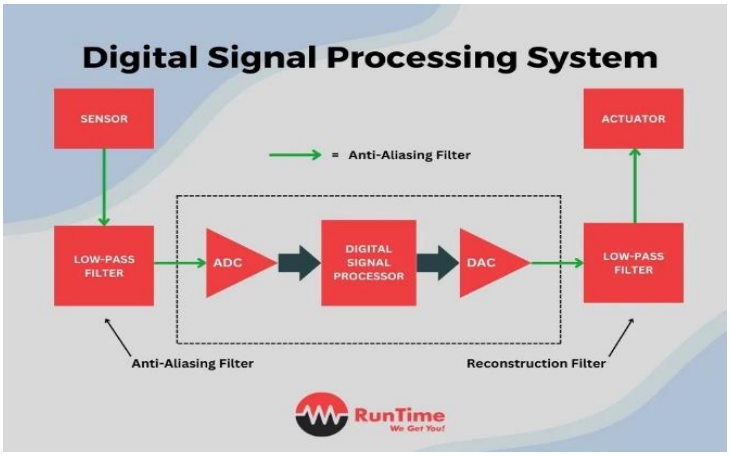
LAKSHMI NARAIN COLLEGE OF TECHNOLOGY EXCELLENCE

Digital Signal Processing [EC-601] Laboratory Manual



Submitted By:

Enrollment No:

Submitted To:

Department of Electronics & Communication Engineering

Lakshmi Narain College of Technology Excellence, Bhopal
Department of Electronics & Communication Engineering

VISION OF THE DEPARTMENT

To become reputed in providing technical education in the field of electronics and communication engineering and produce technocrats working as leaders.

MISSION OF THE DEPARTMENT

1. *To provide congenial academic environment and adopting innovative learning process.*
2. *To keep valuing human values and transparency while nurturing the young engineers.*
3. *To strengthen the department by collaborating with industry and research organization of repute.*
4. *To facilitate the students to work in interdisciplinary environment and enhance their skills for employability and entrepreneurship.*

Lakshmi Narain College of Technology Excellence, Bhopal

Department of Electronics & Communication Engineering

PROGRAM SPECIFIC OUTCOME (PSO)

PSO1: Analyze specific engineering problems relevant to Electronics & Communication Engineering by applying the knowledge of basic sciences, engineering mathematics and engineering fundamentals.

PSO2: Apply and transfer interdisciplinary systems and engineering approaches to the various areas, like Communications, Signal processing, VLSI and Embedded system, PCB Designing.

PSO3: Inculcate the knowledge of Engineering and Management principles to meet demands of industry and provide solutions to the current real time problems.

PSO4: Demonstrate the leadership qualities and strive for the betterment of organization, environment and society.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

PEO1: Recognize and apply appropriate experimental and scientific skills to solve real world problems to create innovative products and systems in the field of electronics and communication engineering.

PEO2: To evolve graduates with ability to apply, analyze, design in Electronics & Communication Systems.

PEO3: Motivate graduates to become responsible citizens with moral & ethical values for the welfare of Society.

PEO4: Inculcate the habit of team work with professional quality of leadership to become successful contributors in industry and/ or entrepreneurship in view of Global & National status of technology.

Lakshmi Narain College of Technology Excellence, Bhopal

Department of Electronics & Communication Engineering

General Lab Policies

- All labs must be attended and completed. In the event that you cannot attend a lab, prior approval must be obtained. In such case, it is required that you make up the lab at another time.

- Satisfactory completion of all the labs is required for passing the course. If you are unable to complete the lab in the assigned lab time, it is expected that you would complete the lab on your own.

- At the beginning of a lab session, the instructor will collect report for the previous week's lab. Any late lab report will have its grade reduced. If, for any valid reason, you are not able to meet the deadline, let the instructor know well in advance of start of the lab.

- You are responsible for keeping track of your e-mail. In case of difficulty with any specific lab or any other problem concerning the lab, please come and talk to the lab instructor or use e-mail.

Student Name

Signature _____

Instructor Name

Signature _____

Lakshmi Narain College of Technology Excellence, Bhopal

Department of Electronics & Communication Engineering

Course- Digital Signal Processing (EC-601)

Course Outcomes (CO's)

CO1- Analyze the process of converting analog signal to discrete form along with their circuits.

CO2- Analyze various Analogue to Digital conversion techniques along with various Line Coding methods.

CO3- Compare various digital transmission techniques on the base of Spectral properties.

CO4- Develop an expression for probability of error of different digital communication techniques.

CO5- Design communication systems with optimum capacity.

Lakshmi Narain College of Technology Excellence, Bhopal

Department of Electronics & Communication Engineering

DSP LAB INDEX

S.No.	List of Experiments	Date of Performing	Date of Submission	Remark
1	Write a program for Generation of Continuous and Discrete Unit Step Function signal.			
2	Write a program for Generation of Ramp and exponential signal in Continuous and Discrete domain.			
3	Write a program for addition and subtraction of two given signal (discrete and continuous domain)			
4	Write a program to generate the sample, unit step, ramp and exponential signal**.**			
5	Write a program to generate signal shifting, folding, addition and multiplication.			
6	To study Power density spectrum Density			
7	Implementation of Decimation-in-time radix-2 FFTalgorithm FFT of a sequence using DIT-FFT method			
8	Implementation of Circular convolution and Linear convolution using DFT in Scilab			
9	Implementation of IIR digital filter using Butterworth method and bilinear transformation method.			
10	To develop program for computing DFT			

Lakshmi Narain College of Technology Excellence, Bhopal

Department of Electronics & Communication Engineering

Date of Experiment: _____

EXPERIMENT NO.:- 1

Aim:- Write a program for Generation of Continuous and Discrete Unit Step Function Signal.

