PABNA UNIVERSITY OF SCIENCE AND TECHNOLOGY

# FACULTY OF ENGINEERING AND TECHNOLOGY

## DEPARTMENT OF INFORMATION AND COMMUNICATION ENGINEERING

## LAB REPORT

**COURSE CODE: ICE-2206**

**COURSE TITTLE: SIGNALS AND SYSTEMS SESSIONAL**


**SUBMITTED BY:**

Naima Islam

Roll: 200601

Session: 2019-2020

$2^{nd}$ Year $2^{nd}$ Semester

Department of Information and Communication Engineering, Pabna University of Science and Technology

**SUBMITTED TO:**

Sohag Sarker

Associate Professor

Department of Information and Communication Engineering, Pabna University of Science and Technology


**DATE OF SUBMISSION: 14-05-2023**

**SIGNATURE**

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# PABNA UNIVERSITY OF SCIENCE AND TECHNOLOGY

**FACULTY OF ENGINEERING AND TECHNOLOGY**
**DEPARTMENT OF INFORMATION AND COMMUNICATION ENGINEERING**

## Course Code: ICE-2206

### Course Tittle: Signals and Systems Sessional

**Experiment No:** 01

**Experiment Name:** Explain and implement Discrete Fourier Transform (DFT) and Inverse Discrete Fourier Transform (IDFT).


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Experiment NO.: 01

Experiment Name: To explain and implement Discrete Fourier Transform (DFT) and Inverse Discrete Fourier Transform (IDFT)

Theory:

DFT: DFT converts a finite sequence of equally spaced samples of a function into a same length sequence of equally-spaced samples of the discrete-time Fourier transform which is complex valued function of frequency.

DFT converts the time domain sequence to an equivalent frequency domain. considering $x[n]$ is a N-point sequence. Hence, DFT of $x[n]$ is given by,

$$X[K] = \sum_{n=0}^{N-1} x[n] e^{-j\frac{2\pi}{N}nK}$$

IDFT: The fourier transform converts a time domain signal into a frequency domain. This frequency domain representation is exactly the same signal but in different form. The IDFT brings the signal back to the time domain from frequency domain. And the IDFT is given by,

$$x[n] = \frac{1}{N} \sum_{K=0}^{N-1} X[K] e^{j\frac{2\pi}{N}nK}$$

Let us considering an example, Here we have to determine DFT and IDFT of the given signal.

$x(n) = \{1, 1, 1, 1\}$

$N = 4$

The DFT is given by,

$$X[K] = \sum_{n=0}^{N-1} x(n)\, e^{-j\frac{2\pi}{N}nK} \quad ; K=0,1,2,\ldots (N-1)$$

$$= \sum_{0}^{3} x(n)\, e^{-j\frac{\pi}{2}nK} \quad ; K=0,1,2,3$$

when, $K=0$

$$X[0] = \sum_{0}^{3} x(n)\, e^{0}$$

$$= x(0) + x(1) + x(2) + x(3)$$

$$= 1+1+1+1$$

$$= 4$$

when, $K=1$

$$X[1] = \sum_{0}^{3} x(n)\, e^{-j\frac{\pi}{2}n}$$

$$= x(0)e^{0} + x(1)e^{-j\pi/2} + x(2)e^{-j\pi} + x(3)e^{-j3\pi/2}$$

$$= 1 + \left(\cos\frac{\pi}{2} - j\sin\frac{\pi}{2}\right) + (\cos\pi - j\sin\pi) + (\cos 3\pi/2 - j\sin 3\pi/2)$$

$$= 0$$

when, $K=2$

$$X[2] = \sum_{0}^{3} x(n)\, e^{-jn\pi}$$

$$= x(0)e^{-0} + x(1)e^{-j\pi} + x(2)e^{-j2\pi} + x(3)e^{-j3\pi}$$

$$= 1 + (\cos\pi - j\sin\pi) + (\cos 2\pi - j\sin 2\pi) + (\cos 3\pi - j\sin 3\pi)$$

$$= 0$$

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When, $K=3$

$$X[3] = \sum_{0}^{3} x(n) e^{-j\frac{3\pi}{2}n}$$

$$= x(0)e^{0} + x(1)e^{-j3\pi/2} + x(2)e^{-j3\pi} + x(3)e^{-j9\pi/2}$$

$$= 0$$

Therefore DFT of $x(n)$ is $X[K] = \{1, 0, 0, 0\}$

To find IDFT,

$$x(n) = \frac{1}{N}\sum_{K=0}^{N-1} X[K] e^{j\frac{2\pi}{N}nK} \quad ; n = 0, 1, \ldots (N-1)$$

$$x(n) = \frac{1}{4}\sum_{0}^{3} X[K] e^{j\frac{\pi}{2}nK} \quad ; n = 0, 1, 2, 3$$

when, $n=0$

$$x(0) = \frac{1}{4}\sum_{0}^{3} X[K] e^{0}$$

$$= \frac{1}{4}\left[X[0] + X[1] + X[2] + X[3]\right]$$

$$= 1$$

when, $n=1$

$$x(1) = \frac{1}{4}\sum_{0}^{3} X[K] e^{j\pi/2K}$$

$$= \frac{1}{4}\left[X[0]e^{0} + X[1]e^{j\pi/2} + X[2]e^{j\pi} + X[3]e^{j3\pi/2}\right]$$

$$= \frac{1}{4}[4+0+0+0]$$

$$= 1$$

when, $n=2$

$$x(2) = \frac{1}{4}\sum_{0}^{3} x[K]e^{j\pi K}$$

$$= \frac{1}{4}\left[x[0]e^{0} + x[1]e^{j\pi} + x[2]e^{j2\pi} + x[3]e^{j3\pi}\right]$$

$$= \frac{1}{4}[4+0+0+0]$$

$$=1$$

when, $n=3$

$$x(3) = \frac{1}{4}\sum_{0}^{3} x[K]e^{j3\pi/2K}$$

$$= \frac{1}{4}\left[x[0]e^{0} + x[1]e^{j3\pi/2} + x[2]e^{j3\pi} + x[3]e^{j9\pi/2}\right]$$

$$= \frac{1}{4}[4+0+0+0]$$

$$=1$$

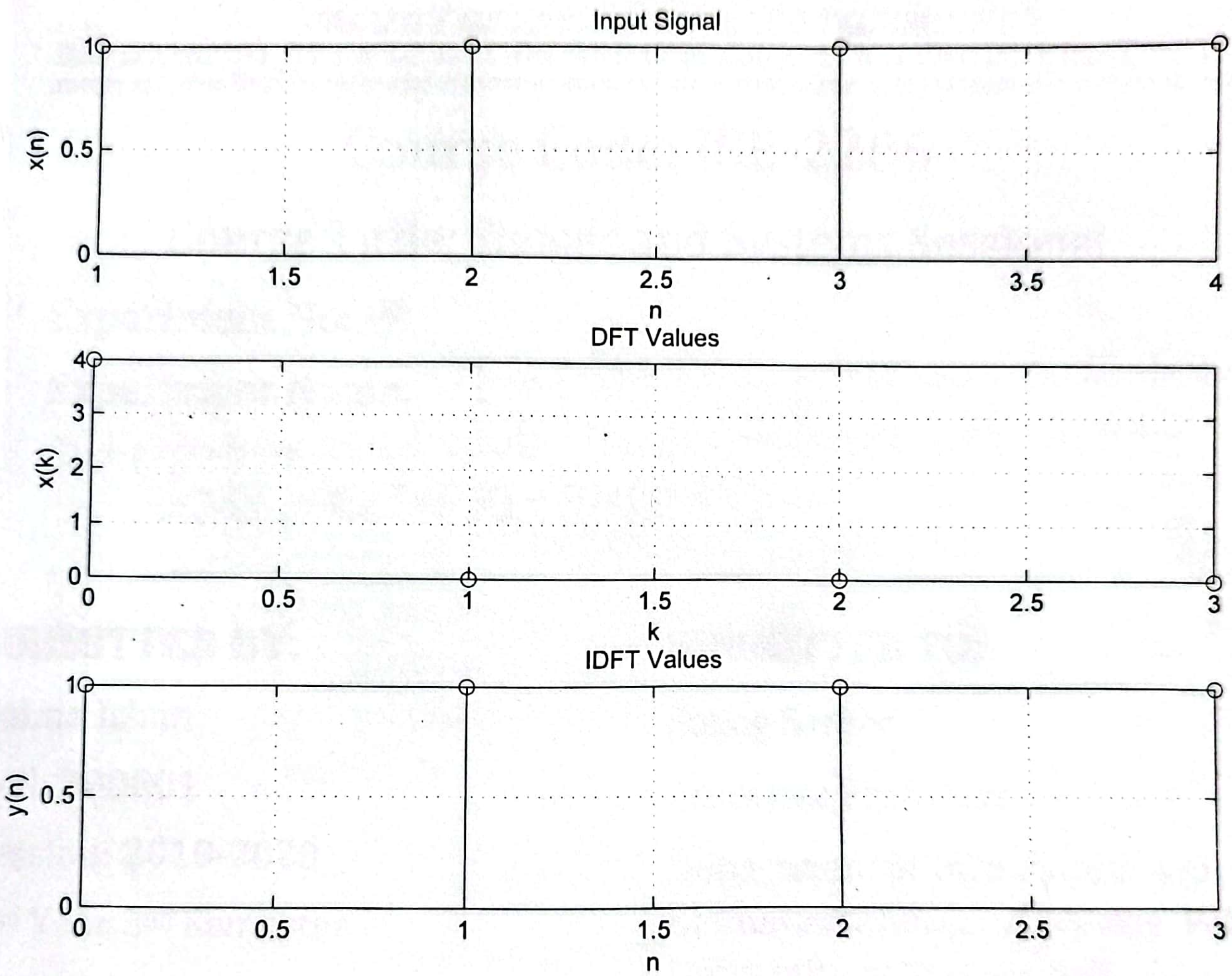
Therefore, the IDFT is $x(n) = \{1, 1, 1, 1\}$

