INSTITUTE OF ENGINEERING

ADVANCED COLLEGE OF ENGINEERING AND MANAGEMENT

Kupondole, Lalitpur

(AFFILIATED TO TRIBHUVAN UNIVERSITY)

Lab no:4

Subject: DSAP

Submitted By:

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Submitted To:

Department of Computer and Electronics Engineering

Lab:04

Title: LTI SYSTEM

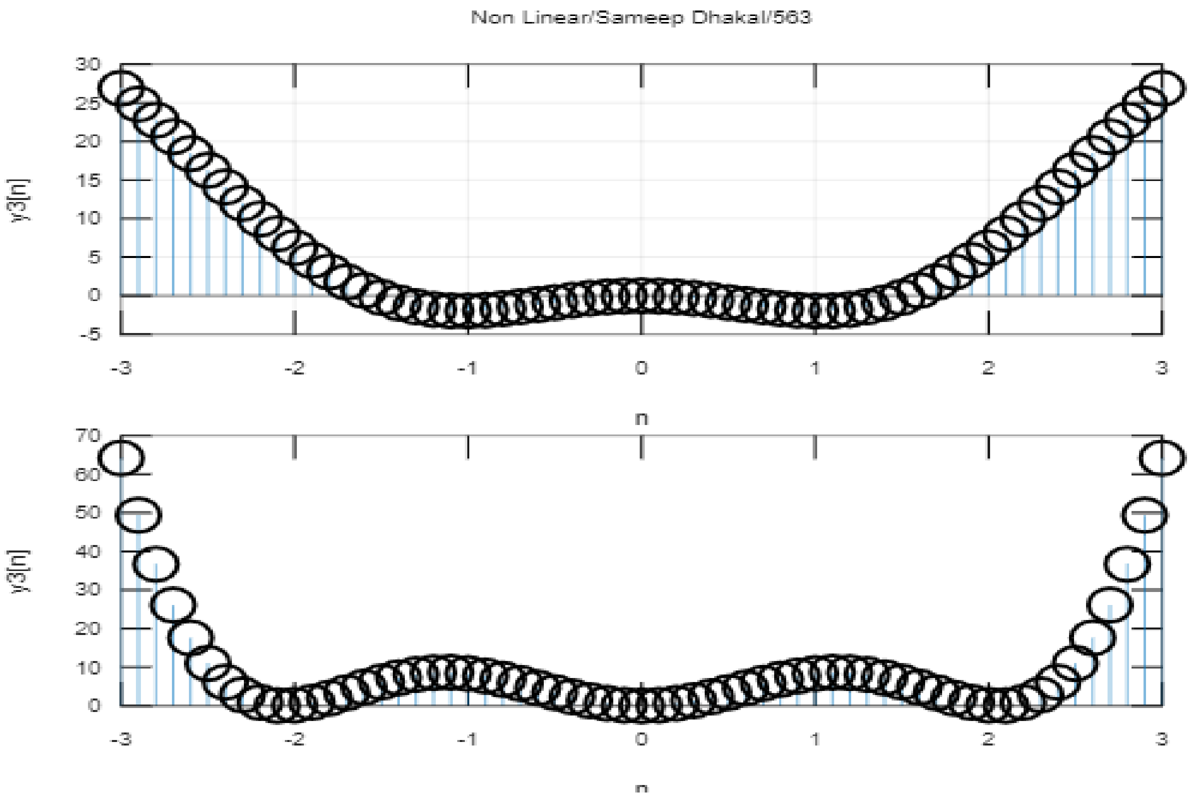
Objective: To learn about LTI system and its various signals

Introduction:

Linear time-invariant systems (LTI systems) are a class of systems used in signals and systems that are both linear and time-invariant. Time-invariant systems are systems where the output does not depend on when an input was applied. These properties make LTI systems easy to represent and understand graphically. A good example of an LTI system is any electrical circuit consisting of resistors, capacitors, inductors and linear amplifiers. Linear time-invariant system theory is also used in image processing, where the systems have spatial dimensions instead of, or in addition to, a temporal dimension.
Convolution is a mathematical operation which takes two functions and produces. a third function that represents the amount of overlap between one of the functions and a. reversed and translated version of the other function. Convolution is a mathematical operation which takes two functions and produces a third function that represents the amount of overlap between one of the functions and a reversed and translated version of the other function.