TOOL:- SCILAB /MATLAB

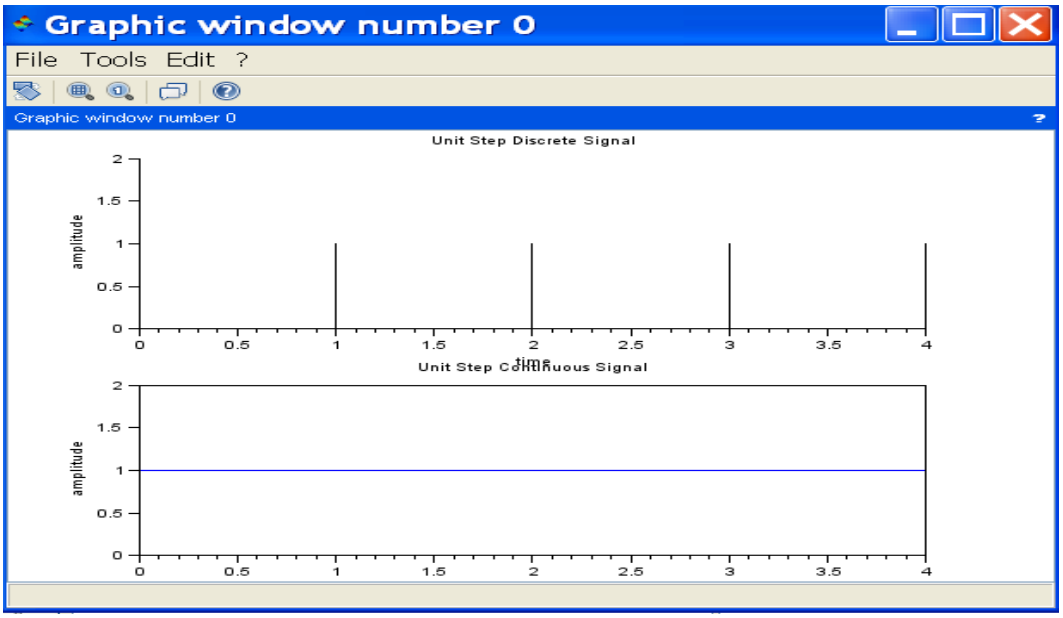
Program:-

```
t=0:4;
y=ones(1,5);
subplot(2,1,1);
plot2d3 (t,y);
xlabel('time');
ylabel('amplitude');
title('Unit Step Discrete Signal');
subplot(2,1,2);
plot(t,y);
xlabel('time');
ylabel('amplitude');
title('Unit Step Continuous Signal');
```

Output:

Lakshmi Narain College of Technology Excellence, Bhopal

Department of Electronics & Communication Engineering



Date of Experiment: _____

EXPERIMENT NO.:- 2

Aim:- Write a program for Generation of Ramp and exponential signal in Continuous and Discrete domain.

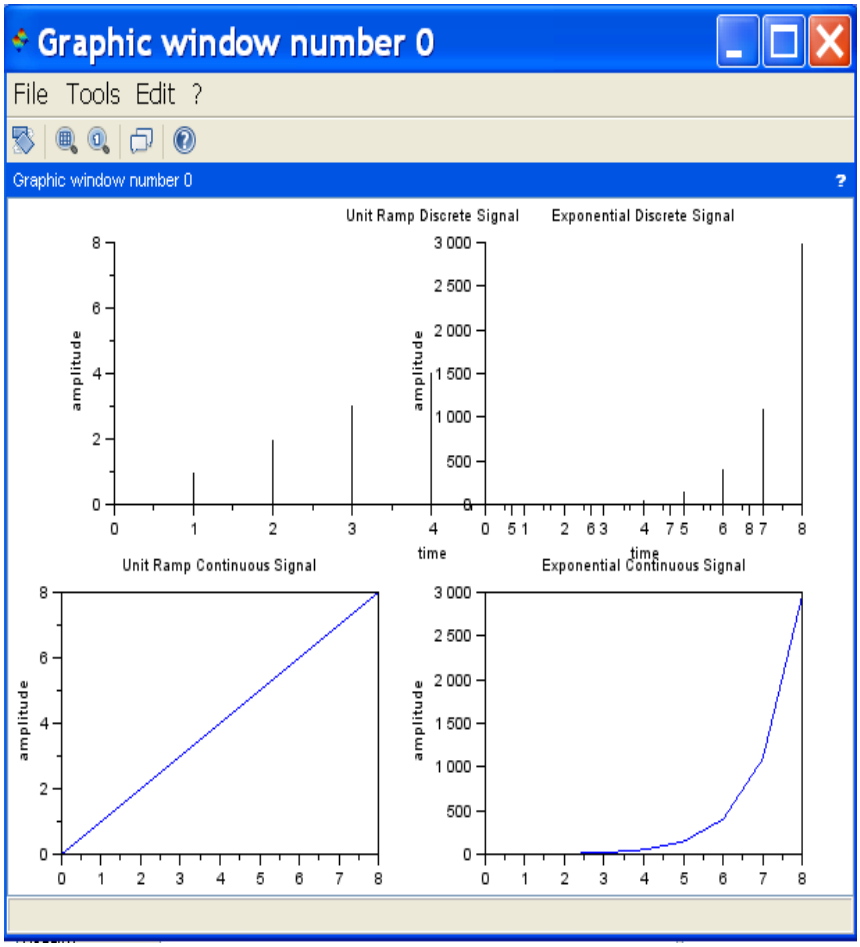
TOOL:- SCILAB /MATLAB

Program:-

```
n1=0:8;
y1=n1;
y2=exp(n1);
subplot(2,1,1);
plot2d3 (n1,y1);
xlabel('time');
ylabel('amplitude');
title('Unit Ramp Discrete Signal');
subplot(2,2,2);
plot2d3 (n1,y2);
xlabel('time');
ylabel('amplitude');
title('Exponential Discrete Signal');
subplot(2,2,3);
plot(n1,y1);
xlabel('time');
ylabel('amplitude');
title('Unit Ramp Continuous Signal');
```

```
subplot(2,2,4);
plot(n1,y2);
xlabel('time');
ylabel('amplitude');
title ('Exponential Continuous Signal');
```