Source code:

```
clc;
close all;
clear all;
x = input("Enter the sequence x(n) = ");
N = input('Input N: ');
disp(N);
subplot(3,1,1);
stem(x);
xlabel('n');
ylabel('x(n)');
title('Input signal');
grid on;
If N > length(x)
  x = [x, zeros(1, N-Length(x))];
end
% DFT computation
y = zeros(1, N);
for K=0: N-1
   for n=0 : N-1
       y(K+1) = y(K+1) + x(n+1) * exp((-1i*2*pi*K*n
                                        /N))
   end
end
disp(y);
subplot(3,1,2);
stem(0:N-1, abs(y));
xlabel('K');
ylabel('x(K)');
title('DFT values');
grid on;
```

% IDFT computation

```
M = length(y);
m = zeros(1, M);
for n=0 : M-1
    for K=0 : M-1
        m(n+1)= m(n+1) + ((1/M)*y(K+1).*exp((1i*2*
                                            pi*K*n)/M);
    end
end
disp(m);
subplot(3,1,3)
stem(0:M-1, m);
xlabel('n');
ylabel('y(n)');
title('IDFT values');
grid on;
```



Input Signal
x(n)
n
DFT Values
x(k)
k
IDFT Values
y(n)
n

# PABNA UNIVERSITY OF SCIENCE AND TECHNOLOGY

**FACULTY OF ENGINEERING AND TECHNOLOGY**
**DEPARTMENT OF INFORMATION AND COMMUNICATION ENGINEERING**

## Course Code: ICE-2206

### Course Tittle: Signals and Systems Sessional

**Experiment No:** 02

**Experiment Name:** Let $x(n) = \{1, 2, \underset{\uparrow}{3}, 4, 5, 6, 7, 6, 5, 4, 3, 2, 1\}$
Determine and plot the following sequence:

$$y(n) = 2x(n-5) - 3x(n+4)$$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Experiment NO: 02

Experiment Name: Let $x(n) = \{1, 2, \underset{\uparrow}{3}, 4, 5, 6, 7, 6, 5, 4, 3, 2, 1\}$ Determine the following sequence and plot this.

$$y(n) = 2x(n-5) - 3x(n+4)$$

Theory: A signal is defined as a function which conveys information. Shifting is important property that a signal can perform.

Let us consider $x(n)$ is a discrete time signal. The shifting version of $x(n)$ is defined by

$y(n) = x(n - n_0)$ ; here $n_0$ is the time shift.

If $n_0 > 0$ then $x(n)$ is shifted to the right.

If $n_0 < 0$ then $x(n)$ is shifted to the left.