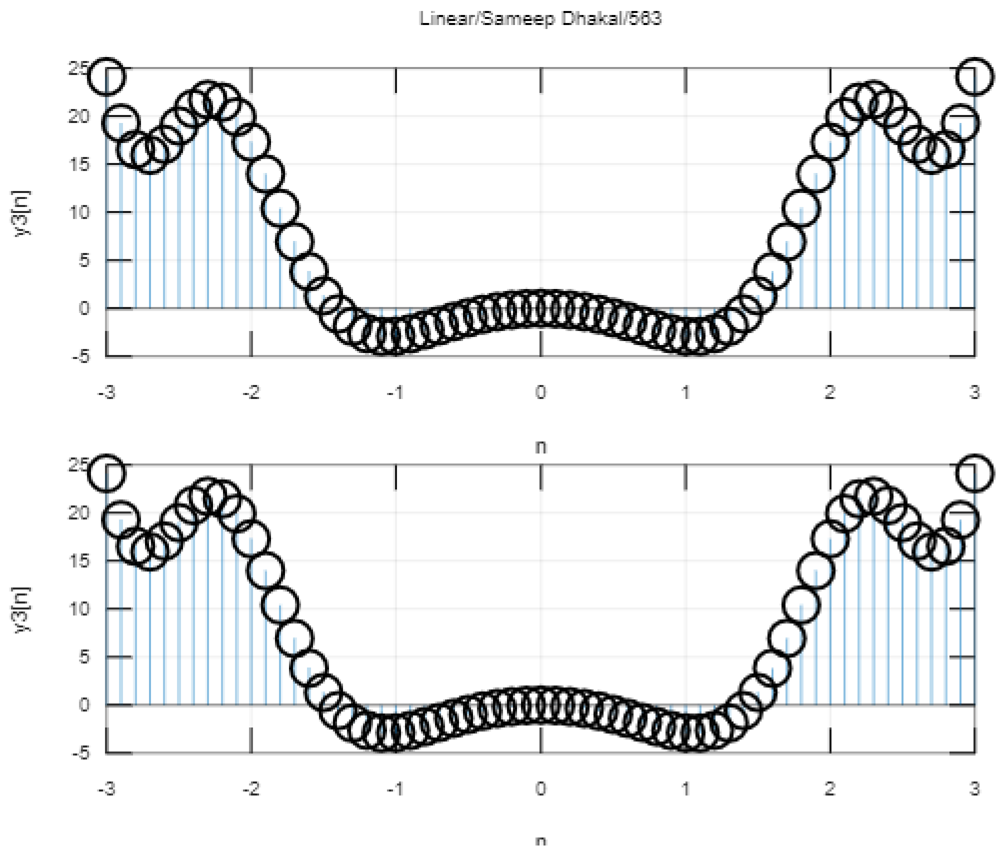
1.Determine whether the system is linear or not. Plot the required signals to verify the result.

```
clc;
clear all;
a1=3;
a2=-7;
n=-3:0.1:3;
x1=n;
x2=sin(n);
y1=x1.^2;
y2=x2.^2;
y3=a1*y1+a2*y2;
x3=a1*x1+a2*x2;
y4=x3.^2;
subplot(2,1,1);
stem(n,y3);
grid on;
title('Non Linear/Sameep Dhakal/563’);
xlabel('n');
ylabel('y3[n]');
subplot(2,1, 2);
stem(n,y4);
grid on;
xlabel('n');
ylabel('y3[n]');
grid on;
```


