Digital Signal Processing

Assignment 1

CLO 1 -> PLO 1

Student should score 40% in OBE specific questions to ensure their accumulated scores towards respective PLOs are above 40%

Question1:

a) The impulse response of h[n] of a linear time invariant signal is known to be zero, except in the interval $N0 <= n <= N1$. The input is known to be zero except in the interval $N2 <= n <= N3$. As a result .the output is constrained to be zero except in some interval $N4 <= n <= N5$.Determine N4 and N5 in terms of N0, N1, N2 and N3.

b) If x[n] is zero, except for N consecutive points and h[n] is zero for M consecutive points, what is the maximum number of consecutive points for which y[n] can be non-zero?

Question 2:

By direct evaluation of convolution sum, determine the step response of linear time invariant system whose impulse response is

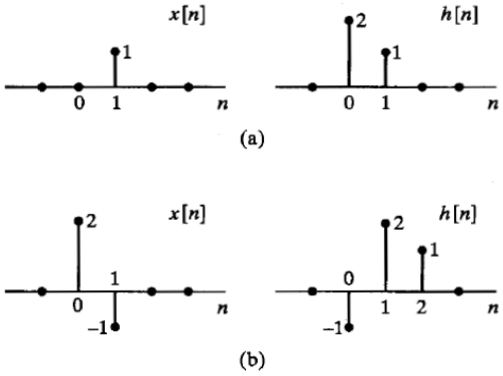
$$h[n] = a^{-n}u[-n], \qquad 0 < a < 1.$$

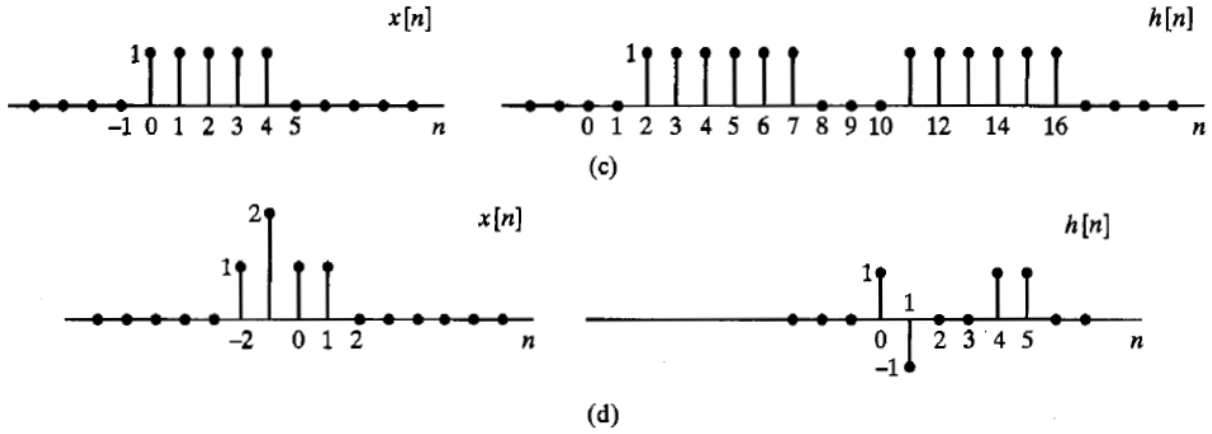
Question 3:

Consider an arbitrary system with input x[n] and output y[n].Show that if x[n] is zero for all n than y[n] must also be zero for all n.

Question 4:

For each of the pair of sequences in Figure 1, use discrete convolution to find response to the input x[n] of a linear time invariant system with impulse response h[n].





Question 5:

Using the Definition of linearity (Eq(2.26a)-(2.26b)), Show that the ideal delay system (Example 2.3) and the ideal moving averaging system (Example 2.4) are both linear.

Question 6:

The impulse response of a linear-time invariant system is shown in Figure 2. Determine and clearly sketch the response of this system to the input $x[n] = u[n-4]$.