Let us consider the mentioned signal,

$x(n) = \{1, 2, \underset{\uparrow}{3}, 4, 5, 6, 7, 6, 5, 4, 3, 2, 1\}$

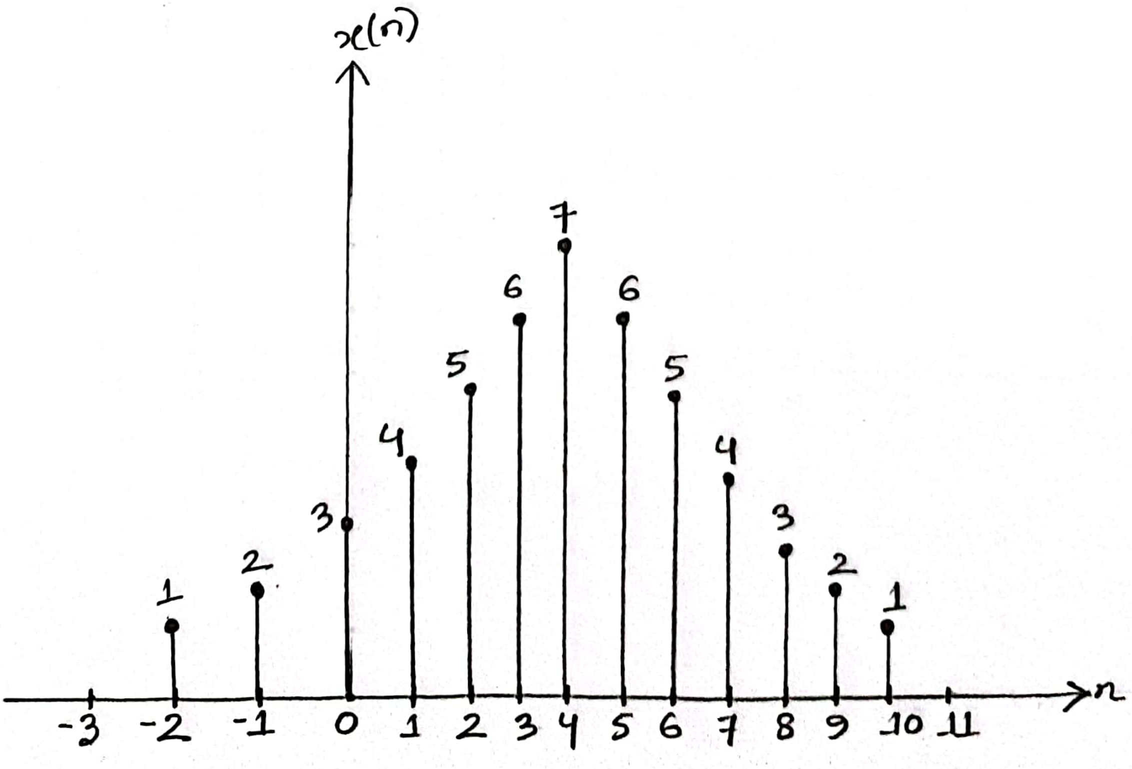



Figure-01: $x(n)$

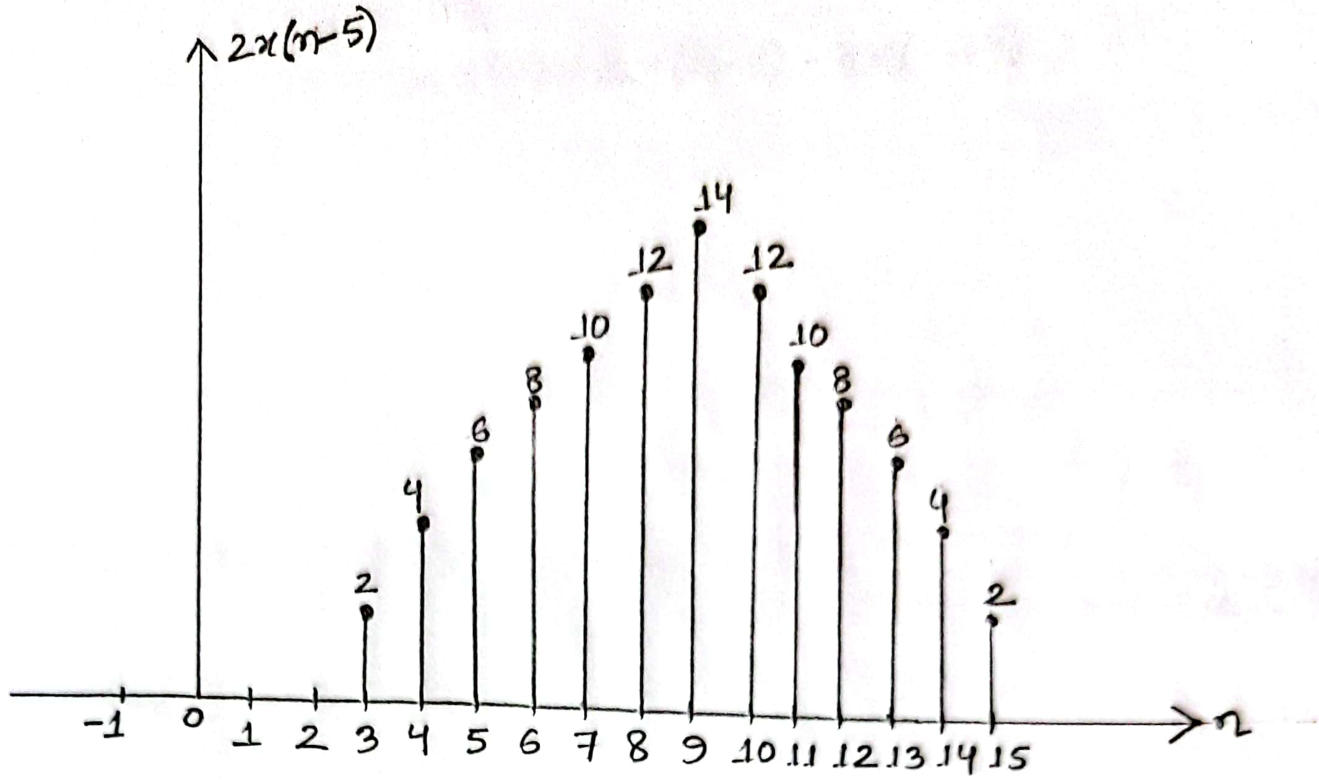



Figure-02: $2x(n-5)$

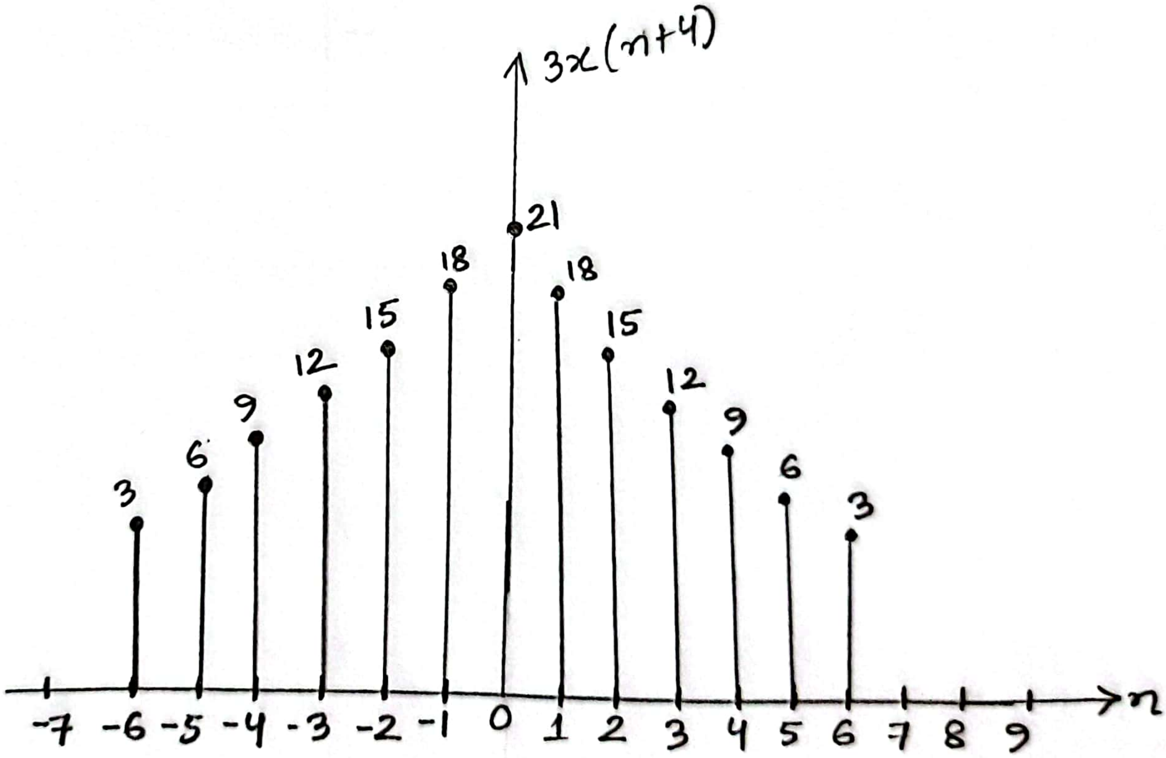
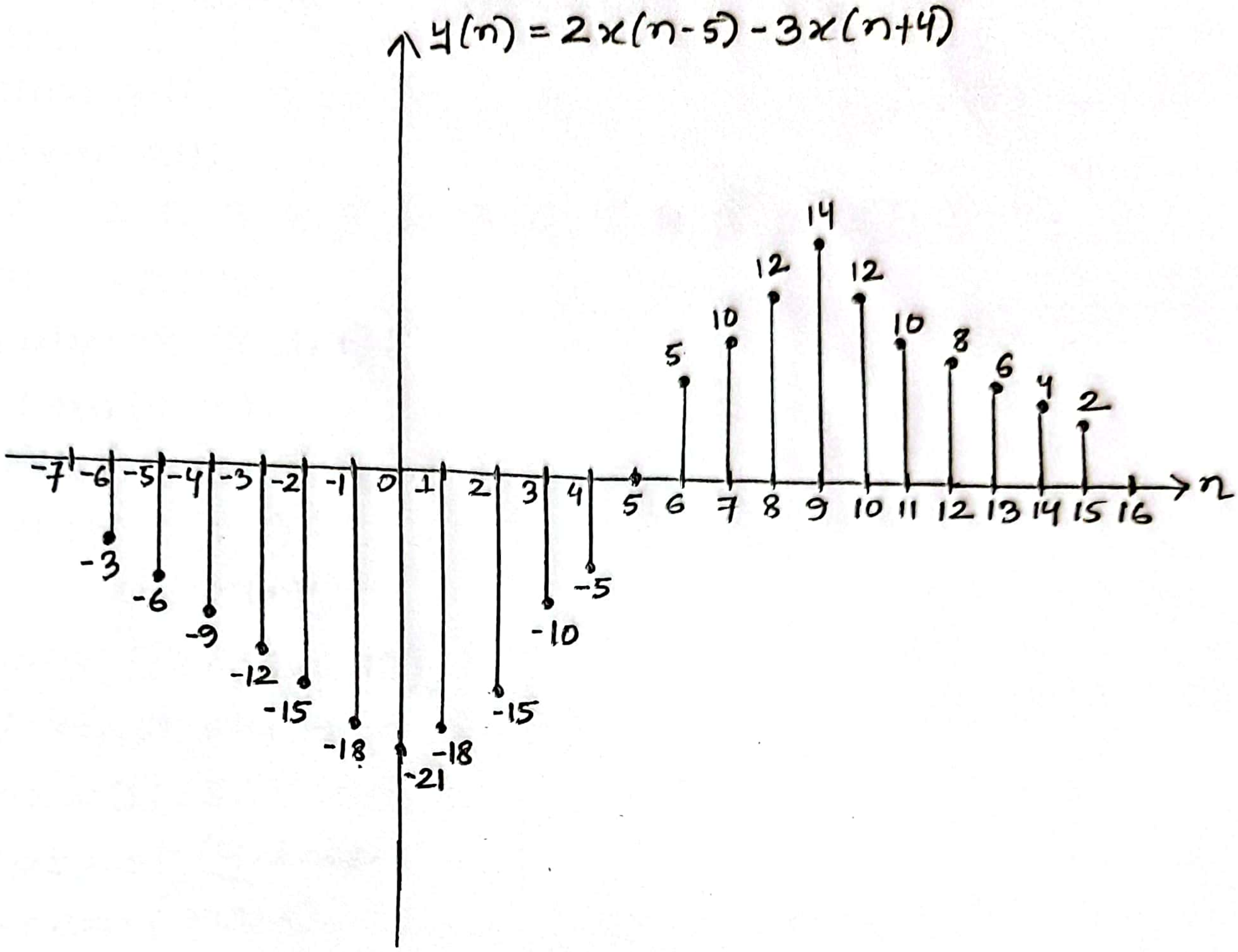



Figure-03: $3x(n+4)$



y(n) = 2x(n-5) - 3x(n+4)
14
12
12
10
10
8
5
6
4
2
-7
-6
-5
-4
-3
-2
-1
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
n
-3
-6
-9
-12
-15
-18
-21
-18
-15
-10
-5


