Signals and Systems – Spring 2024

Problem Set 3

Issued: Mar. 28, 2024 Due: Apr. 5, 2024

Reading Assignment：

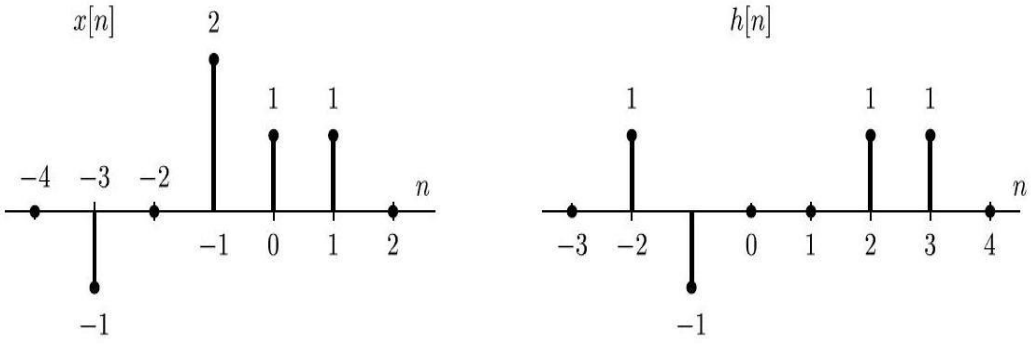
Chap. 2

Chap. 9.4, 10.4, 3.8-3.11, 6.0-6.2, 6.5

Problem 1

Compute the convolution $y[n] = x[n] * h[n]$ of each of the two following pairs of signals:

(a). $x[n]$ and $h[n]$ are depicted below



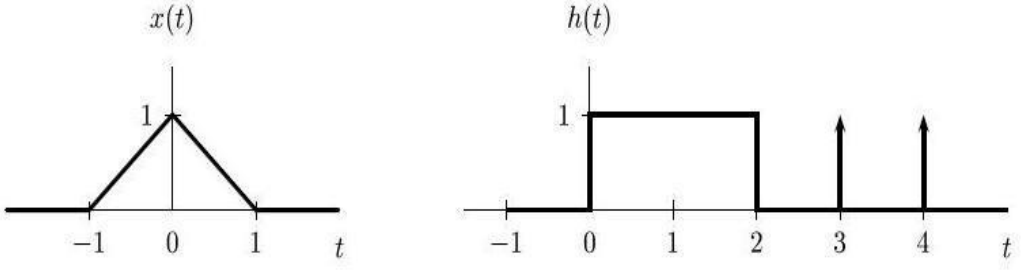
(b). $x[n] = u[n+4] - u[n-1]$, $h[n] = 2^n u[2-n]$.

Problem 2

Compute the convolution $y(t) = x(t) * h(t)$ for each of the following pairs of signals:

(a). $x(t) = e^{-t}u(t+1)$, $h(t) = e^{2t}u(-t)$

(b). $x(t)$ and $h(t)$ are depicted below:



Problem 3

The following are impulse responses of either discrete-time or continuous-time LTI systems. Determine whether each system is causal and/or stable. Justify your answer:

(a). $h[n] = 2^n u[3-n]$

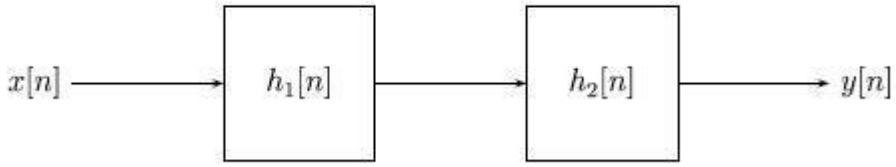
(b). $h(t) = u(1-t) - \frac{1}{2}e^{-t}u(t)$

(c). $h[n] = [1-(0.99)^n]u[n]$

(d). $h(t) = e^{15t}\,[u(t-1) - u(t-100)]$

Problem 4

Consider the cascade of LTI systems with unit sample responses $h_1[n]$ and $h_2[n]$ depicted below:

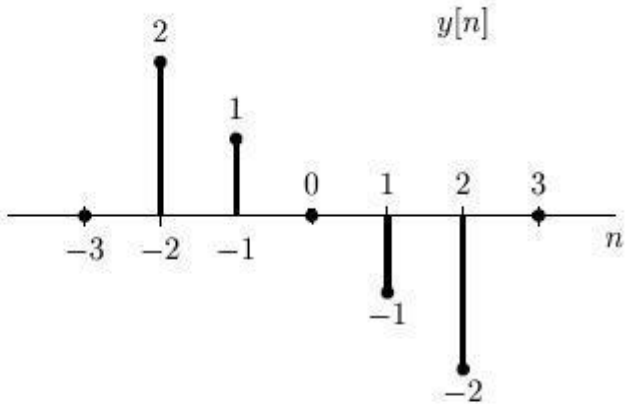


Suppose we are given the following information:

- $h_2[n] = \delta[n] - \delta[n-1]$
- If the input is

$$x[n] = u[n] - u[n-2]$$

then the output is as depicted below



Find $h_1[n]$.