Non Linear/Sameep Dhakal/563
y3[n]
n
y3[n]
n
30
25
20
15
10
5
0
-5
70
60
50
40
30
20
10
0
-3
-2
-1
0
1
2
3

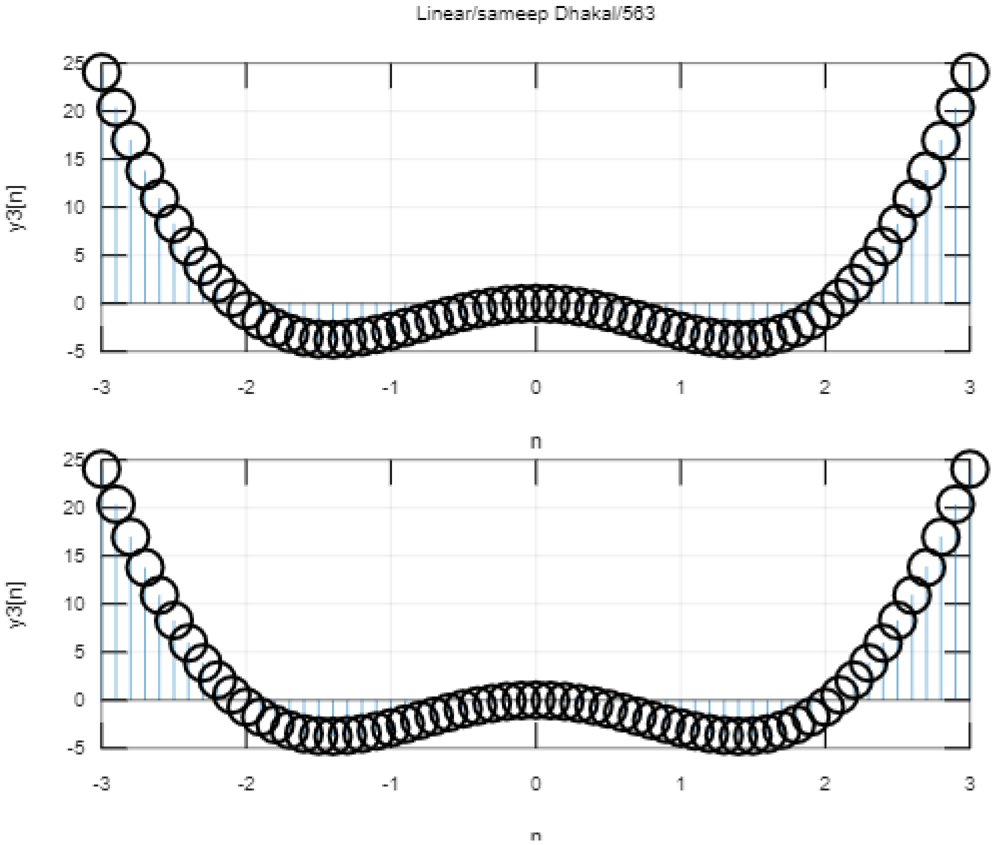
b. y[n]=x[n^2].

```
clc;
clear all;
a1=3;
a2=-7;
n=-3:0.1:3;
x1=n;
x2=sin(n);
y1=n.^2;
y2=sin(n.^2);
y3=a1*y1+a2*y2;
x3=a1*x1+a2*x2;
y4=a1.*n.^2+a2.*sin(n.^2);
subplot(2,1,1);
stem(n,y3);
grid on;
title('  Linear/Sameep Dhakal/563');
xlabel('n');
ylabel('y3[n]');
subplot(2,1, 2);
stem(n,y4);
grid on;
xlabel('n');
ylabel('y3[n]');
grid on;
```


Linear/Sameep Dhakal/563
y3[n]
n
y3[n]
n

c. y[n]=nx[n]

