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Section: A

Question: The impulse response of LTI system is,

$$x(n) = \{1, -3, \underset{\uparrow}{2}, 1\}$$

Determine the response of the system to the input signal

$$h(n) = \{1, \underset{\uparrow}{2}, 2, 1\}$$

Answer:

Here, $V_0(n) = x(k)\,h(0-k)$

$\therefore V_0(n) = \{-1, -6, 4, 1\}$

$y_0(n) = \sum V_0(n) = 0$

$V_1(n) = x(k)\,h(1-k)$

$\Rightarrow V_1(n) = \{0, -3, 4, 2, 0\}$

$\Rightarrow y_1(n) = \sum V_1(n) = 3$

$V_2(n) = x(k)\,h(2-k)$

$\Rightarrow V_2(n) = \{0, 0, 2, 2, 0, 0\}$

$\Rightarrow y_2(n) = \sum V_2(n) = 4$

$V_3(n) = x(k)\, h(3-k)$

$\Rightarrow V_3(n) = \{0, 0, 0, 1, 0, 0, 0\}$

$\Rightarrow y_3(n) = \sum V_3(n) = 1$

$V_4(n) = x(k)\, h(3-k)$

$\Rightarrow V_4(n) = \{0, 0, 0, 0, 0, 0, 0, 0\}$

$\Rightarrow y_4(n) = \sum V_4(n) = 0$

$V_5(n) = x(k)\, h(5-k)$

$\Rightarrow V_5(n) = \{0, 0, 0, 0, 0, 0, 0, 0, 0\}$

$\Rightarrow y_5(n) = \sum V_5(n) = 0$

$V_{-1}(n) = x(k)\, h(-1-k)$

$\Rightarrow V_{-1}(n) = \{0, 2, -6, 2, 0\}$

$\Rightarrow y_{-1}(n) = \sum V_{-1}(n) = -2$

$V_{-2}(n) = x(k)\, h(-2-k)$

$\Rightarrow V_{-2}(n) = \{0, 0, 2, -3, 0, 0\}$

$\Rightarrow y_{-2}(n) = \sum V_{-2}(n) = -1$

$V_{-3}(n) = x(k)\,h(-3-k)$

$\Rightarrow V_{-3}(n) = \{0, 0, 0, 1, 0, 0, 0\}$

$\Rightarrow y_{-3}(n) = \sum V_{-3}(n) = 1$

$V_{-4}(n) = x(k)\,h(-4-k)$

$\Rightarrow V_{-4}(n) = \{0, 0, 0, 0, 0, 0, 0, 0\}$

$\Rightarrow y_{-4}(n) = \sum V_{-4}(n) = 0$

$V_{-5}(n) = x(k)\,h(-5-k)$

$\Rightarrow V_{-5}(n) = \{0, 0, 0, 0, 0, 0, 0, 0, 0\}$

$\Rightarrow y_{-5}(n) = \sum V_{-5}(n) = 0$

So, the system response will be as below –

$y(n) = \{\ldots, 0, 0, 1, -1, -2, 0, 3, 4, 1, 0, 0, \ldots\}$