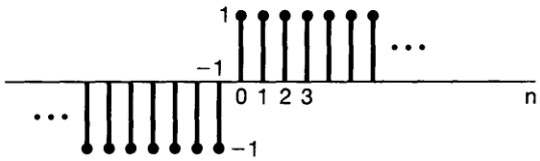
Homework 1

Digital Signal Processing
CE 352 / EE 453 (L1)

Fall 2021

Question 1
(20 points)

For the signal x[n]



Sketch and label the following signals:

a) $x[n]u[2-n]$
b) $x[n-3]\delta[n-3]$

Question 2
(20 points)

Consider the following system properties, introduced in Chapter 1 of the textbook:

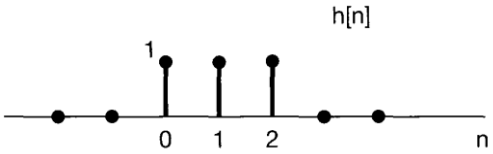
1) Memoryless
2) Causal
3) Linear
4) Time Invariant
5) Stable

Determine which of these properties hold and which do not hold for each of the following systems. Justify your answers

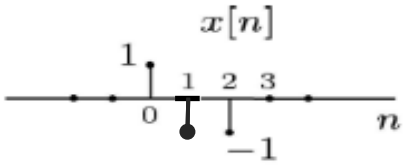
a) $y[n] = x[2-n]$
b) $y[n] = nx[-n]$

Question 3
(20 points)

Consider a discrete-time LTI system with the following impulse response:



Determine the output of this LTI system for the following input:



Question 4

(20 points)

Consider the following system properties

1) Causality
2) Stability

Determine which of these properties hold and which do not hold for each of the LTI systems whose impulse response is given below: (Justify your answers)

a) $h[n] = \delta[n] - \delta[n-1] + \delta[n+1]$
b) $h[n] = (0.2)^n u[n]$

Question 5

(20 points)

Consider the systems represented by the following Linear, Constant Coefficient Difference Equations (LCCDEs):

1) $y[n] + y[n-2] = x[n] + x[n-2] + x[n-3]$
2) $y[n] - 2x[n-2] = x[n-1] + 2x[n]$
3) $y[n] + 2y[n-2] = x[n] + 3x[n-2] + y[n-3]$

a) Identify which of these systems are FIR and IIR systems.
b) For IIR systems, draw the block diagrams for Direct Form I and Direct Form II realizations.
c) In part (b), make an attempt to minimize the number of adder blocks needed. (Hint: notice the coefficients of LCCDE).