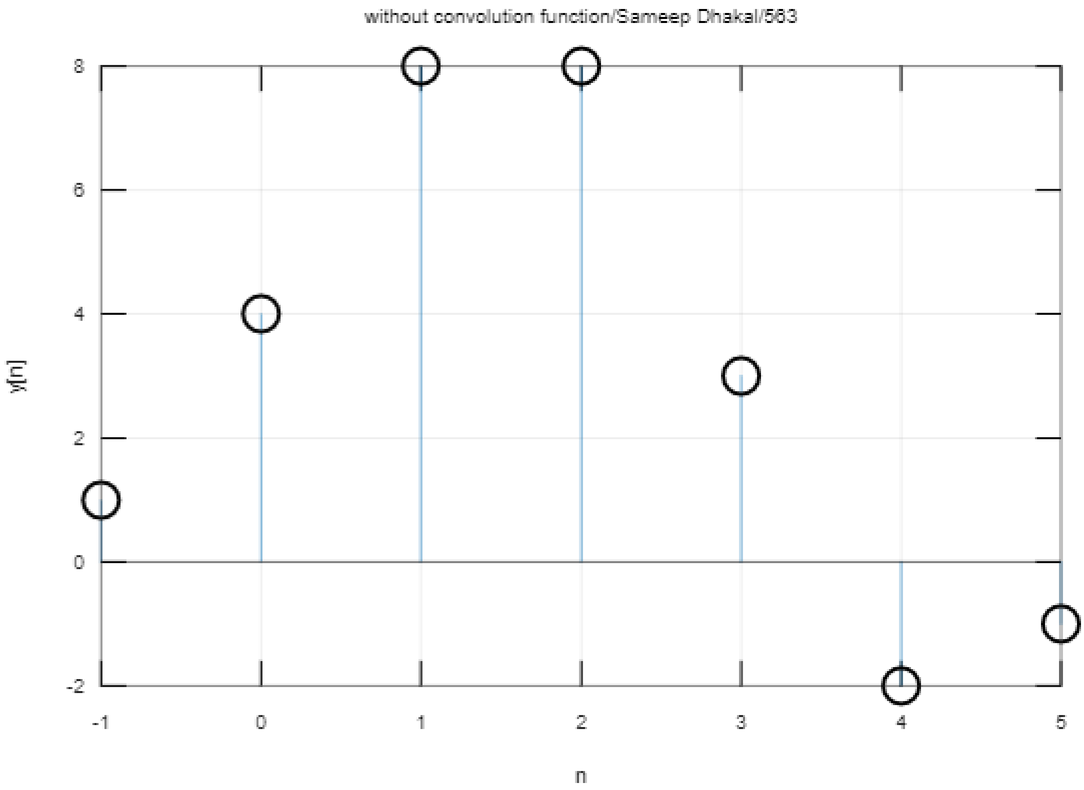
```
clc;
clear all;
a1=3;
a2=-7;
n=-3:0.1:3;
x1=n;
x2=sin(n);
y1=n.*x1;
y2=n.*sin(n);
y3=a1*y1+a2*y2;
x3=a1*x1+a2*x2;
y4=n.*x3;
subplot(2,1,1);
stem(n,y3);
grid on;
title('Linear/sameep Dhakal/563');
xlabel('n');
ylabel('y3[n]');
subplot(2,1, 2);
stem(n,y4);
grid on;
xlabel('n');
ylabel('y3[n]');
```


