

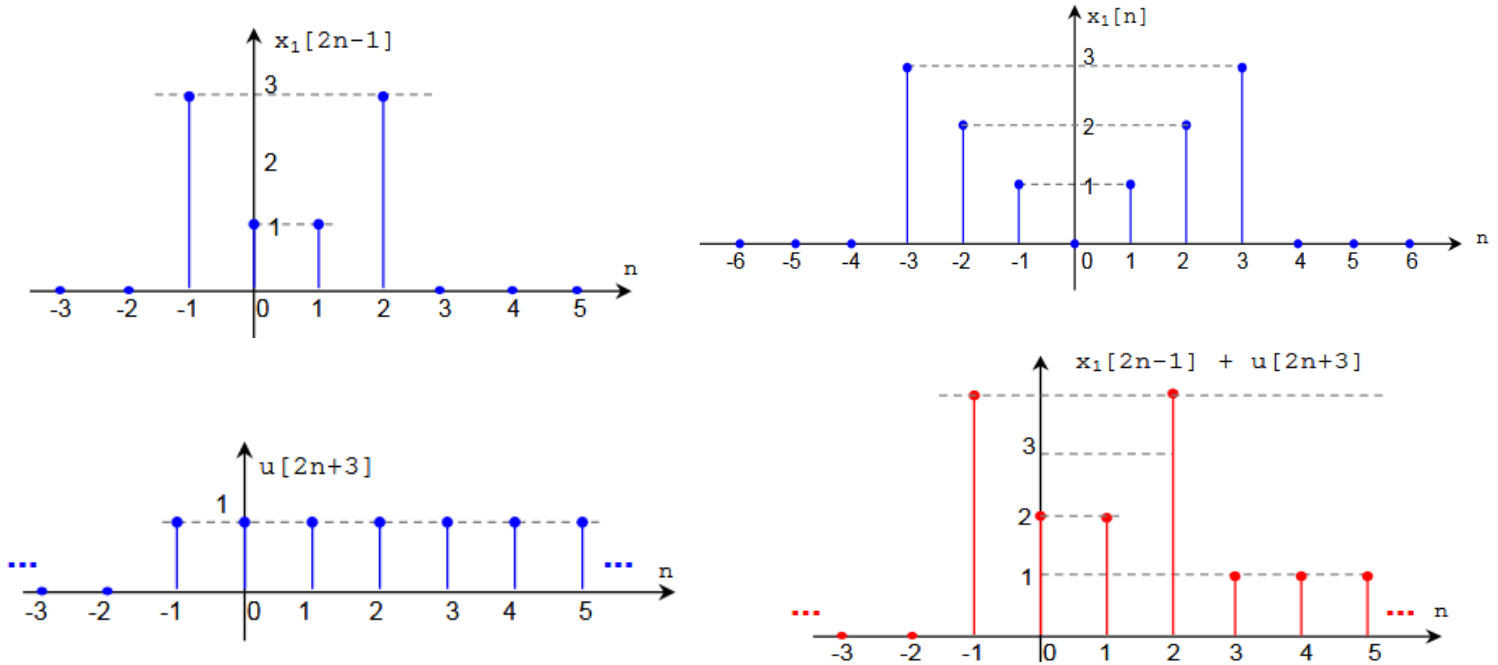
Islamic University of Gaza
Electrical Engineering Department
EELE 3310 Signals & Systems
Mid-Term Exam
November 7, 2019



Dr. Basil Hamed
Name:

Exam Time 1:00-2:00
ID #

1. a) The discrete-time signal $x_1[n]$ is shown in the figure. Sketch of the following signal. (4 PT)
 $x_1[2n-1] + u[2n+3]$



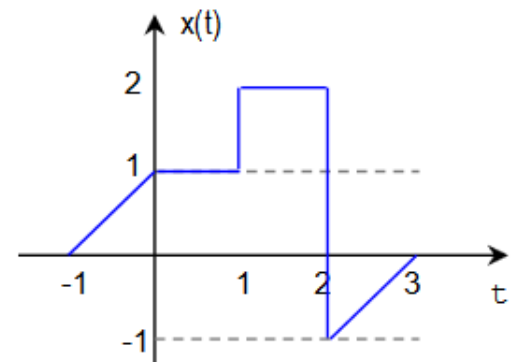
- b) Express the signal in the following figure in terms of elementary signals (4 PT)

Solution

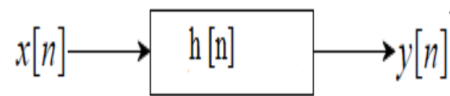
$$x(t) = r(t+1) - r(t) + u(t-1) - 3u(t-2) + r(t-2) - r(t-3)$$