Figure-04: y(n)

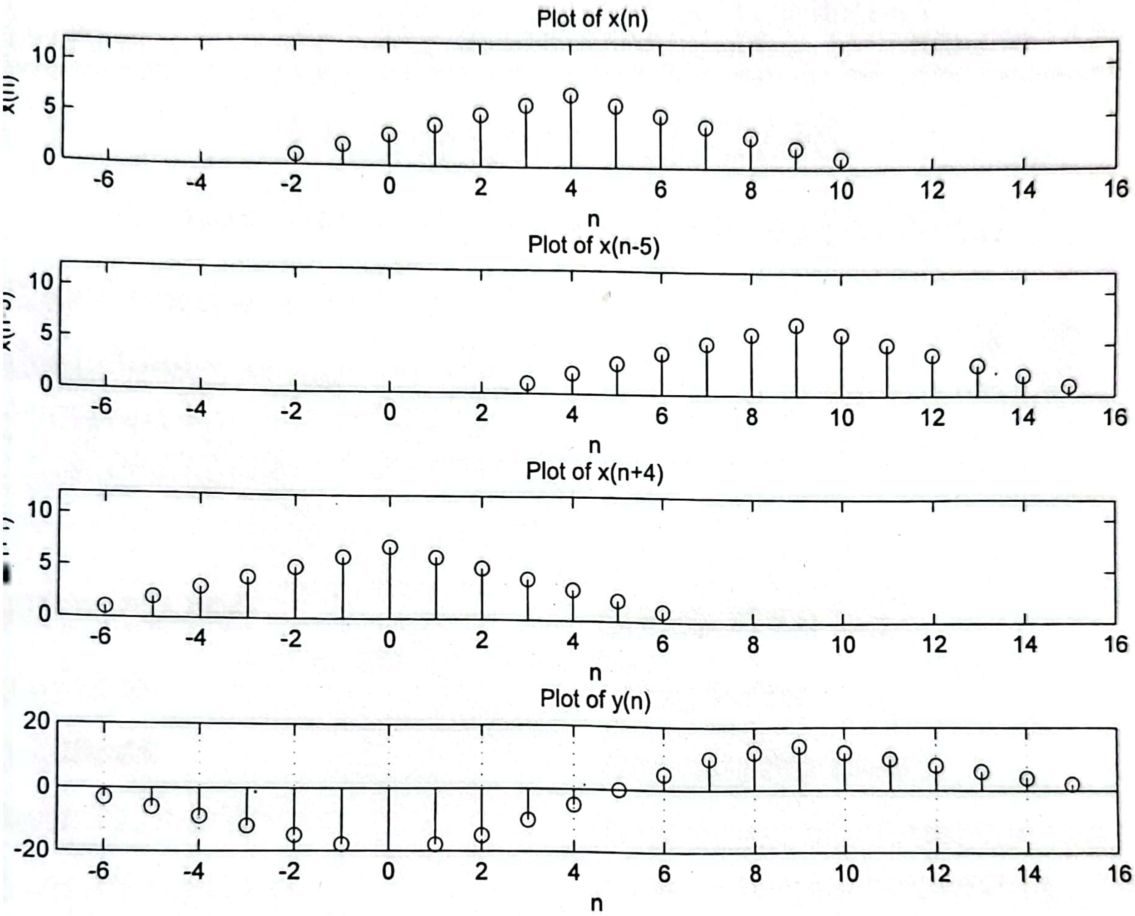
Source code:

```
clc;
close all;
clear all;
x=[1 2 3 4 5 6 7 6 5 4 3 2 1];
n= -2:10;
subplot (4,1,1);
stem(n,x);
title('Plot of x(n)');
xlabel('n');
ylabel('x(n)');
axis([-7,16,0,12]);
% First shifting of x(n)
n1 =3:15;
subplot (4,1,2);
stem(n1,x);
title('Plot of x(n-5)');
xlabel('n');
ylabel('x(n-5)');
axis([-7, 16, 0, 12]);
% second shifting of x(n)
n2= -6:6;
subplot(4,1,3);
stem(n2,x);
title('Plot of x(n+4)');
xlabel('n');
ylabel('x(n+4)');
axis([-7, 16, 0, 12]);
```

```
% computing y(n) using the given formula
m = min(min(n1), min(n2)); max(max(n1), max(n2));
y1 = zeros (1, length(m));
temp = 1;
for i=1 : length(m),
    if (m(i) < min(n1) || m(i) > max(n1))
        y(i) = 0;

    else
        y1(i) = x(temp);
        temp = temp + 1;
    end
end
y2 = zeros (1, length(m));
temp = 1;
for i=1 : length(m)
    if (m(i) < min(n2) || m(i) > max(n2))
        y2(i) = 0;

    else
        y2(i) = x(temp);
        temp = temp+1;
    end
end
y = 2.*y1 - 3.*y2;
subplot (4,1,4);
stem(m,y);
title('Plot of y(n)');
xlabel('n');
ylabel('y(n)');
axis ([-7, 16, -20, 20]);
grid on;
```

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**DEPARTMENT OF INFORMATION AND COMMUNICATION ENGINEERING**

# Course Code: ICE-2206

## Course Tittle: Signals and Systems Sessional

**Experiment No:** 03

**Experiment Name:** Write MATLAB code to perform the following operations on a sinusoidal wave: (i) sampling, (ii) Quantization, (iii) Coding


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Experiment NO:03

Experiment Name: Write a matlab program to perform following operation-
(i) sampling (ii) Quantization (iii) coding

Theory:

Sampling: sampling is a process by which a continuous time signal is converted into a sequence of discrete samples, with each samples representing the amplitude of the signal at a particular instant of time.

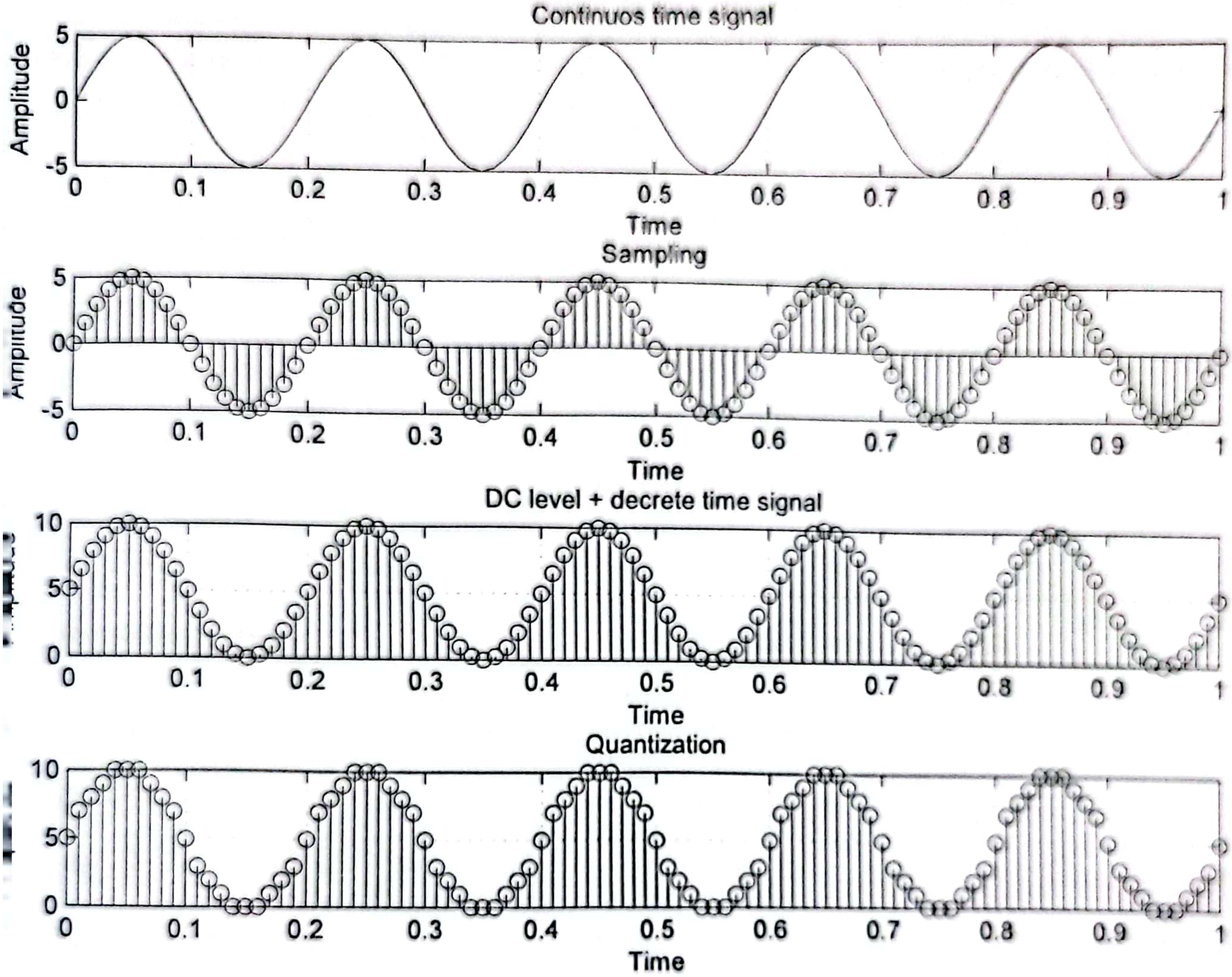
Quantization: quantization is a process by which each sample produced by the sampling circuit to the nearest level is selected from a finite number of descrete amplitude level. In other words, rounding of a typical sample is known as quantization process.
The difference between an input value and its quantised value is reffered to as quantization error.