Linear/sameep Dhakal/563
y3[n]
n
y3[n]
n

2. Two discrete signals are given as h[n]={1,2,1,-1} and x[n]={1,2,3,1}. Plot these two signals :

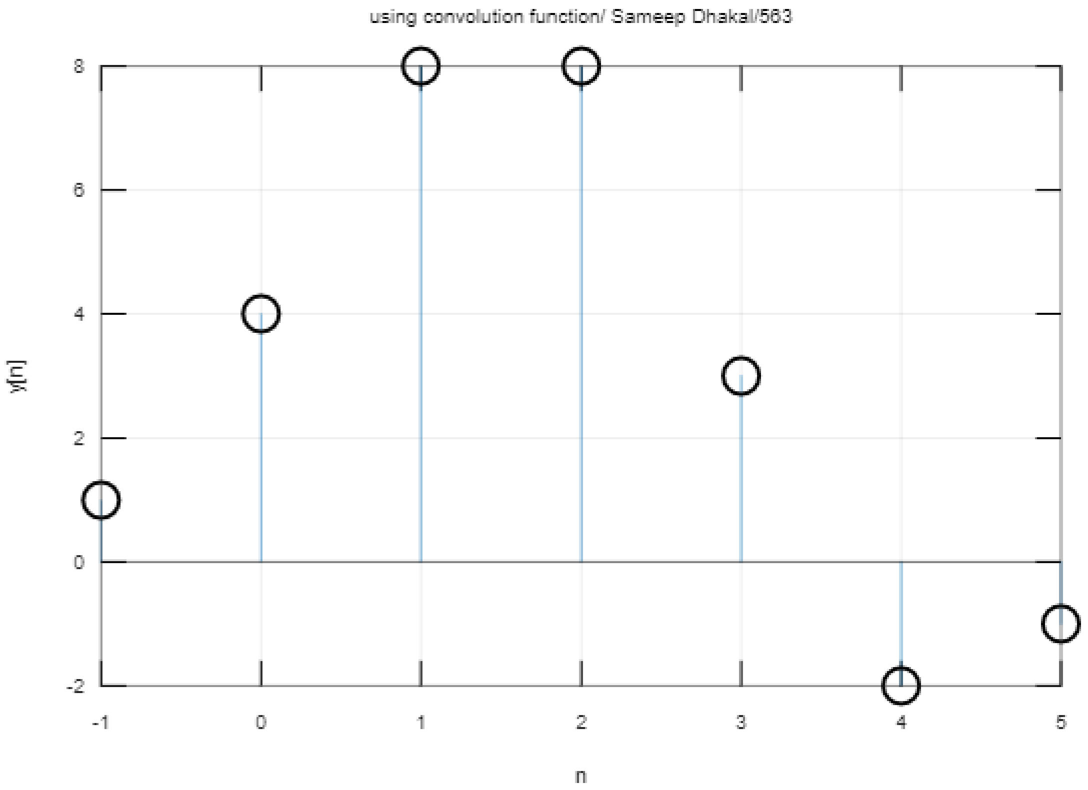
i) Without using conv function.

```
clc;
clear all;
h= [1 2 1 -1];
nh= [-1 0 1 2];
x= [1 2 3 1];
nx= [0 1 2 3];
X= [x, zeros(1,length(h))];
H= [h, zeros(1,length(x))];
n1= length(x);
n2= length(h);
for n=1:n1+n2-1
y(n)=0;
   for k= 1:n1
      if((n-k+1)>0)
      y(n)=y(n)+X(k)*H(n-k+1);
      end;
   end;
end;
n= min(nh)+min(nx):max(nh)+max(nx);
stem(n,y);
grid on;
title('without convolution function/Sameep Dhakal/563');
xlabel('n');
ylabel('y[n]')
grid on;
```