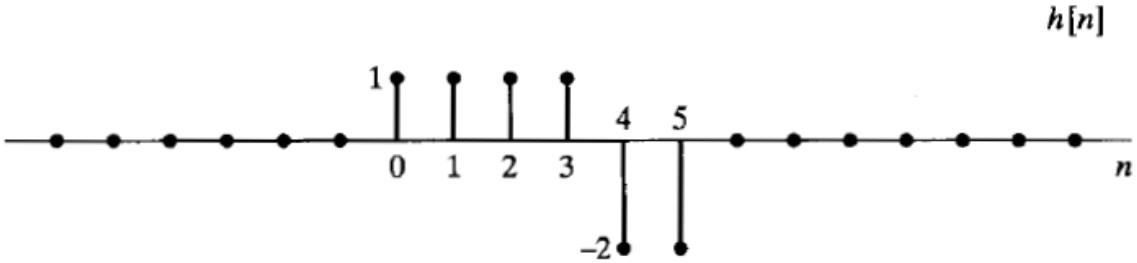


Figure 2

Question 7:

A linear time invariant system has impulse response $h[n] = u[n]$. Determine the response of this system to the input x[n] shown in figure 2 and described as

$$x[n] = \begin{cases} 0, & n < 0, \\ a^n, & 0 \le n \le N_1, \\ 0, & N_1 < n < N_2, \\ a^{n-N_2}, & N_2 \le n \le N_2 + N_1, \\ 0, & N_2 + N_1 < n, \end{cases}$$

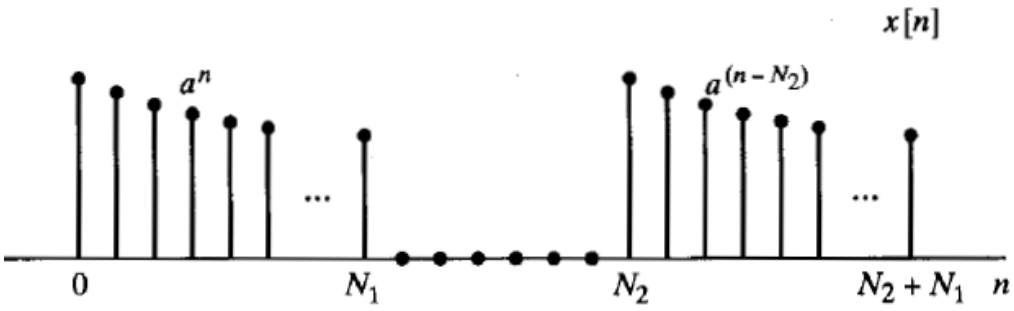


Figure 3

Question 8:

A discrete time signal x[n] is shown in figure 4

Figure 4

Sketch and label carefully each of the following signals:

I. X[n-2]
II. X[4-n]
III. X[2n]
IV. X[n]u[2-n]
V. X[n-1]δ[n-3]

Question 9:

The system T in figure 5 is known to be time invariant. When the inputs to the system are x1[n], x2[n] and x3[n], the responses of the systems are y1[n], y2[n] and y3[n] as shown