Output:



Lakshmi Narain College of Technology Excellence, Bhopal

Department of Electronics & Communication Engineering

Date of Experiment: _____

EXPERIMENT NO.:- 3

Aim: - Write a program for addition and subtraction of two given signal (discrete and continuous domain)

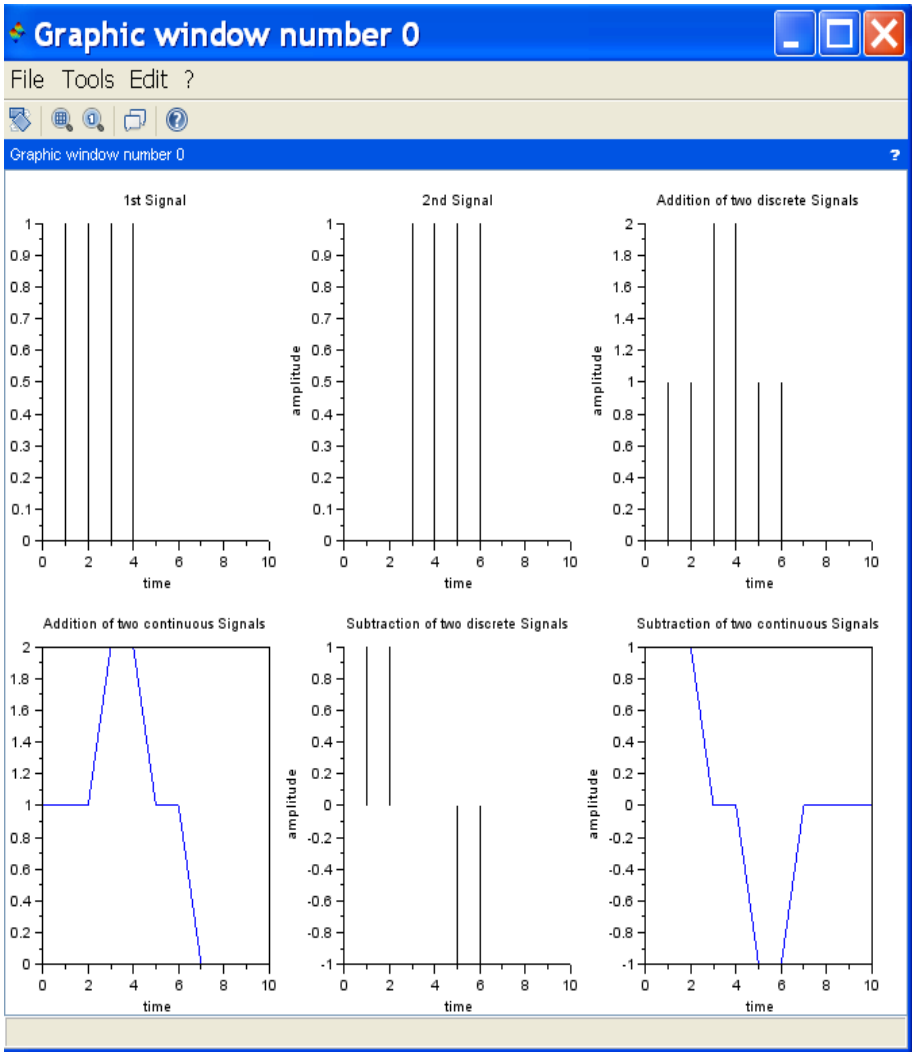
TOOL: - SCILAB /MATLAB

Program:-

```
clc
n1=0:10;
y1=[ones(1,5),zeros(1,6)];
y2=[zeros(1,3),ones(1,4),zeros(1,4)];
y3=y1+y2;
y4=y1-y2;
subplot(2,3,1);
plot2d3 (n1,y1);
xlabel('time');
ylabel('amplitude');
title('1st Signal');
subplot(2,3,2);
plot2d3 (n1,y2);
xlabel('time');
ylabel('amplitude');
title('2nd Signal');
```

```
subplot(2,3,3);
plot2d3(n1,y3);
xlabel('time');
ylabel('amplitude');
title('Addition of two discrete Signals');
subplot(2,3,4);
plot(n1,y3);
xlabel('time');
ylabel('amplitude');
title('Addition of two continuous Signals');
subplot(2,3,5);
plot2d3(n1,y4);
xlabel('time');
ylabel('amplitude');
title('Subtraction of two discrete Signals');
subplot(2,3,6);
plot(n1,y4);
xlabel('time');
ylabel('amplitude');
title('Subtraction of two continuous Signals');
```

Output:


Graphic window number 0
File Tools Edit ?
Graphic window number 0
1st Signal
2nd Signal
Addition of two discrete Signals
Addition of two continuous Signals
Subtraction of two discrete Signals
Subtraction of two continuous Signals
amplitude
time

Date of Experiment: _____

EXPERIMENT NO.:- 4

Aim: - Write a program to generate the sample, unit step, ramp and exponential signal.