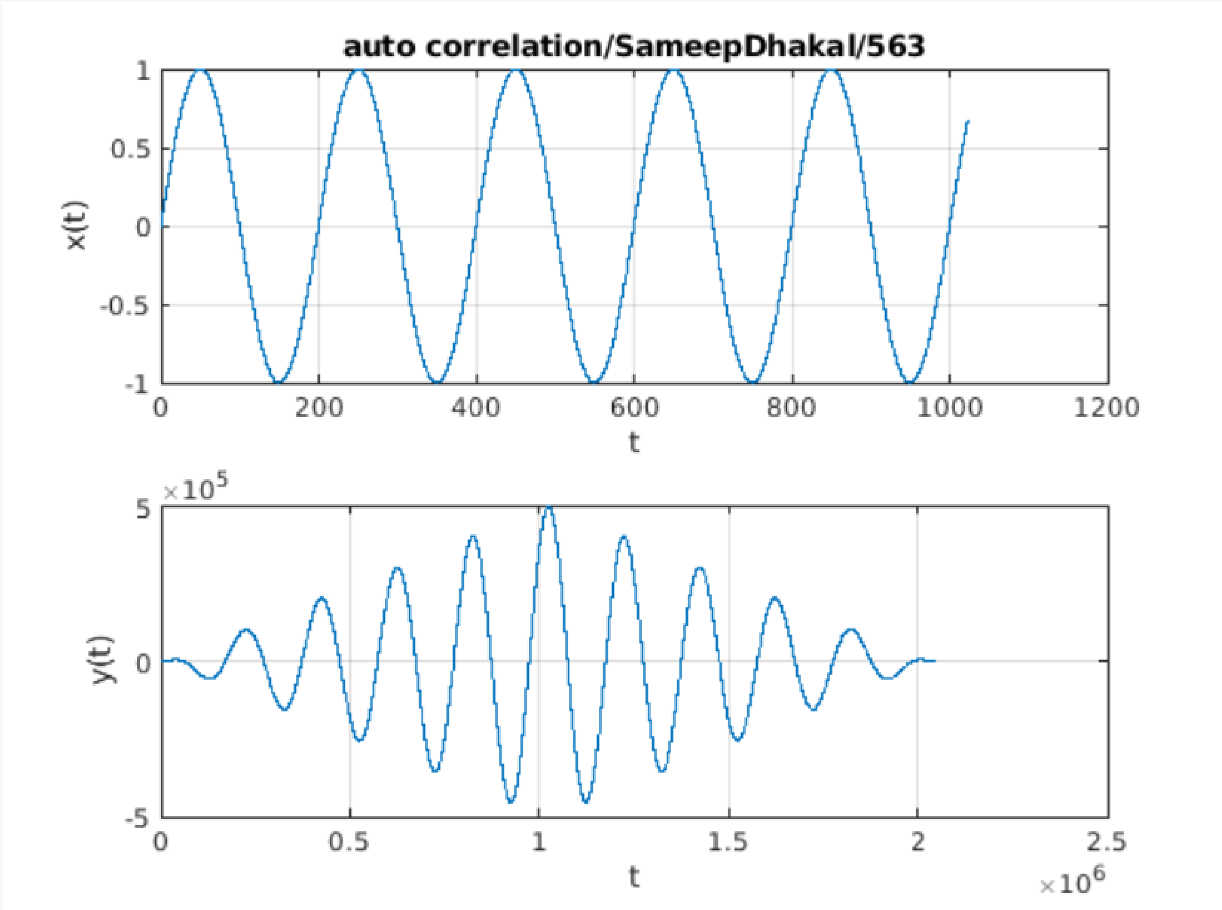
ii) Using conv function.

```
clc;
clear all;
h= [1 2 1 -1];
nh= [-1 0 1 2];
x= [1 2 3 1];
nx= [0 1 2 3];
y=conv(x,h);
n= min(nh)+min(nx):max(nh)+max(nx);
stem(n,y);
grid on;
title('using convolution function/ Sameep Dhakal/563');
xlabel('n');
ylabel('y[n]')
grid on;
```


using convolution function/ Sameep Dhakal/563
y[n]
n
8
6
4
2
0
-2
-1
0
1
2
3
4
5

3. Plot the autocorrelation sequence of a sine wave with a frequency of 1Hz, sampling frequency is 200 Hz.

```
clc;
clear;
A=1;
f=1;
fs=200;
w=2*pi*(f/fs);
t=0:0.001:1024;
x=A*sin(w*t);
subplot(2,1,1);
plot(t,x);
title('auto correlation/SameepDhakal/563');
xlabel('t');
ylabel('x(t)');
grid on;
y=xcorr(x);
subplot(2,1,2);
plot(y);
xlabel('t');
ylabel('y(t)');
grid on;
```



Discussion and Conclusion : In this lab we learnt about the applications of LTI system and convolution and plotted various signals.