Seth Ricks

ECEN 380
1/31/2026

PS04: 2.32(c), 2.34(b), 2.39(d), 2.46(b), 2.49(a)(c)(e), MATLAB 2.83 for 2.34(b)

4

(2.32(c)) Discrete-time LTI system has impulse response h[n] in figure a

Determine output if input is figure b.

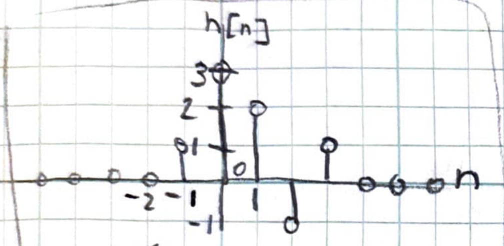


figure a

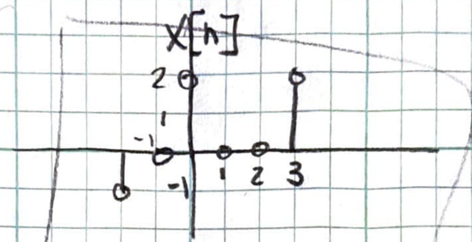


figure b

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

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

$$y[n] = -h[n+1] + 2h[n] + 2h[n-3]$$

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

$$+ 2\left[\delta[n+1] + 3\delta(n) + 2\delta[n-1] + -\delta[n-2] + \delta[n-3]\right]$$

$$+ 2\left[\delta[n-2] + 3\delta[n-3] + 2\delta[n-4] + \delta[n-5] + \delta[n-6]\right]$$

$$y[n] = -\delta[n+2] + (-3+2)\delta[n+1] + (-2+6)\delta[n] + (1+4)\delta[n-1] + (-1+-2+2)\delta[n-2]$$

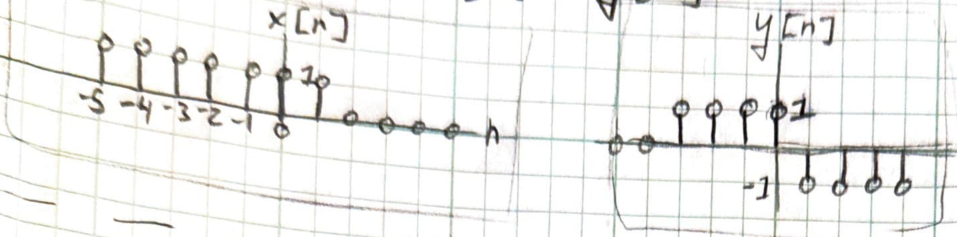
$$+ (2+6)\delta[n-3] + 4\delta[n-4] + 2\delta[n-5] + 2\delta[n-6]$$

$$\boxed{y[n] = -\delta[n+2] - 1\delta[n+1] + 4\delta[n] + 5\delta[n-1] - \delta[n-2] + 8\delta[n-3] + 4\delta[n-4] + 2\delta[n-5] + 2\delta[n-6]}$$

2.34 (b) Consider discrete time signals depicted below. Evaluate convolution.

2/4

$$m[n] = x[n] * y[n]$$



$$x[n] = \delta[n+5] + \delta[n+4] + \delta[n+3] + \delta[n+2] + \delta[n+1] + \delta[n] + \delta[n-1]$$

$$y[n] = \delta[n+3] + \delta[n+2] + \delta[n+1] + \delta[n] + -\delta[n-1] + -\delta[n-2] + -\delta[n-3] + -\delta[n-4]$$

$$m[n] = x[n+3] + x[n+2] + x[n+1] + x[n] + -x[n-1] + -x[n-2] + -x[n-3] + -x[n-4]$$