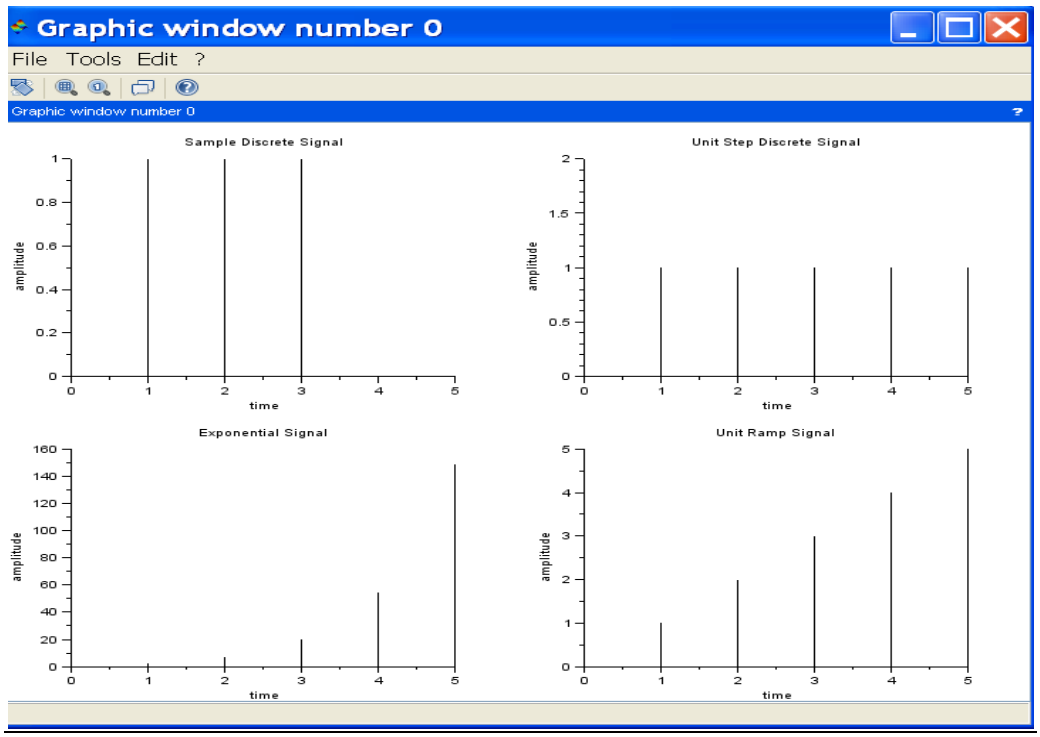
TOOL: - SCILAB 5.4

Program:-

```
clc
n1=0:5;
y1=[ones(1,4),zeros(1,2)];
y2=[ones(1,6)];
y3=exp(n1);
y4=n1;
subplot(2,2,1);
plot2d3 (n1,y1);
xlabel('time');
ylabel('amplitude');
title('Sample Discrete Signal');
subplot(2,2,2);
plot2d3 (n1,y2);
xlabel('time');
ylabel('amplitude');
title('Unit Step Discrete Signal');
subplot(2,2,3);
plot2d3(n1,y3);
```

```
xlabel('time');
ylabel('amplitude');
title('Exponential Signal');
subplot(2,2,4);
plot2d3(n1,y4);
xlabel('time');
ylabel('amplitude');
title('Unit Ramp Signal');
```

Output:



Date of Experiment: _____

EXPERIMENT NO.:-5

Aim:- Write a program to generate signal shifting, folding, addition and multiplication.

