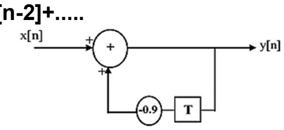
Assignment 01
Digital Signal Processing

Instructions:
Solve following questions. Mention all steps clearly.
Draw graphs and diagrams where necessary.

Question 01 (CLO-02)

Find the first four sample values of the impulse response, **h[n]** for each the following digital processors:

a) The system illustrated in figure below:
b) The system **y[n]=x[n]+x[n-1]+x[n-2]+.....**



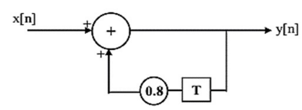
Solution:

a) y[n]=-0.9y[n-1]+x[n]
The impulse response is
h[n]=-0.9h[n-1]+delta(n)
The system is clearly causal, so that
h[n]=0 for n greater 0, hence
h[0]=-0.9h[-1]+delta(0)=0+1=1
h[1]=-0.9h[0]+delta(1)= -0.9*1+0= -0.9
h[2]=-0.9h[1]=0.81
h[3]=-0.9h[2]= -0.729

b) h[n]=delta(n)+delta(n-1)+delta(n-2)+......
h[0]=delta(0)+delta(-1)+delta(-2)+.....=1
h[1]=delta(1)+delta(0)+delta(-1)+.....=1
h[2]=delta(2)+delta(1)+delta(0)+.....=1
h[3]=delta(3)+delta(2)+delta(1)+.....=1

Question 02 (CLO-02)

Find and sketch the first few sample values of the impulse and step responses of the system given in figure below:

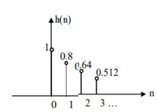


Solution:

1) For impulse response

$h(n) = 0.8h(n-1) + \delta(n)$

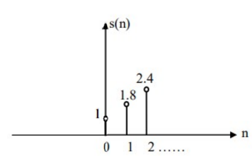
$h(0) = 1, h(1) = 0.8, h(2) = 0.64, h(3) = 0.512$ *and so on..*



2) For step response

$$s(n) = \sum_{m=-\infty}^{n} h(m)$$

s(0)=h(0)=1
s(1)=h(0)+h(1)=1+0.8=1.8
s(2)=h(0)+h(1)+h(2)=1+0.8+0.64=2.44
s(3)=h(0)+h(1)+h(2)+h(3)=2.952
s(4)=s(3)+h(4)=3.3616 and so on..



Question 03 (CLO-02)

Find the circular convolution between
x[n]=1,2,3,4 n greater than equals to 0
h[n]=4,3,2,1 n greater than equals to 0

Solution:

Circular convolution is used for periodic sequences and is given by:

$$y[n] = \sum_{m=0}^{N-1} h(m) \times x(n-m) = \sum_{m=0}^{N-1} x(m).h(n-m)$$

$n = 4$

$y[n] = \Sigma_{m=0}^{3} h(n-m) \times x(m)$

$y[0] = \Sigma_{m}^{3} h(-m) \times x(m) = x(0)h(0) + x(1)h(-1) + x(2)h(-2) + x(3)h(-3)$

$= 1 * 4 + 2 * 1 + 3 * 2 + 4 * 3 = 24$

$y[1] = \Sigma_{m}^{3} h(1-m) \times x(m) = x(0)h(1) + x(1)h(0) + x(2)h(-1) + x(3)h(-2)$
$= 1 * 3 + 2 * 4 + 3 * 1 + 4 * 2 = 22$

$y[2] = \Sigma_{m}^{3} h(2-m) \times x(m) = x(0)h(2) + x(1)h(1) + x(2)h(0) + x(3)h(-1)$
$= 1 * 2 + 2 * 3 + 3 * 4 + 4 * 1 = 24$

$y[3] = \Sigma_{m}^{3} h(3-m) \times x(m) = x(0)h(3) + x(1)h(2) + x(2)h(1) + x(3)h(0)$
$= 1 * 1 + 2 * 2 + 3 * 3 + 4 * 4 = 30$