Problem 5 OWN, Problem 6.1

Problem 6 OWN, Problem 6.3

Problem 7 OWN, Problem 6.12

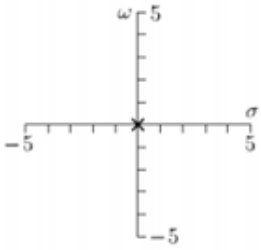
Problem 8 OWN, Problem 6.28(a)

Problem 9 OWN, Problem 6.30

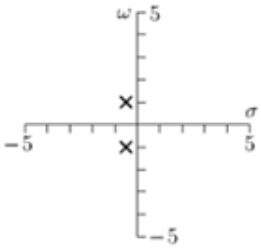
Problem 10

The following plots show pole-zero diagrams, impulse responses, Bode magnitude plots, and Bode angle plots for six causal CT LTI systems. Determine which corresponds to which.

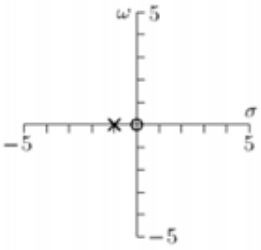
Pole-zero diagram 1



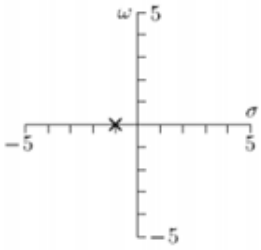
Pole-zero diagram 2



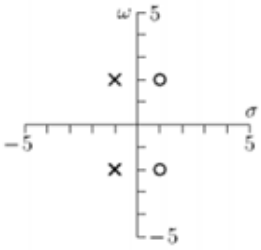
Pole-zero diagram 3



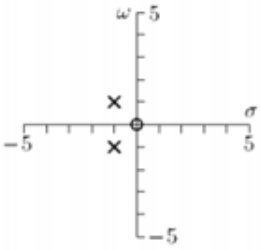
Pole-zero diagram 4



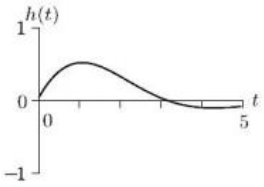
Pole-zero diagram 5



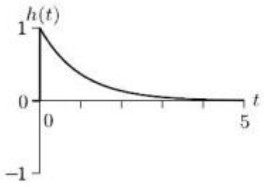
Pole-zero diagram 6



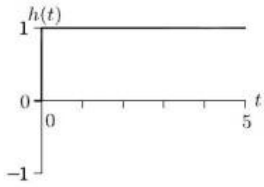
Impulse response 1



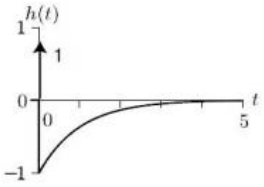
Impulse response 2



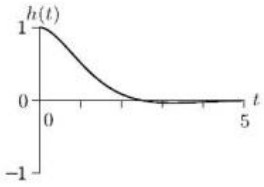
Impulse response 3



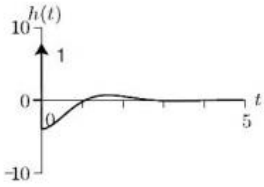
Impulse response 4



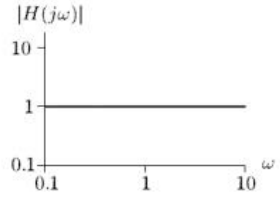
Impulse response 5



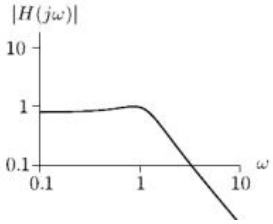
Impulse response 6



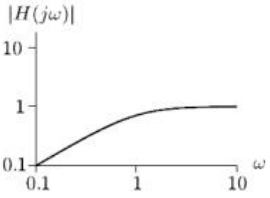
Bode Magnitude 1



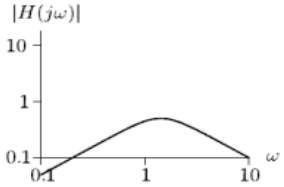
Bode Magnitude 2



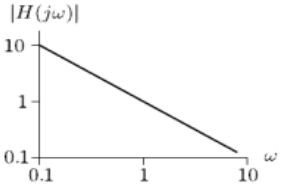
Bode Magnitude 3



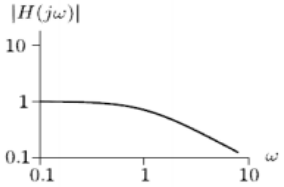
Bode Magnitude 4



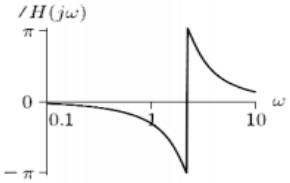
Bode Magnitude 5



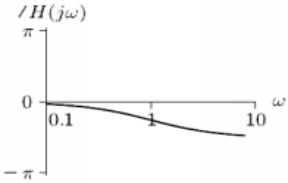
Bode Magnitude 6



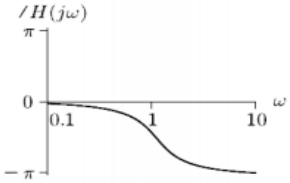
Bode Angle 1



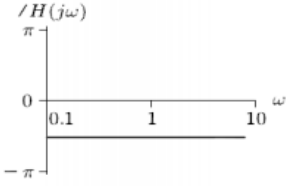
Bode Angle 2



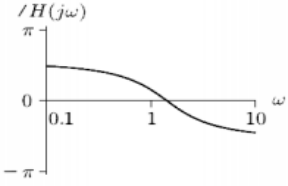
Bode Angle 3



Bode Angle 4



Bode Angle 5



Bode Angle 6