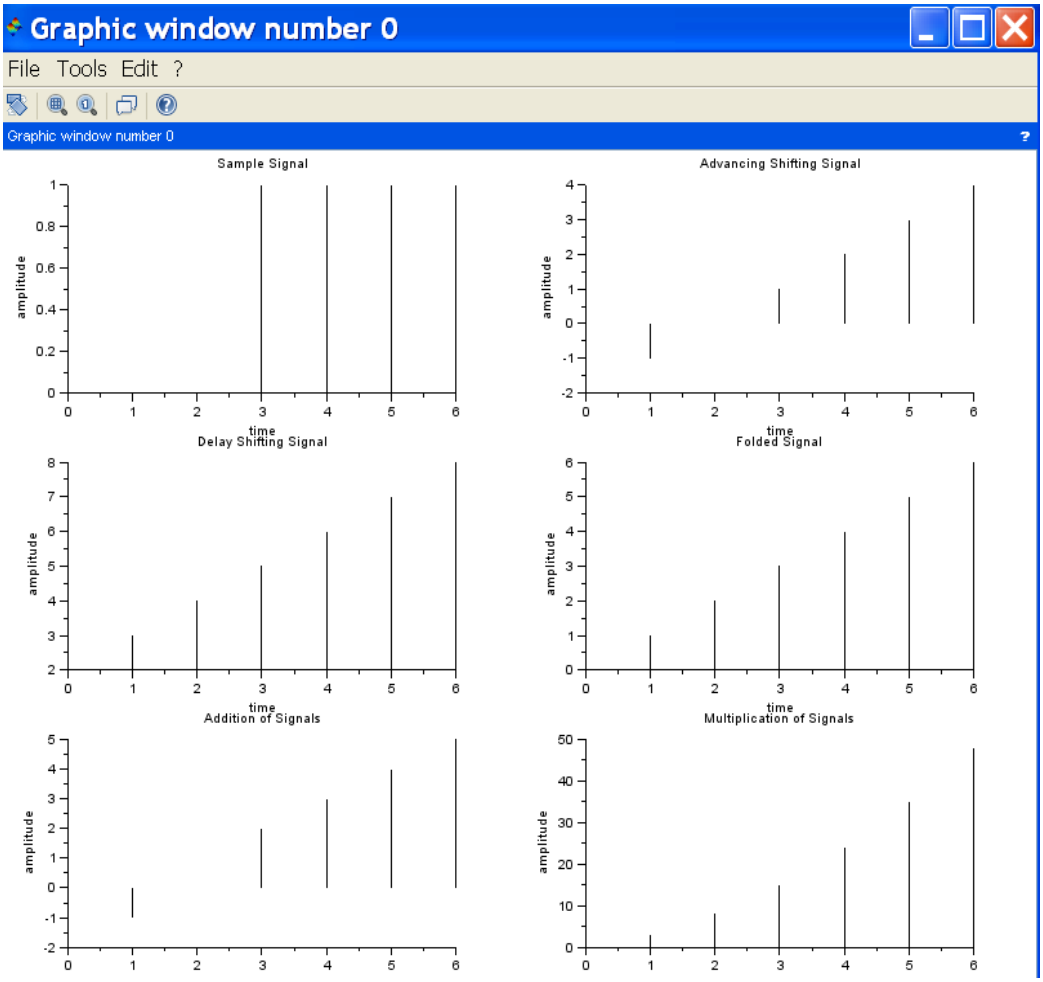
TOOL:- SCILAB 5.4

Program:-

```
clc
n1=0:6;
y1=[zeros(1,3),ones(1,4)];
y2=n1-2;
y3=n1+2;
y4=n1;
y5=y1+y2;
y6=y3.*y4;
subplot(3,2,1);
plot2d3 (n1,y1);
xlabel('time');
ylabel('amplitude');
title('Sample Signal');
subplot(3,2,2);
plot2d3 (n1,y2);
xlabel('time');
ylabel('amplitude');
```

```
title('Advancing Shifting Signal');
subplot(3,2,3);
plot2d3(n1,y3);
xlabel('time');
ylabel('amplitude');
title('Delay Shifting Signal');
subplot(3,2,4);
plot2d3(n1,y4);
xlabel('time');
ylabel('amplitude');
title('Folded Signal');
subplot(3,2,5);
plot2d3(n1,y5);
xlabel('time');
ylabel('amplitude');
title('Addition of Signals');
subplot(3,2,6);
plot2d3(n1,y6);
xlabel('time');
ylabel('amplitude');
title('Multiplication of Signals');
```

Output:


Graphic window number 0
File Tools Edit ?
Graphic window number 0
Sample Signal
Advancing Shifting Signal
Delay Shifting Signal
Folded Signal
Addition of Signals
Multiplication of Signals
amplitude
time

Date of Experiment: _____

EXPERIMENT NO.:-6

AIM: - To study Power density spectrum Density.

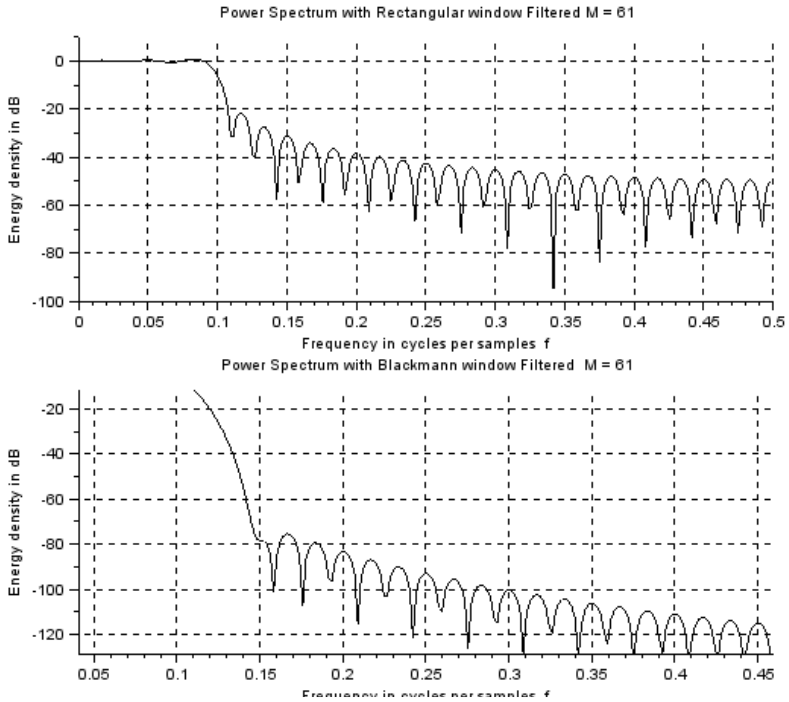
Tool: SCILAB 5.4

Program:

```
//Caption:Determination of spectrum of a signal
//With maximum normalized frequency f = 0.1
//using Rectangular window and Blackmann window
clear all;
close;
clc;
N = 61;
cfreq = [0.1 0];
[wft,wfm,fr]=wfir('lp',N,cfreq,'re',0);
disp(wft,'Time domain filter coefficients hd(n)=');
disp(wfm,'Frequency domain filter values Hd(w)=');
WFM_dB = 20*log10(wfm);//Frequency response in dB
for n = 1:N
h_balckmann(n)=0.42-0.5*cos(2*%pi*n/(N-1))+0.08*cos(4*%pi*n/(N-1));
end
wft_blmn = wft'.*h_balckmann;
disp(wft_blmn,'Blackmann window based Filter output h(n)=')
wfm_blmn = frmag(wft_blmn,length(fr));
WFM_blmn_dB =20*log10(wfm_blmn);
subplot(2,1,1)
```

```
plot2d(fr,WFM_dB)
xgrid(1)
xtitle('Power Spectrum with Rectangular window Filtered M = 61','Frequency in cycles per samples f','Energy density in dB')
subplot(2,1,2)
plot2d(fr,WFM_blmn_dB)
xgrid(1)
xtitle('Power Spectrum with Blackmann window Filtered M = 61','Frequency in cycles per samples f','Energy density in dB')
```

Output:



Lakshmi Narain College of Technology Excellence, Bhopal

Department of Electronics & Communication Engineering

Date of Experiment: _____

EXPERIMENT NO. 7

AIM: Implementation of Decimation-in-time radix-2 FFT algorithm FFT of a sequence using DIT-FFT method

TOOLS REQUIRED:

Scilab-5.4/ Matlab software Personal computer

```
% Direct computation of FFT

x=[1 1 0 0];
N=4;
y=fft(x,N);

stem(abs(y));

ylabel
('Amplitude');
xlabel ('N');
title('Magnitude Response');
```

```
%Matlab Program for FFT using DIT algorithm

clc; clear all; close all;
x=input('enter x[n]:');
N=length(x);
levels=nextpow2(N);
xn=[x,zeros(1,(2^levels)-
N)]; x=bitrevorder(xn)
N=length(xn);
tw=cos(2*pi*(1/N)*(0:N/2-1))-
j*sin(2*pi*(1/N)*(0:N/2-1)); for level=1:levels;
```

```
    L=2^level;
    twlvl=tw(1:N/L:N/
    2); for k=0:L:N-L;
for n=0:L/2-1; A=x(n+k+1);
        B=x(n+k+(L/2)+1)*twlvl(n+1);
        x(n+k+1)=A+B;
        x(n+k+(L/2)+1)=A-B;
    end
    end
    x end
     XK=x
n=0:N-1;
subplot(2,2,1);stem(n,xn);title('x(n)');xlabel('n');ylabel('Amplitude');
subplot(2,2,2);stem(n,real(XK));title('Real part of X(K)');xlabel('n');ylabel('Amplitude');
subplot(2,2,3);stem(n,imag(XK));title('Imag part of X(K)');xlabel('n');ylabel('Amplitude');
```