Coding: It is a system in which signals used to represent letters or numbers.
coding operation represent each quantized sample by binary number.

Source code:

```
clc;
close all;
clear all;
A =5;
f =5;
t=0:0.01:1;
x=A*sin(2*pi*f*t);
subplot (4,1,1);
plot(t,x);
title('continuous time signal');
xlabel('Time');
ylabel('Amplitude');
grid on;
subplot(4,1,2);
stem (t,x);
title ('sampling');
xlabel('Time');
ylabel ('Amplitude');
% DC level + Discrete time signal
x1 = A +x;
subplot(4,1,3);
stem(t, x1);
title('DC Level + Discrete time signal');
xlabel('Time');
ylabel('Amplitude');
grid on;
```

```
% quantization
x2 = round(x1);
subplot(4,1,4);
stem(t,x2);
title('quantization');
xlabel('Time');
ylabel('Amplitude');
grid on;
% coding
x3 = dec2bin(x2);
disp(x3);
```


Continuos time signal
Amplitude
Time
Sampling
Amplitude
Time
DC level + decrete time signal
Time
Quantization
Time

# ABNA UNIVERSITY OF SCIENCE AND TECHNOLOGY

**FACULTY OF ENGINEERING AND TECHNOLOGY**
**DEPARTMENT OF INFORMATION AND COMMUNICATION ENGINEERING**

## Course Code: ICE-2206

### Course Tittle: Signals and Systems Sessional

**Experiment No:** 04

**Experiment Name:** Determine and plot the following sequences over the indicated interval using MATLAB:

$$x(n) = 2\delta(n+2) - \delta(n-4); \quad -5 \leq n \leq 5$$

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Experiment NO: 04

Experiment Name: Determine and plot the following sequence,

$$x(n) = 2\delta(n+2) - \delta(n-4), \quad -5 \le n \le 5$$

Theory:

Impulse function: A function that has zero duration infinite amplitude and unit area under it is known as impulse function.

In discrete time, the unit impulse is simply a sequence that is zero except $n=0$.

It is defined as,

$$\delta(n) = \begin{cases} 0, & n \ne 0 \\ 1, & n = 0 \end{cases}$$

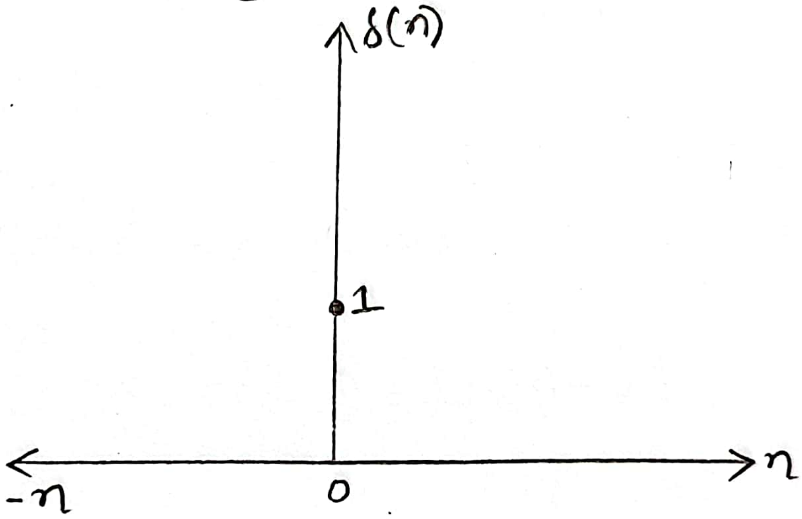



Figure-01: Graphical representation of a discrete time impulse function (unit impulse)