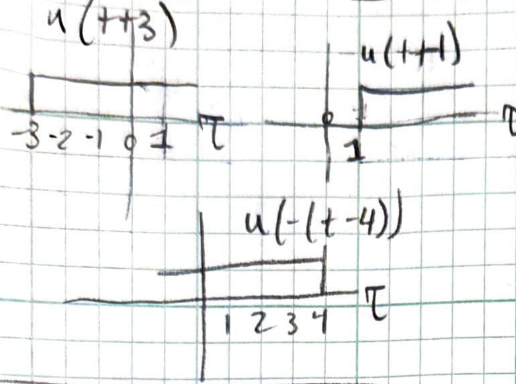
$+\delta[n]$

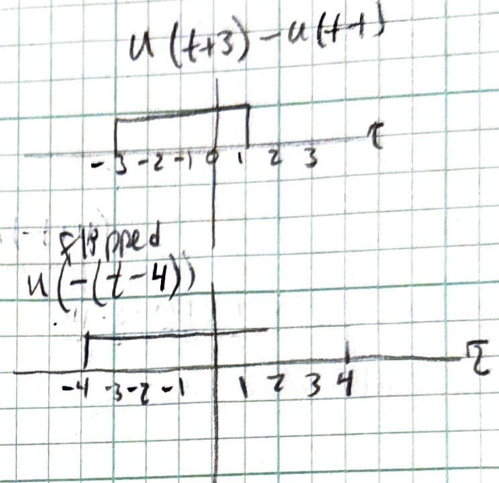
$$m[n] = \delta[n+8] + \delta[n+7] + \delta[n+6] + \delta[n+5] + \delta[n+4] + \delta[n+3] + \delta[n+2]$$
$$+ \delta[n+7] + \delta[n+6] + \delta[n+5] + \delta[n+4] + \delta[n+3] + \delta[n+2]$$
$$+ \delta[n+6] + \delta[n+5] + \delta[n+4] + \delta[n+3] + \delta[n+2] + \delta[n+1]$$
$$+ \delta[n+5] + \delta[n+4] + \delta[n+3] \qquad + \delta[n]$$
$$+ \delta[n+2] + \delta[n+1]$$
$$+ \delta[n] + \delta[n-1]$$
$$+ -\delta[n+4] + -\delta[n+3] - \delta[n+2] - \delta[n+1] + -\delta[n] + -\delta[n-1] + -\delta[n-2]$$
$$+ -\delta[n+3] + -\delta[n+2] + -\delta[n+1] + -\delta[n] + -\delta[n-1] + -\delta[n-2] + -\delta[n-3]$$
$$+ -\delta[n+2] + -\delta[n+1] + -\delta[n] + -\delta[n-1] + -\delta[n-2] + -\delta[n-3] + -\delta[n-4]$$
$$+ -\delta[n+1] + -\delta[n] + -\delta[n-1] + -\delta[n-2] + -\delta[n-3] + -\delta[n-4] + -\delta[n-5]$$
$$\delta[n-6]$$

$$\boxed{m[n] = \delta[n+8] + 2\delta[n+7] + 3\delta[n+6] + 4\delta[n+5] + 3\delta[n+4] + 2\delta[n+3] + \delta[n+2] - 1\delta[n+1] - 2\delta[n] - 3\delta[n-1] - 4\delta[n-2] - 3\delta[n-3] - 2\delta[n-4] - \delta[n-5]}$$

2.39(d) Evaluate continuous time integral:

$$y(t) = (u(t+3) - u(t-1)) * u(-t+4)$$



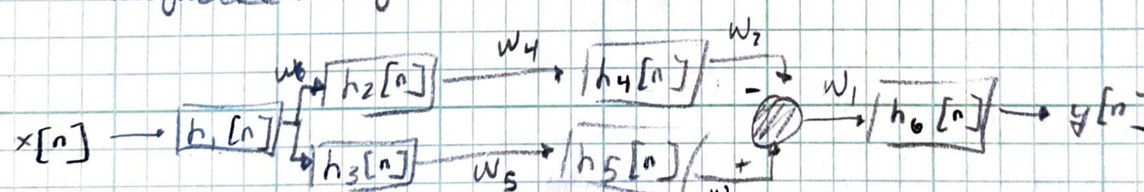


$$\boxed{y(t) = \begin{cases} 4, & t < -3 \\ 1-t, & -3 < t < 1 \\ 0, & t > 1 \end{cases}}$$

$$\int_{-3}^{1} 1\,d\tau = \tau\Big|_{-3}^{1} = 1 + 3 = 4$$

$$\int_{t}^{1} 1\,d\tau = \tau\Big|_{t}^{1} = 1 - t$$

2.46b Find expression for impulse response relating input $x[n]$ or $x(t)$ to output $y[n]$ or $y(t)$ in terms of the impulse response.



$y[n] = w_1 * h_6[n]$

$w_1 = w_3 - w_2$

$w_2 = w_4 * h_4[n]$

$w_3 = w_5 * h_5[n]$

$w_4 = w_6 * h_2[n]$

$w_5 = w_6 * h_3[n]$

$w_6 = x[n] * h_1[n]$

$$\begin{aligned} y[n] &= w_1 * h_6[n] \\ &= (w_3 - w_2) * h_6[n] \\ &= [(w_5 * h_5[n]) - (w_4 * h_4[n])] * h_6[n] \\ &= [[[w_6 * h_3[n]] * h_5[n]] - [[w_6 * h_2[n]] * h_4[n]]] * h_6[n] \\ &= [[[[x[n] * h_1[n]] * h_3[n]] * h_5[n]] - [[[x[n] * h_1[n]] * h_2[n]] * h_4[n]]] * h_6[n] \end{aligned}$$

$$\boxed{y[n] = ((((x[n] * h_1[n]) * h_3[n]) * h_5[n]) - (((x[n] * h_1[n]) * h_2[n]) * h_4[n])) * h_6[n]}$$

2.49 (a)(c)(e) Determine if corresponding system is memoryless, causal, and stable from input responses:

a.) $h(t) = \cos(\pi t)$

c.) $h(t) = 3\delta(t)$

e.) $h(t) = \cos(\pi t)u(t)$

(a.) $h(t) = \cos(\pi t)$

Memoryless? → $\boxed{NO}$ Not an impulse

Causal? → $\boxed{NO}$ $h(t) \neq 0$ for $t<0$

Stable? → $\boxed{NO}$ $h(t)$ not finite on x axis

(c.) $h(t) = 3\delta(t)$

Memoryless? → $\boxed{YES}$ an impulse

Causal? → $\boxed{YES}$ $h(t) = 0$ for $t<0$

Stable? → $\boxed{YES}$ $h(t)$ finite on x axis

(e.) $h(t) = \cos(\pi t)u(t)$

Memoryless? → $\boxed{NO}$ Not an impulse

Causal? → $\boxed{YES}$ $h(t) = 0$ for $t<0$

Stable? → $\boxed{NO}$ $h(t)$ not finite on x axis

Memoryless: $h(t) = k\,\delta(t)$

Causal: $h(t) = 0$ for $t<0$

Stable: $\int_{-\infty}^{\infty} |h(t)|\,dt < \infty$