OR

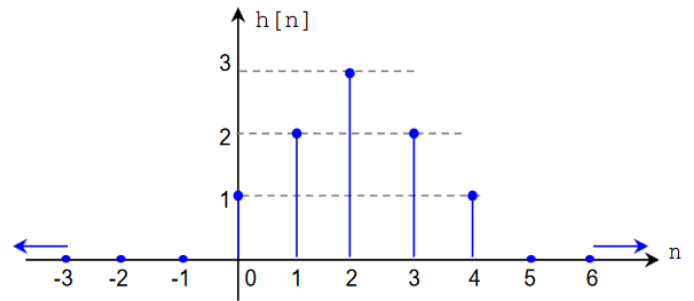
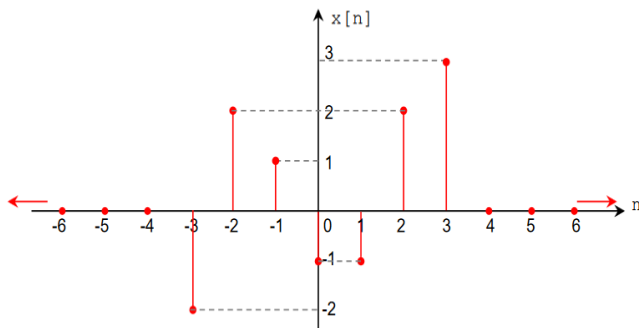
$$x(t) = (t+1)(u(t+1) - u(t)) + u(t) + u(t-1) - 3u(t-2) + (t-3)(u(t-2) - u(t-3))$$



2. Find $y[n]$ for given $x[n]$, and $h[n]$.



(8PT)

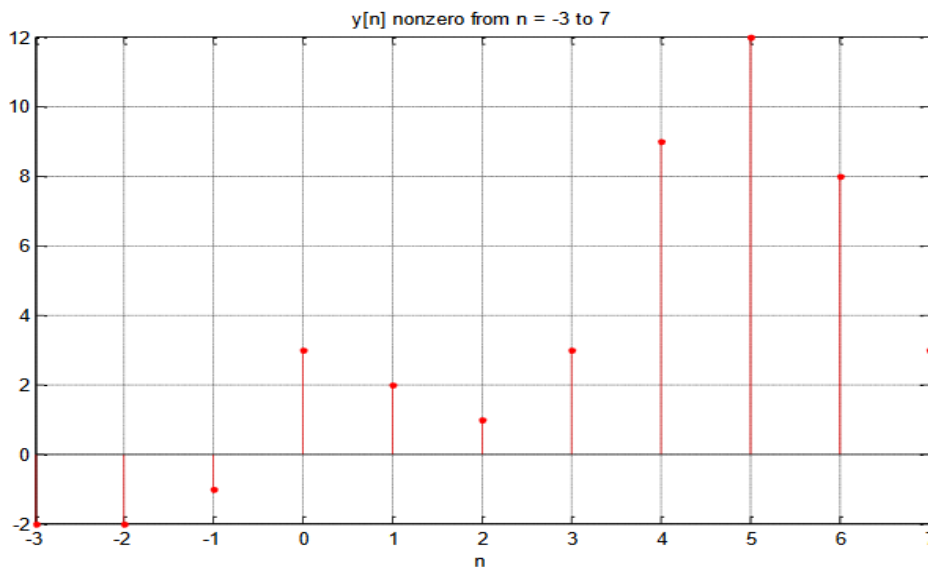


Solution

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

$$y[n] = x[n] * h[n] = x[n] + 2x[n-1] + 3x[n-2] + 2x[n-3] + x[n-4]$$

$$y[n] = \{-2, -2, -1, 3, 2, 1, 3, 9, 12, 8, 3\}$$



3. Consider the continuous -time system described by
 $y(t) = x(t/2)$

(5 PT)

- i. Is the system memoryless? Justify your answer
- ii. Is the system time stable? Justify your answer
- iii. Is the system causal? Justify your answer
- iv. Is the system linear? Justify your answer
- v. Is the system time invariant? Justify your answer

Solution

i. $y(t) = x(t/2)$ It is **NOT memoryless**: $y(2) = x(1)$, $y(3) = x(1.5)$

If $|x(t)| \leq M_x < \infty, \forall t \rightarrow$ it should be that $|y(t)| \leq M_y < \infty, \forall t$

ii. $|y(t)| = |x(t/2)| \leq |x(t)|$

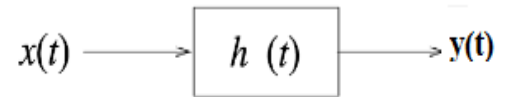
,the system is stable.

iii. It is **NOT causal**, because it depends on future values of the input $x(t)$: For example:
 $y(-1) = x(-0.5)$, $y(-4) = x(-2)$.

iv. If the input to the system is $ax_A(t) + bx_B(t)$, **then**: $y(t) = ax_A(t/2) + bx_B(t/2)$
 $ay_A(t) + by_B(t) = ax_A(t/2) + bx_B(t/2)$ We see that $y(t) = a y_A(t) + b y_B(t)$. Thus, the system is **linear**.

v. The response of the system to a shifted input $x(t-t_0)$ should be the same as if the output $y(t)$ has been shifted by t_0 , i.e., $y(t-t_0)$ Response of system to shifted input $x(t-t_0)$: $y_1(t) = x(t/2-t_0)$. Output $y(t)$ shifted by t_0 : $y(t-t_0) = x((t-t_0)/2)$. We see that $y(t-t_0) \neq y_1(t)$. Thus, the system is **NOT time invariant**.