Let us consider the given sequence as sample,

$$x(n) = 2\delta(n+2) - \delta(n-4); \quad -5 \le n \le 5$$

when,

$n = -5$

$$x(-5) = 2\delta(-5+2) - \delta(-5-4)$$
$$= 2\delta(-3) - \delta(-9)$$
$$= 0$$

when, $n=-4$

$x(-4) = 2\delta(-4+2) - \delta(-4-4)$

$= 2\delta(-2) - \delta(-8) = 0$

when, $n=-3$

$x(-3) = 2\delta(-3+2) - \delta(-3-4)$

$= 2\delta(-1) - \delta(-7) = 0$

when, $n=-2$

$x(-2) = 2\delta(-2+2) - \delta(-2-4)$

$= 2\delta(0) - \delta(-6) = 2*1 = 2$

when, $n=-1$

$x(-1) = 2\delta(-1+2) - \delta(-1-4)$

$= 2\delta(1) - \delta(-4) = 0$

when, $n=0$

$x(0) = 2\delta(0+2) - \delta(-4) = 0$

when, $n=1$

$x(1) = 2\delta(1+2) - \delta(1-4) = 2\delta(3) - \delta(-3) = 0$

when, $n=2$

$x(2) = 2\delta(2+2) - \delta(2-4)$

$= 2\delta(4) - \delta(-2) = 0$

when, $n=3$

$x(3) = 2\delta(3+2) - \delta(3-4)$

$= 2\delta(5) - \delta(-1) = 0$

when, $n=4$

$x(4) = 2\delta(4+2) - \delta(4-4)$

$= 2\delta(6) - \delta(0) = -1$

when, $n=5$

$$x(5) = 2\delta(5+2) - \delta(5-4)$$
$$= 2\delta(7) - \delta(1) = 0$$

Now the graphical representation of the output of this give sequence will be,

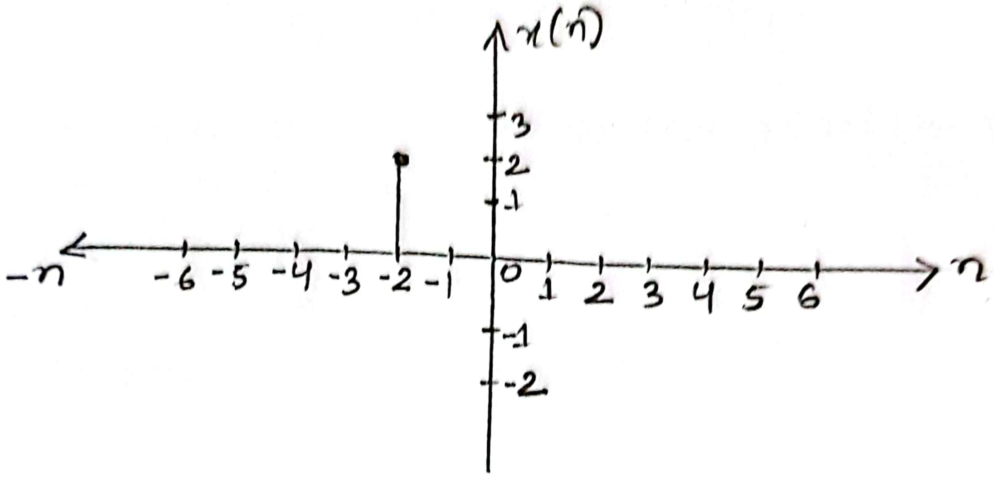
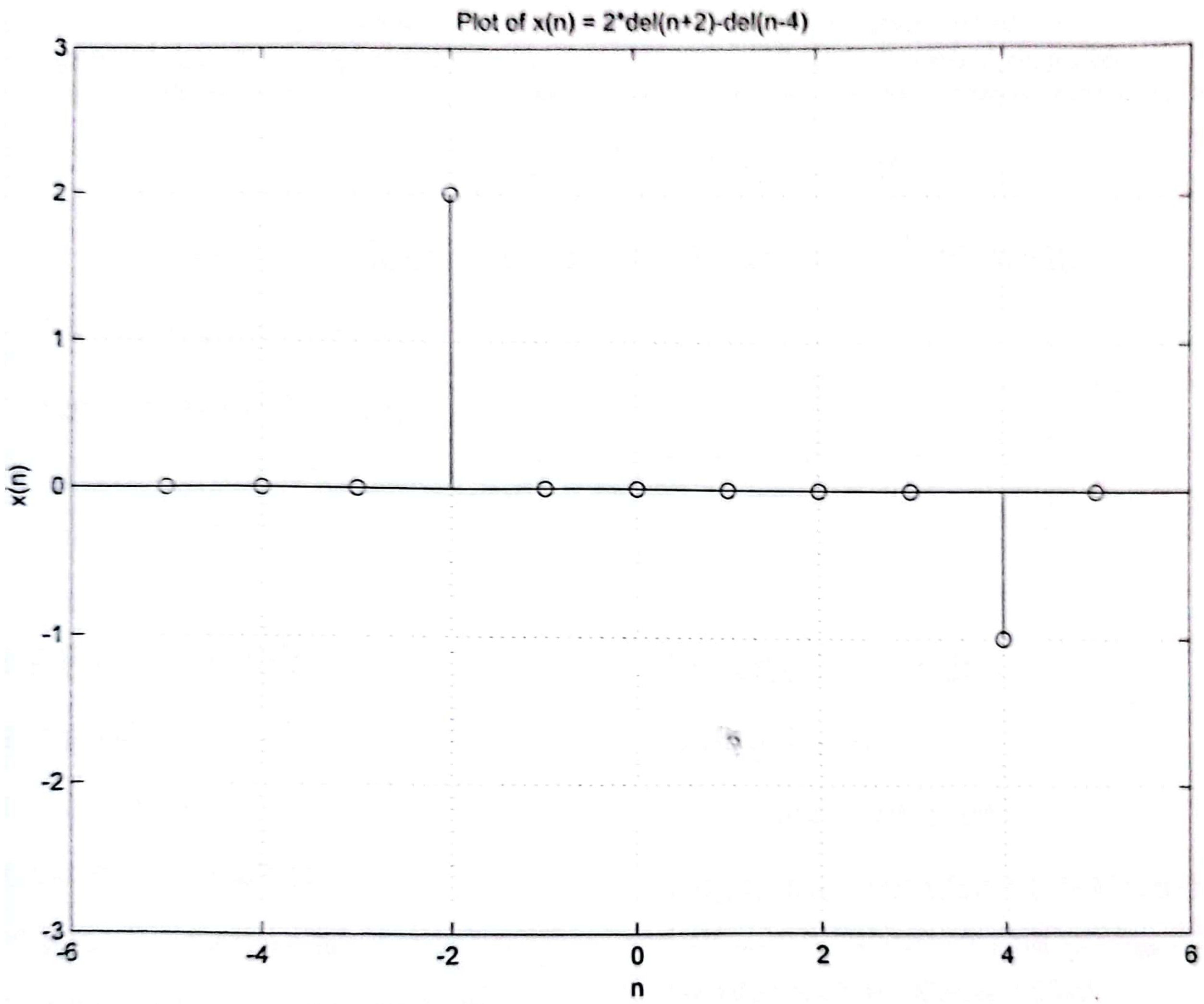



Figure-02 : Discrete-time impulse ~~function~~ sequence

Source code:

```
clc;
closeall;
clearall;
% Define the sequence x(n)
n =-5:5;
x=2*[(n+2)==0] - [(n-4)==0];
stem(n,x);
title('Plot of x(n)=2*del(n+2)-del(n-4)');
xlabel('n');
ylabel('x(n)');
axis([-6 6 -3 3]);
grid on;
```


Plot of x(n) = 2*del(n+2)-del(n-4)
x(n)
n
3
2
1
0
-1
-2
-3
-6
-4
-2
0
2
4
6

# ABNA UNIVERSITY OF SCIENCE AND TECHNOLOGY

**FACULTY OF ENGINEERING AND TECHNOLOGY**
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## Course Code: ICE-2206

### Course Tittle: Signals and Systems Sessional

**Experiment No:** 05

**Experiment Name:** Plot the following signal operations on signals: $x = \{1, 0, 3, 4\}$; $y = \{1, 1, 1, 1\}$; $z = \{3, -1, 0, -4\}$ (i) Signal Addition$(x+y)$ and (ii) Folding of signal $z$.


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Experiment NO:05

Experiment Name: Plot the following signal operations on signals:

$x(n)=\{1,0,\underset{\uparrow}{3},4\}$ ; $y(n)=\{\underset{\uparrow}{1},1,1,1\}$ ; $z(n)=\{3,\underset{\uparrow}{-1},0,-4\}$

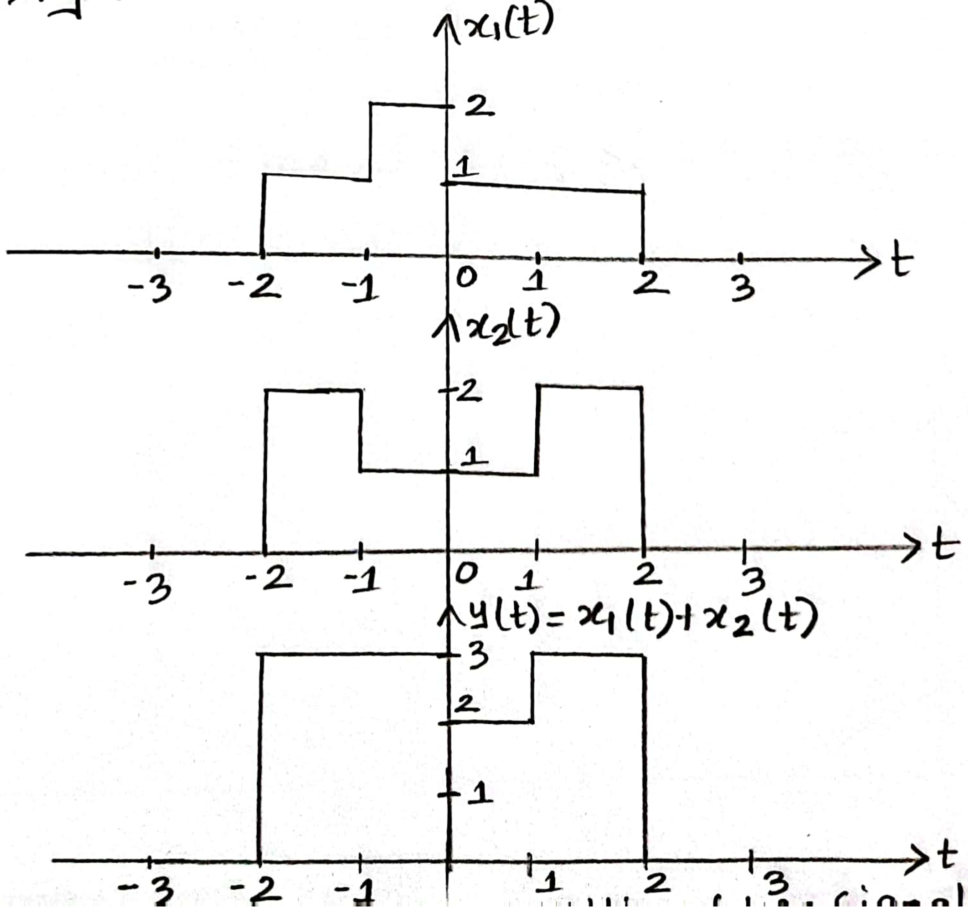
(i) signal addition $(x+y)$ and (ii) Folding of signal $z$.

Theory:

Addition of signal: For a continuous-time signal if $x_1(t)$ and $x_2(t)$ are two signals then signal $y(t)$ obtained by the addition of $x_1(t)$ and $x_2(t)$ is defined by. $y(t)=x_1(t)+x_2(t)$

And if $x_1(n)$ and $x_2(n)$ are discrete-time signals, then the addition of these signal is defined by $y(n)=x_1(n)+x_2(n)$

Here, example of addition of two continuous-time signal.



Eaxample of addition of two discrete-time signal.