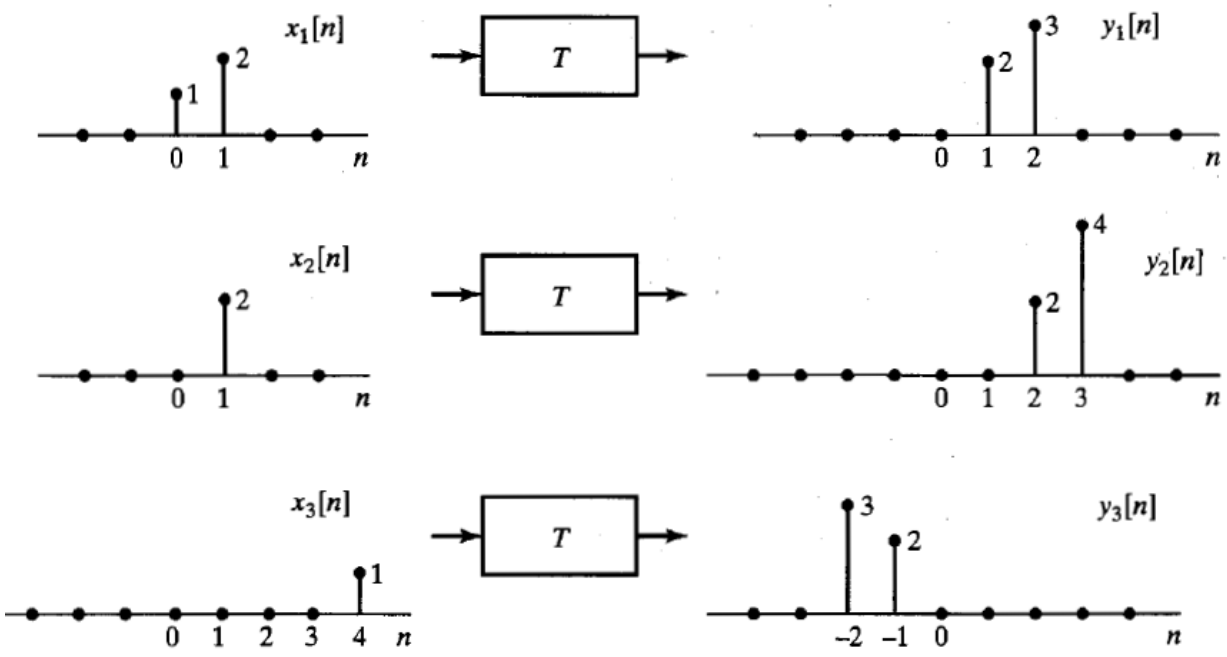
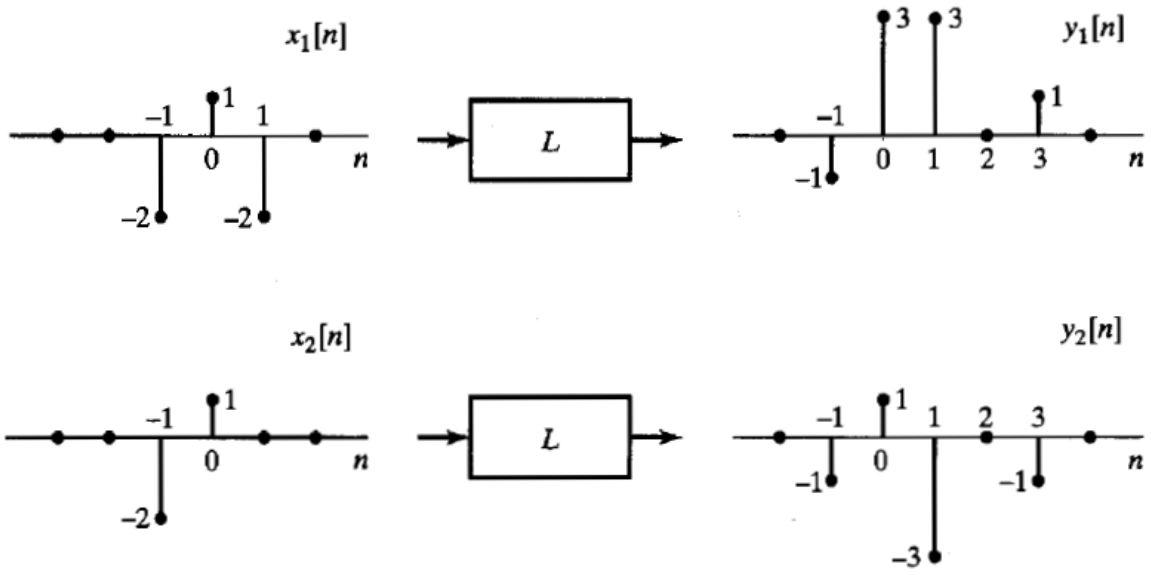


Figure 5

(a) Determine whether the system T could be linear.
(b) If the input x[n] to the system T is δ[n], what is the system response y[n]?
(c) What are all possible inputs x[n] for which the response of the system T can be determined from the given information alone?

Question 10:

The System L in figure 6 is known to be linear. Shown are three output signals y1[n],y2[n] and y3[n] in response to the input signal x1[n],x2[n] and x3[n], respectively.



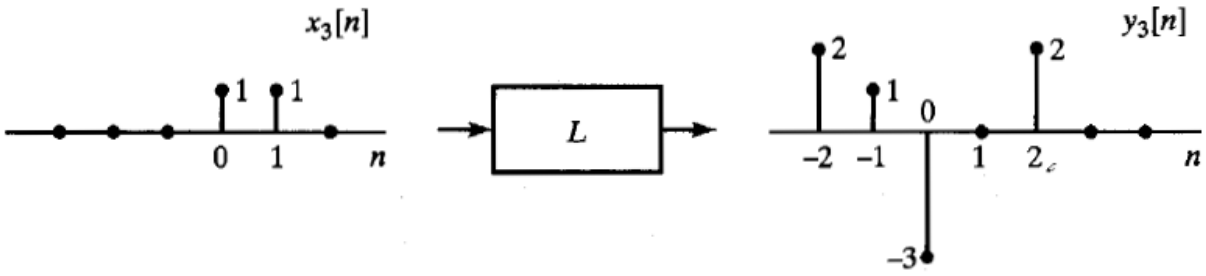


Figure 6

(a) Determine whether the system L could be time invariant.

(b) If the input x[n] to the system T is δ[n], what is the system response y[n]?