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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)

$\frac{4}{4}$

2.32(c) Discrete-time LTI system has impulse response h[n] in figure a
Determine output if input is figure b.

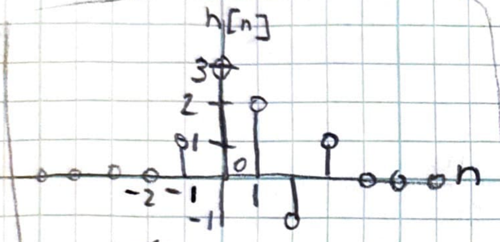


figure a

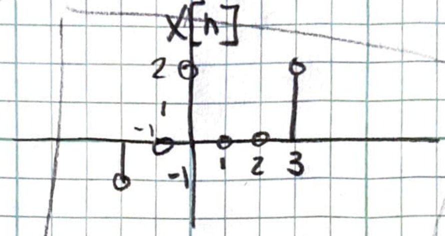


figure b

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

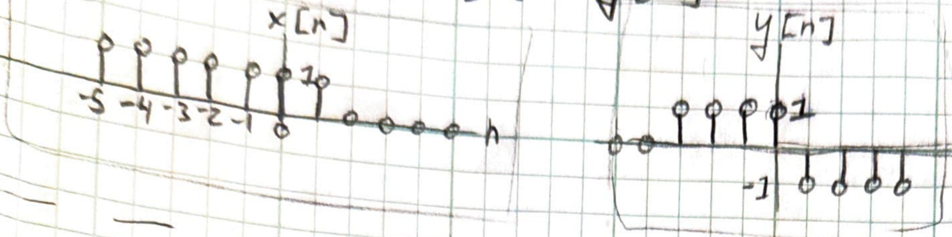
$$y[n] = -h[n+1] + 2h[n] + 2h[n-3]$$
$$= -1[\delta[n+2] + 3\delta[n+1] + 2\delta[n] - \delta[n-1] + \delta[n-2]]$$
$$+ 2[\delta[n+1] + 3\delta[n] + 2\delta[n-1] + -\delta[n-2] + \delta[n-3]]$$
$$+ 2[\delta[n-2] + 3\delta[n-3] + 2\delta[n-4] + \delta[n-5] + \delta[n-6]]$$

$$y[n] = -\delta[n+2] + (-3+2)\delta[n+1] + (-2+6)\delta[n] + (1+4)\delta[n-1] + (-1+-2+2)\delta[n-2]$$
$$+ (2+6)\delta[n-3] + 4\delta[n-4] + 2\delta[n-5] + 2\delta[n-6]$$

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

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

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



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

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

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

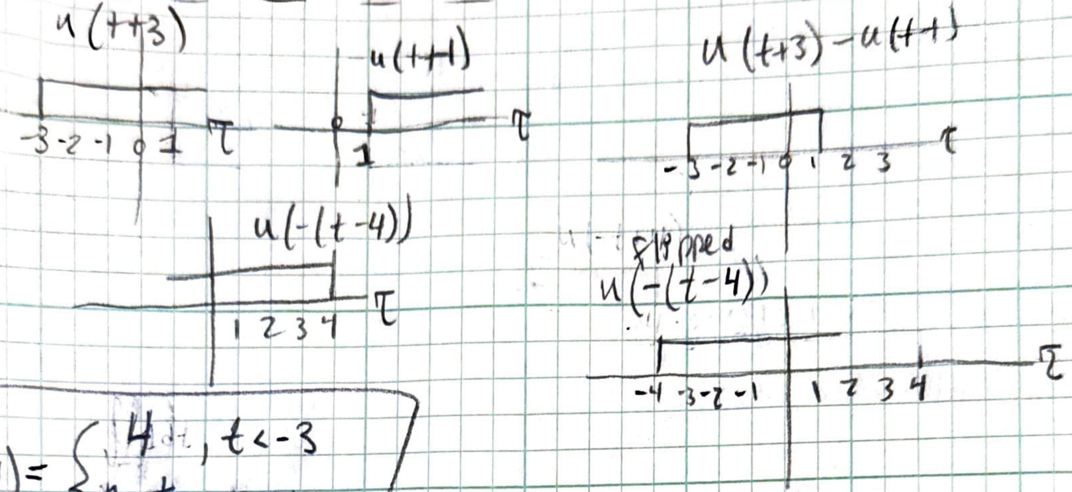
$$m[n] = \delta[n+8] + \delta[n+7] + \delta[n+6] + \delta[n+5] + \delta[n+4] + \delta[n+3] + \delta[n+2]$$
$$+ \delta[n+7] + \delta[n+6] + \delta[n+5] + \delta[n+4] + \delta[n+3] + \delta[n+2]$$
$$+ \delta[n+6] + \delta[n+5] + \delta[n+4] + \delta[n+3] + \delta[n+2] + \delta[n+1]$$
$$+ \delta[n+5] +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

