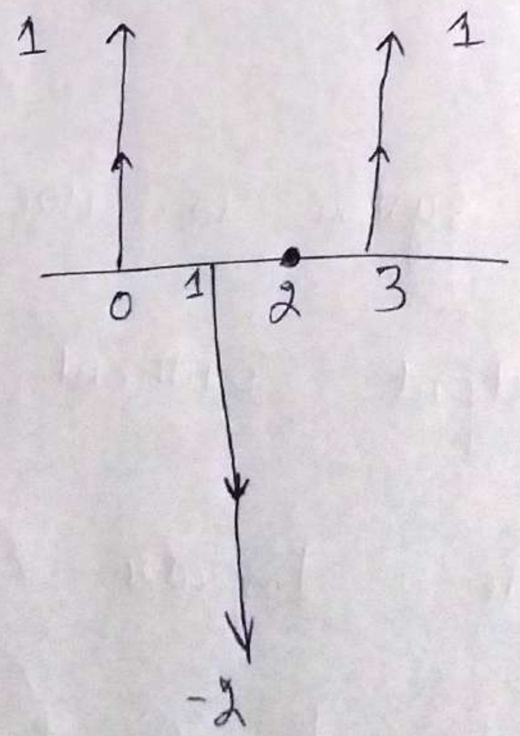
$$x[n] = \delta[n]$$

$$y[n] = h[n]$$

#

$$h[n] = \delta[n] - 2\delta[n-1] + \delta[n-3]$$

$$= \{1, -2, 0, 1\}$$



(#) $y[n] + 2y[n-1] = x[n] + x[n-1]$

Sol:

$$x[n] = \delta[n]$$

$$y[n] = h[n]$$

$$h[n] + 2h[n-1] = \delta[n] + \delta[n-1]$$

$$h[n] = \delta[n] + \delta[n-1] - 2h[n-1] \rightarrow (*)$$

$$h[0] = \delta[\cancel{0}]^{\nearrow 1} + \delta[\cancel{-1}]^{\nearrow 0} - 2h[\cancel{-1}]^{\nearrow 0}$$

$$h[0] = 1$$

∴ Other terms became zero because response is checked on zero only.

$$h[1] = \delta[\cancel{1}]^{\nearrow 0} + \delta[\cancel{0}]^{\nearrow 1} - 2h[\cancel{0}]^{\nearrow 1}$$

$$= 1 - 2$$

$$h[1] = -1$$

$$h[2] = \cancelto{0}{\delta[2]} + \cancelto{0}{\delta[1]} - 2\cancelto{-1}{h[1]}$$

because $h[1] = -1$

$$h[2] = 2$$

$$h[n] = \{ \underset{\uparrow}{1}, -1, 2, \ldots \}$$

— x — x — x —

(4) If a unit step response is applied to a system then the system called as step response.

— x — x —

(8) Find homogeneous and particular solution using impulse response method.

$$y[n] - 5y[n-1] = x[n] \longrightarrow (1)$$

Sol:-

Homogeneous Sol:-

$$y[n] - 5y[n-1] = 0$$

$$\lambda^n - 5\lambda^{n-1} = 0 \Rightarrow \text{Characteristic Eqtn.}$$

$$\lambda^{n-1}(\lambda - 5) = 0$$

$$\boxed{\lambda = 5}$$

$$y_h[n] = C_1(5)^n \longrightarrow (*)$$

As $\quad y_p[n] = 0$

So total solution will be:-

$$y[n] = C_1(5)^n \longrightarrow (ii)$$

Now putting initial conditions.

$\underline{\underline{n=0}}$

$$(ii) \Rightarrow y[0] = C_1(5)^0$$

$$y[0] = C_1 \longrightarrow (iii)$$

$$(i) \Rightarrow \quad y[0] - 5y[-1] = x[0]$$

$$y[0] = 5\cancelto{0}{y[-1]} + \cancelto{1}{x[0]}$$

$$y[0] = 1 \longrightarrow (iv).$$

By comparing eq (iii) & eq (iv)

$$\boxed{C_1 = 1}$$

—— x —— x —— x ——

The only difference in this (IRM) method is that we take initial condition $x[0]$ & $y[0] = 1$

—— x —— x —— x ——

(8) $y[n] + y[n-1] - 6y[n-2] = x[n] \rightarrow (1)$

Sol:-

$\lambda = 2, -3$ (DYS)

Total Solution:-

$$y[n] = C_1(2)^n + C_2(-3)^n \rightarrow (2)$$

Putting initial Condition in (1) & (2).

$n = 0$ ; $n = 1$

$$(2) \Rightarrow y[0] = C_1(2)^0 + C_2(-3)^0$$

$$y[0] = C_1 + C_2 \rightarrow (a)$$

$$(1) \Rightarrow y[0] + y[-1] - 6y[-2] = x[0]$$

$$y[0] = \cancel{x[0]}^{1} + 6\cancel{y[-2]}^{0} - \cancel{y[-1]}^{0}$$

$$x[0] \to \delta[0]$$

$$y[0] = 1 \rightarrow (b)$$

by compearing (a) & (b)

$$C_1 + C_2 = 1 \rightarrow (3)$$

Now

$n = 1$

$$(2) \Rightarrow y[1] = C_1(2)^1 + C_2(-3)^1$$

$$y[1] = 2C_1 - 3C_2 \rightarrow (c)$$

Now putting $n=1$ in eq (1).

$$y[1] + y[1-1] - 6y[1-2] = x[1]$$

$$y[1] + y[0] - 6y[-1] = x[1]$$

$$y[1] = x[1]^{0} - y[0]^{1} + 6y[-1]^{0}$$

$$y[1] = -1 \rightarrow (d)$$

Compearing (c) & (d)

$$2C_1 - 3C_2 = -1 \rightarrow (4).$$

Compearing eq (3) & eq (4)
to get $C_1$ & $C_2$ values.

(DYS)

$$C_1 = ?$$
$$C_2 = ?$$