OUTPUT AND WAVEFORM:

```
enter x[n]:  [1 2 3 4 4 3 2 1]

XK =

    20.0000        -5.8284-2.4142i      0        -0.1716-0.4142i      0        -0.1716 +0.4142i

    0              -5.8284 +2.4142i
```

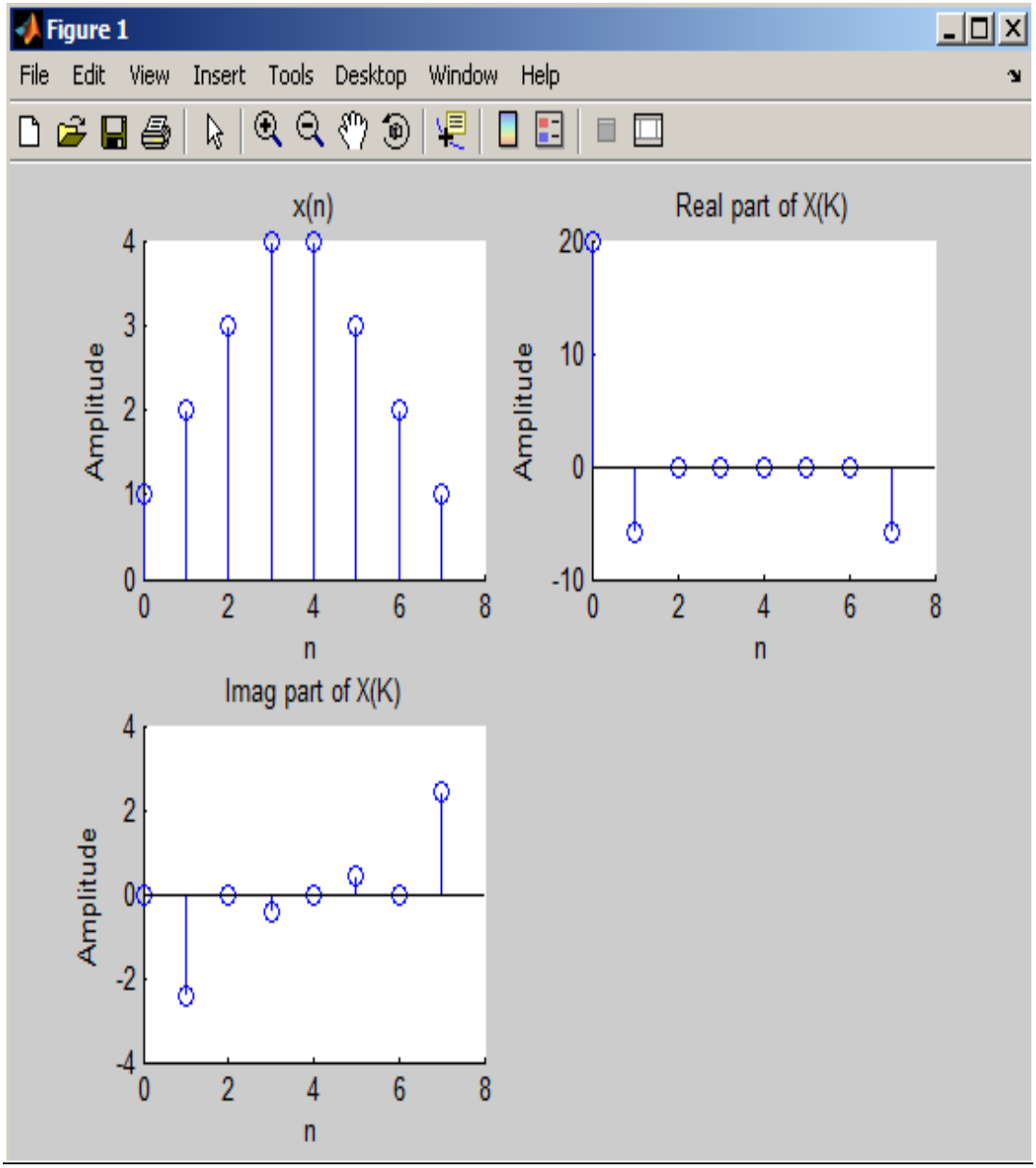


Figure 1
File Edit View Insert Tools Desktop Window Help
x(n)
Amplitude
n
Real part of X(K)
Amplitude
n
Imag part of X(K)
Amplitude
n

Date of Experiment: _____

EXPERIMENT NO. 8

Aim: Circular convolution and Linear convolution using DFT in Scilab

//Performing Circular COnvolution

```
//Using DFT
clear all;
clc;
close;
L = 4; //Length of the Sequence
N = 4;  // N -point DFT
x1 = [2,1,2,1];
x2 = [1,2,3,4];
//Computing DFT
X1 = dft(x1,-1)
X2 = dft(x2,-1)
//Multiplication of 2 DFTs
X3 = X1.*X2
//Circular Convolution Result
x3 =abs(dft(X3,1))
disp(x3,'x3=')
```