$+ \delta[n]$

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

2.39(d) Evaluate continuous time integral: 3/4

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

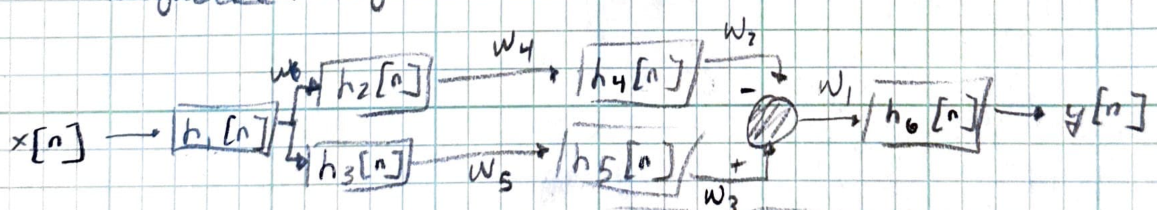


$$\boxed{y(t) = \begin{cases} 4, & t < -3 \\ 1-t, & -3 < t < 1 \\ 0, & t > 1 \end{cases}}$$

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

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

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.



$y[n] = w_1 * h_6[n]$
$w_1 = w_3 - w_2$
$w_2 = w_4 * h_4[n]$
$w_3 = w_5 * h_5[n]$
$w_4 = w_6 * h_2[n]$
$w_5 = w_6 * h_3[n]$
$w_6 = x[n] * h_1[n]$

$$y[n] = w_1 * h_6[n]$$
$$= (w_3 - w_2) * h_6[n]$$
$$= [(w_5 * h_5[n]) - (w_4 * h_4[n])] * h_6[n]$$
$$= \Big[[[w_6 * h_3[n]] * h_5[n]] - [[w_6 * h_2[n]] * h_4[n]]\Big] * h_6[n]$$
$$= \Big[\big[[[x[n] * h_1[n]] * h_3[n]] * h_5[n]\big] - \big[[[x[n] * h_1[n]] * h_2[n]] * h_4[n]\big]\Big] * h_6[n]$$

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

MATLAB R2022b - academic use

HOME PLOTS APPS LIVE EDITOR INSERT VIEW

Live Editor - C:\Users\sethr\OneDrive\Desktop\ECEN380\Homework\Homework 4\Problem_2.83.mlx

homework1.m | MATLAB_review.m | homework3_question197.mlx | Homework2.mlx | Problem_2.83.mlx

Problem 2.83 for 2.34(b)

Repeat Problem 2.34(b), using MATLAB conv command.

```
n = -5:5;
x = zeros(size(n));

x(n==-5)  = 1; x(n==-4) = 1; x(n==-3) = 1; x(n==-2) = 1; x(n==-1) = 1; x(n== 0) = 1; x(n== 1) = 1;

subplot(3, 1, 1);
stem(n, x, 'filled','Color','r')
ylim([-2 2])
xlabel('n')
ylabel('x[n]')
grid on

y = zeros(size(n));

y(n==-3) = 1; y(n==-2) = 1; y(n==-1) = 1; y(n==0) = 1; y(n==1) = -1; y(n== 0) = 1; y(n== 1) = -1; y(n== 2) = -1; y(n== 3) = -1; y(n== 4) = -1;

subplot(3, 1, 2);
stem(n, y, 'filled','Color','b')
ylim([-2 2])
xlabel('n')
ylabel('y[n]')
grid on

subplot(3, 1, 3);
m = conv(x, y);
n_convoluted = (n(1) + n(1)) : (n(end) + n(end));
stem(n_convoluted, m, 'filled','Color','m')
xlabel('n')
ylabel('m[n] = x[n] * y[n]')
grid on

% This is what m is in variables...
% 0 0   1   2   3   4   3   2   1   -1  -2  -3  -4  -3  -2  -1  0   0   0   0   0
% Which equates to ...
% m[n] =     δ[n+8] + 2δ[n+7] + 3δ[n+6]
%          + 4δ[n+5] + 3δ[n+4] + 2δ[n+3]
%          -  δ[n+2] -  δ[n+1] - 2δ[n]
%          - 3δ[n-1] - 4δ[n-2] - 3δ[n-3]
%          + 2δ[n-4] -  δ[n-5]
% Which matches the graph!
```

Figure