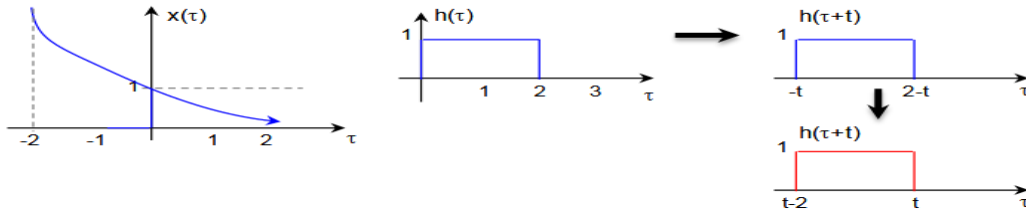
4. Determine $y(t)$ where $x(t)$ and $h(t)$ are given below. (9 PT)



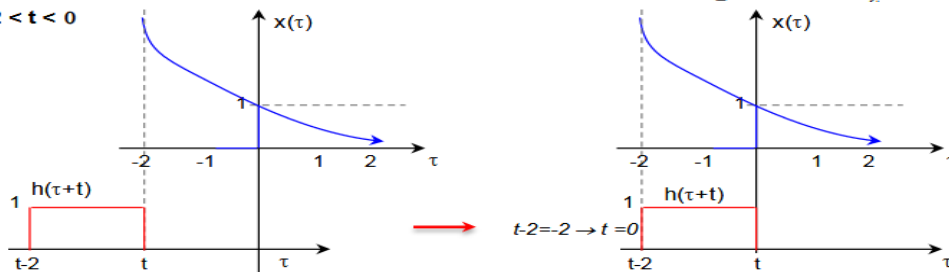
$$x(t) = e^{-2t} (u(t+2) - u(t-2))$$

$$h(t) = u(t) - u(t-2)$$

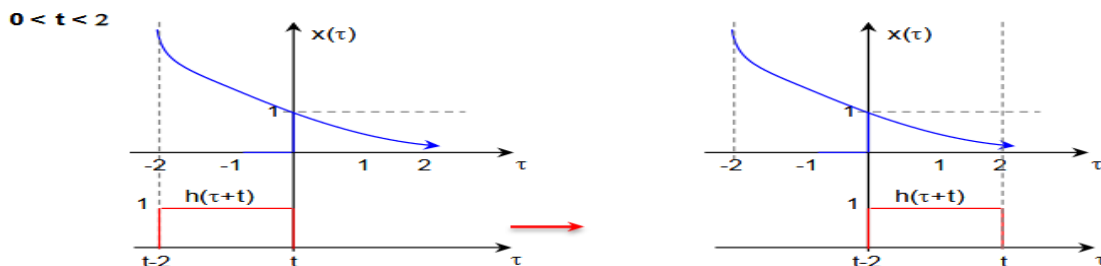
Solution



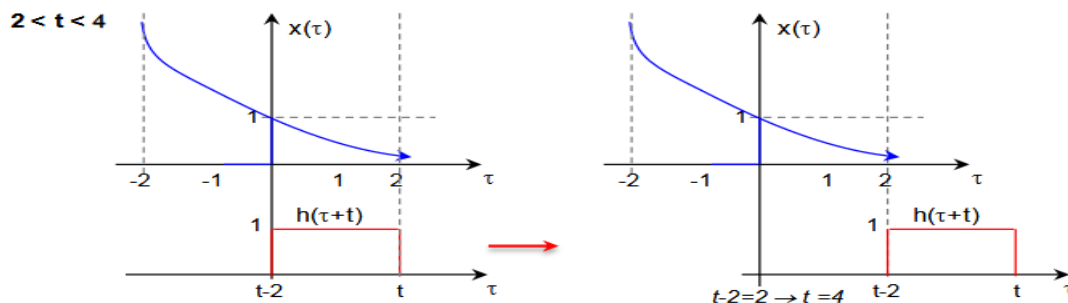
$$-2 < t < 0: w_t(\tau) = e^{-2\tau}, -2 < \tau < t, \rightarrow y(t) = \int_{-2}^t e^{-2\tau} d\tau = \frac{1}{2}(e^4 - e^{-2t}), -2 < t < 0$$



$$0 < t < 2: w_t(\tau) = e^{-2\tau}, t-2 < \tau < t, \rightarrow y(t) = \int_{t-2}^t e^{-2\tau} d\tau = \frac{1}{2}(e^{-2(t-2)} - e^{-2t}), 0 < t < 2$$



$$2 < t < 4: w_t(\tau) = e^{-2\tau}, t-2 < \tau < 2, \rightarrow y(t) = \int_{t-2}^2 e^{-2\tau} d\tau = \frac{1}{2}(e^{-2(t-2)} - e^{-4}), 2 < t < 4$$



$$t < -2 \text{ or } t > 4: w_t(\tau) = 0, \forall \tau, \rightarrow y(t) = 0, t < -2 \text{ or } t > 4$$