Linear Convolution

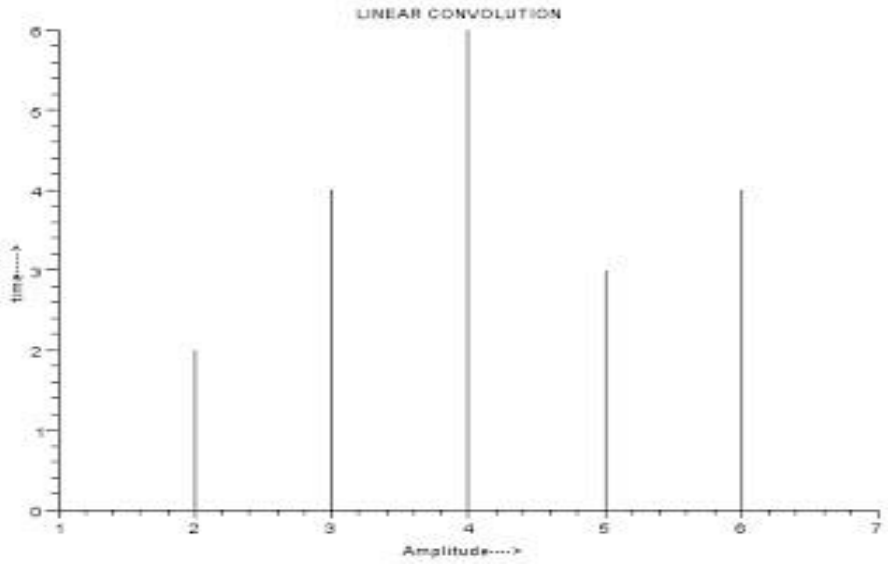
Scilab code:

```
clc;clear;xdel(winsid());
x = input("ENTER THE FIRST SEQUENCE    ");
h = input("ENTER THE SECOND SEQUENCE    ");
y = convol(x,h);
plot2d3('gnn',y);
xlabel("Amplitude---->");
ylabel("time----->");
title("LINEAR CONVOLUTION");
```

Input:

```
ENTER THE FIRST SEQUENCE      [1 2 3 4]
ENTER THE SECOND SEQUENCE      [1 0 1 0]
```

Output:-



Lakshmi Narain College of Technology Excellence, Bhopal

Department of Electronics & Communication Engineering

Date of Experiment: _____

EXPERIMENT NO. 9

Aim-Implementation of IIR digital filter using Butterworth method and bilinear transformation

TOOLS REQUIRED:

Scilab /Mat lab software Personal computer

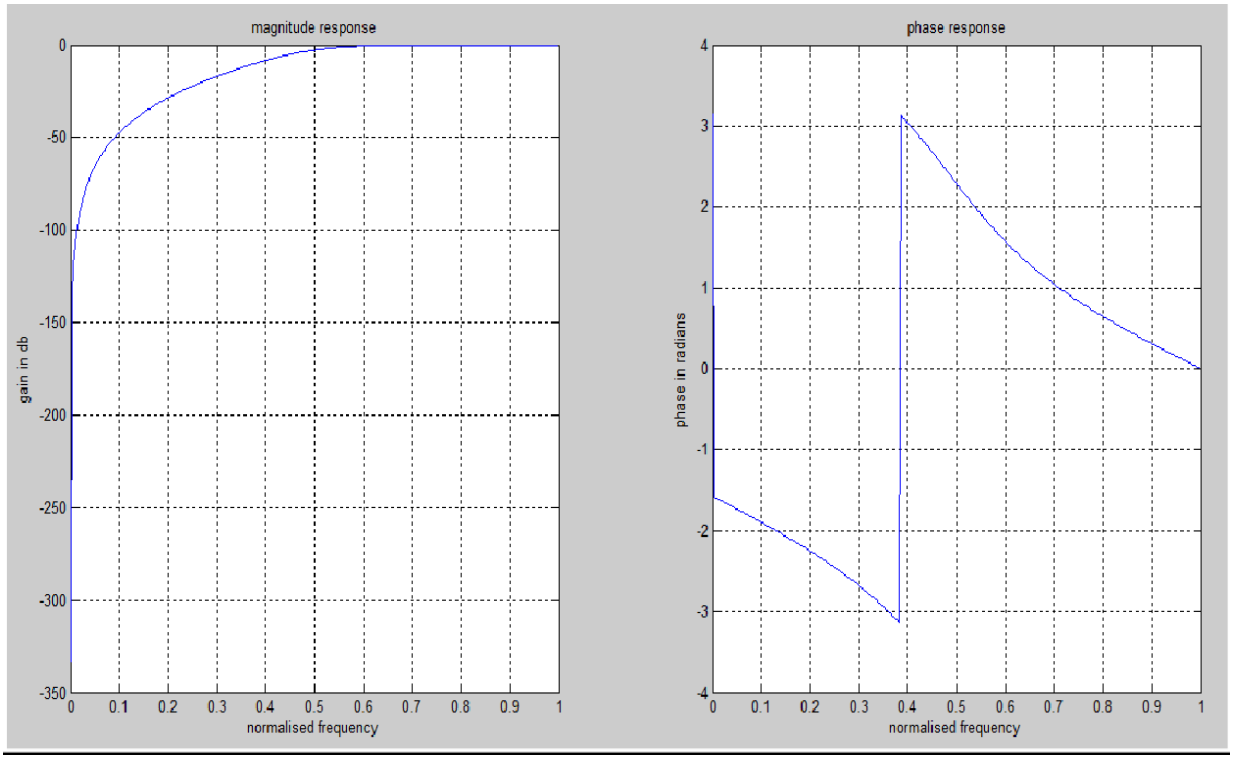
a) To Design a Butterworth High pass filter for the given specifications usingMatlab.

```
%To design a Butterworth Highpass filter for the given
specifications clf;
alphap=input('enter pass attenuation in db=');%passband attenuation in db
alphas=input('enter stopband attenuation in db=');% stopband attenuation in
dbfp=input('enter passband frequency in hz='); % passband frequency
in hz fs=input('enter stopband frequency in hz='); % stopband
frequency in hz F=input('enter sampling frequency in hz='); %
sampling frequency in hzomp=2*fp/F; %frequency in radians
oms=2*fs/F;
%to find cutoff frequency and order of the filter
[n,wn]=buttord(omp,oms,alphap,alphas);
%system function of the filter
[b,a]=butter(n,wn,'high');
w=0:0.01:pi;
[h,om]=freqz(b,a,w,'whole');
m=20*log10(abs(h));
```

```
an=angle(h);

subplot(1,2,1;

plot(om/pi,m;

grid;

xlabel('normalised frequency');

ylabel('gain in db');

title('magnitude

response'); subplot(1,2,2);

plot(om/pi,an);

grid;

xlabel('normalised

frequency'); ylabel('phase in

radians'); title('phase

response');  disp(b);

disp(a);

INPUT

S:

enter pass attenuation in db=.4
enter stopband attenuation in db=30
enter passband frequency in hz=800
enter stopband frequency inhz=400
enter sampling frequency in hz=2000
```

OUTPUT WAVEFORMS

B=0.0265 -0.1058 0.1587 -0.1058 0.0265
A= 1.0000 1.2948 1.0206 0.3575 0.0550



Date of Experiment: _____

EXPERIMENT NO. 10

Aim :- To develop program for computing DFT

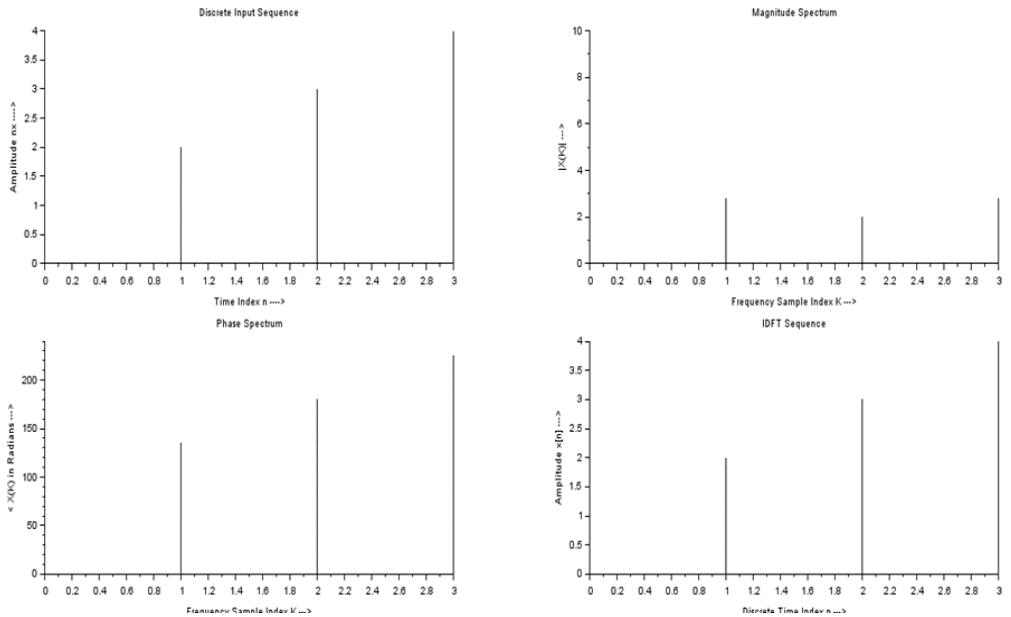
TOOLS REQUIRED:

Scilab/Matlab software Personal computer

Program:-

```
--> xn = input('Enter the Real Input Discrete sequence x[n] = ');
Enter the Real Input Discrete sequence x[n] = [1,2,3,4]


--> N = length(xn);

--> XK = zeros(1,N);

--> IXK = zeros(1,N);

--> for k = 0:N-1
> for n = 0:N-1
> XK(k+1) = XK(k+1)+xn(n+1)*exp(-%i*2*%pi*k*n/N);
> end
> end

--> [phase, db] = phasemag(XK)
phase  =

  0.   135.   180.   225.
db  =

  20.   9.0308999   6.0205999   9.0308999

-->disp(XK,'Discrete Fourier Transform X(k) = ');

  10. + 0.i  -2. + 2.i  -2. - 9.797D-16i  -2. - 2.i

 "Discrete Fourier Transform X(k) = "

--> disp(abs(XK),'Magnitude Spectral Samples =');

  10.   2.8284271   2.   2.8284271

 "Magnitude Spectral Samples ="

-->disp(phase,'Phase Spectral Samples = ');

  0.   135.   180.   225.
```

```
 "Phase Spectral Samples = "
--> n = 0:N-1;
--> K = 0:N-1;
-->subplot(2,2,1);
--> a = gca();
--> a.x_location = "origin";
--> a.y_location = "origin";
--> plot2d3('gnn',n,xn);
-->xlabel("Time Index n ----> ");
-->ylabel("Amplitude nx ----> ");
-->title("Discrete Input Sequence");
-->subplot(2,2,2);
--> a = gca();
--> a.x_location = "origin";
--> a.y_location = "origin";
--> plot2d3('gnn',K,abs(XK));
-->xlabel("Frequency Sample Index K ---> ");
--> ylabel("|X(K)| ---> ");
-->title("Magnitude Spectrum");
-->subplot(2,2,3);
--> a = gca( );
--> a.x_location = "origin";
--> a.y_location = "origin";
--> plot2d3('gnn',K,phase);
-->xlabel("Frequency Sample Index K ---> ");
-->ylabel(" < X(K) in Radians ---> ");
```

```
-->title("Phase Spectrum");
-->
--> // Code Block to find the IDFT of the Sequence
-->
--> for n = 0:N-1
> for K = 0:N-1
> IXK(n+1) = IXK(n+1)+XK(K+1)*exp(%i*2*%pi*K*n/N);
> end
> end

--> IXK = IXK/N;

--> ixn = real(IXK);

-->subplot(2,2,4);

--> a = gca();

--> a.x_location = "origin";

--> a.y_location = "origin";

--> plot2d3('gnn',[0:N-1],ixn)

-->xlabel("Discrete Time Index n ---> ");

-->ylabel(" Amplitude x[n] ---> ");

-->title("IDFT Sequence");
```

Output :