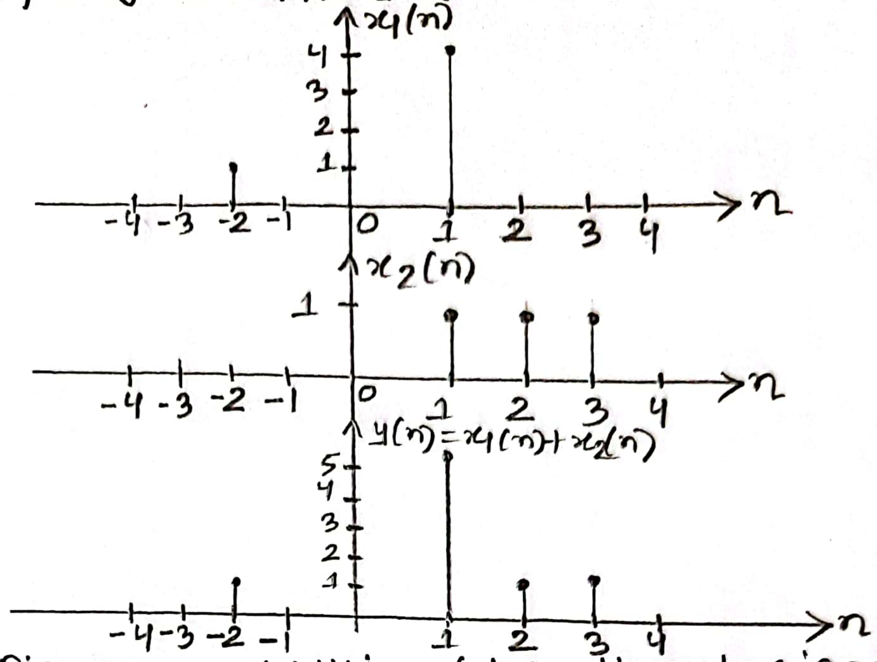



Figure-02: Addition of two discrete signals

**Folding of a Signal:** Folding of a signal obtained by replacing t into -t in continuous-time signal. And n into -n in discrete time signal. The period will be unchanged in both case. Folding of a continuous-time signal will be,

$$y(t) = x(-t)$$

In discrete-time, folding of a signal will be,

$$y(n) = x(-n)$$

Example:

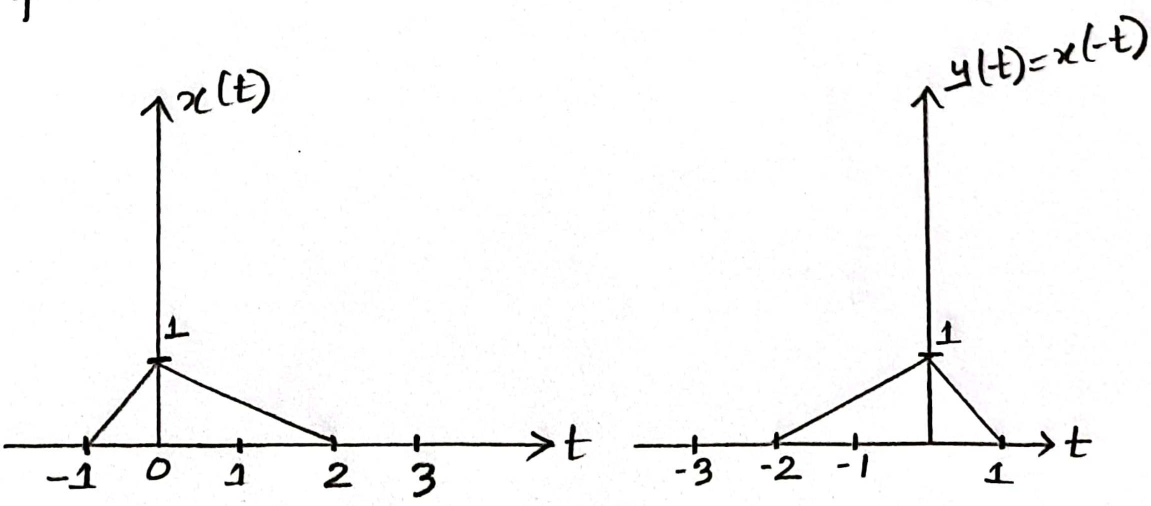



Figure-03: Folding of continuous time signal

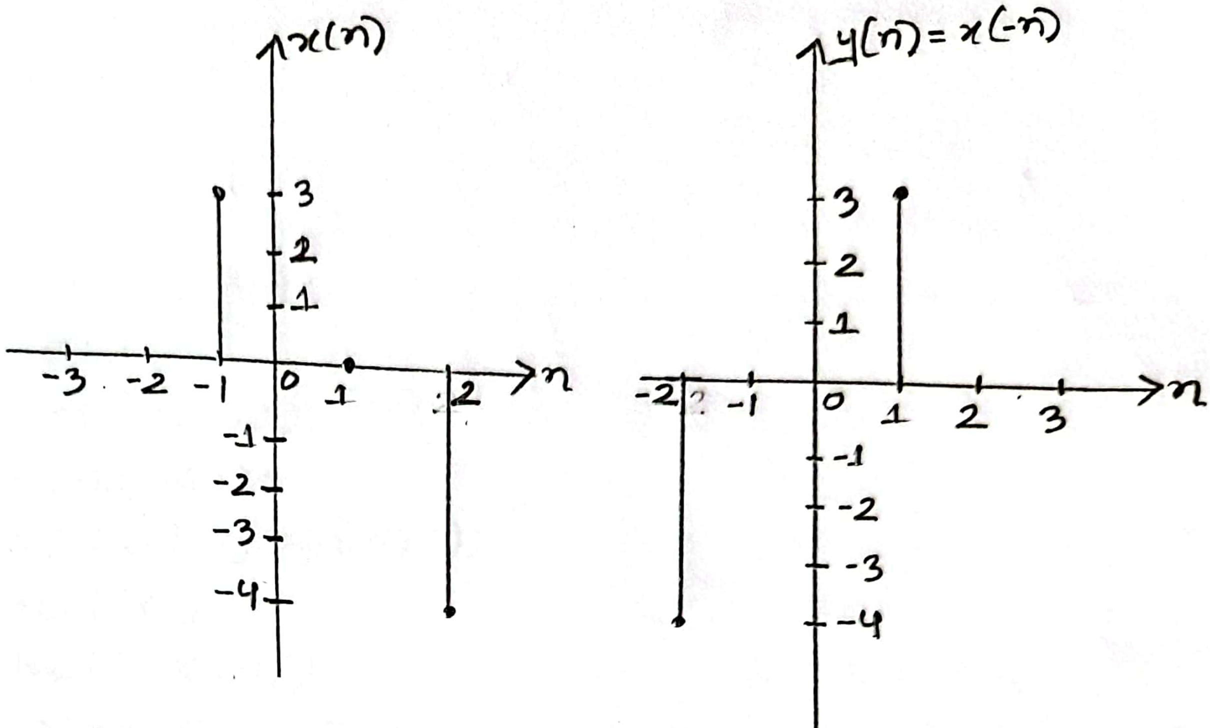


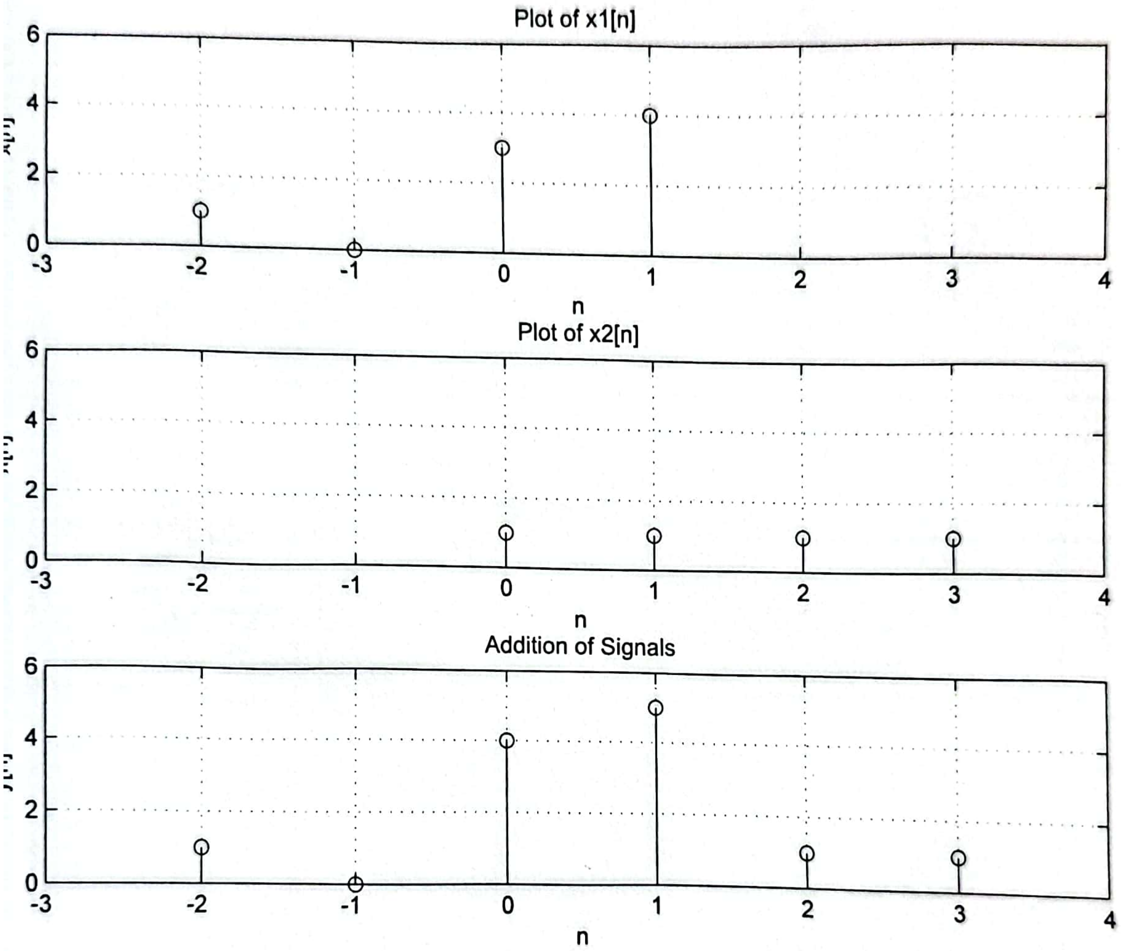

Figure-04: Folding of descrete-time signal

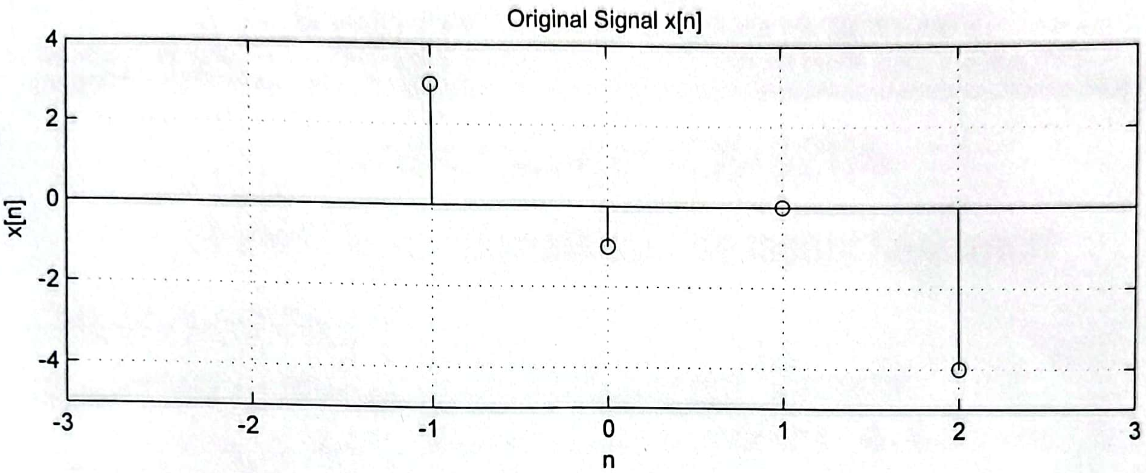
Source code:

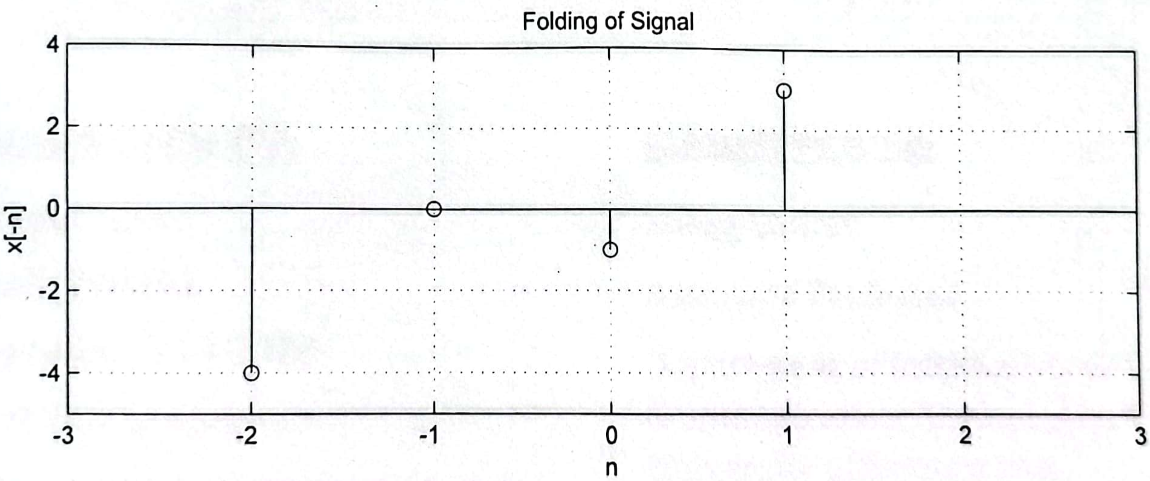
```
clc;
close all;
clear all;
figure(1):
x1 = [1 0 3 4];
n1 =-2:1;
subplot(3,1,1);
stem(n1, x1);
title('Plot of x1(n)');
xlabel('n');
ylabel('x(n)');
axis([-3,4,0,6]);
grid on;
x2=[1 1 1 1]
n2=0:3;
subplot(3,1,2);
stem(n2,x2);
title('Plot of x2 [n]');
xlabel('n');
ylabel('x[n]');
axis([-3,4,0,6]);
grid on;
m = min(min(n1),min(n2)); max(max(n1),max(n2));
y1 = zeros(1, length(m));
temp =1;
```

```
for i=1 : length(n)
  if (n(i) < min(n1) || n(i) > max(n1))
      y1(i) = 0;
  else
      y1(i) = x1(temp);
      temp = temp + 1;
  end
end
y2 = zeros(1, length(n));
temp = 1;
for i=1 : length(n)
  if (n(i) < min(n2) || n(i) > max(n2))
      y2(i) = 0;
  else
      y2(i) = x2(temp);
      temp = temp+1;
  end
end
y = y1 + y2;
subplot(3, 1, 3);
stem(n, y);
title('Addition of signals');
xlabel('n');
ylabel('y[n]');
axis([-3 4 0 -6]);
grid on;
```

```
Figure(2);
x = [3 -1 0 -4];
n = -1 :2;
subplot(2,1,1);
stem(n,x);
title('Original signal x[n]');
xlabel('n');
ylabel('x[n]');
axis([-3 , 3,-5, 4]);
grid on;
xbar =fliplr(x);
n bar = fliplr(-n);
subplot (2,1,2);
stem(n bar, x bar);
title('' Foldings of signal');
xlabel ('n');
ylabel ('x[n]');
axis([-3,3,-5,4]);
grid on;
```


Plot of x1[n]
6
4
2
0
-3
-2
-1
0
1
2
3
4
n
Plot of x2[n]
n
Addition of Signals
n


Original Signal x[n]
x[n]
n
4
2
0
-2
-4
-3
-2
-1
0
1
2
3


Folding of Signal
x[-n]
n
4
2
0
-2
-4
-3
-2
-1
0
1
2
3

# PABNA UNIVERSITY OF SCIENCE AND TECHNOLOGY

FACULTY OF ENGINEERING AND TECHNOLOGY
DEPARTMENT OF INFORMATION AND COMMUNICATION ENGINEERING

## Course Code: ICE-2206

### Course Tittle: Signals and Systems Sessional

**Experiment No:** 06

**Experiment Name:** Plot Following Operations:
$x = \{1, 2, 3, 4\}$ ; $y = \{1, 1, 1, 1\}$ ; $z = \{-2, 3, 0, 1, 5\}$ ;
(i) Signal Multiplication $(x * y)$ and (ii) Signal shifting $(z)$


**SUBMITTED BY:**

**Naima Islam**

Roll: **200601**

Session: 2019-2020

2nd Year 2nd Semester

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**Sohag Sarker**

Associate Professor

Department of Information and Communication Engineering, Pabna University of Science and Technology.


SIGNATURE

Experiment NO:06

Experiment Name: Plot following operations:

$x(n) = \{1, 2, \underset{\uparrow}{3}, 4\}$; $y(n) = \{\underset{\uparrow}{1}, 1, 1, 1\}$; $z(n) = \{-2, 3, \underset{\uparrow}{0}, 1, 5\}$

(i) signal multiplication ($x*y$) and (ii) signal shifting ($z$)

Theory: A signal is defined as a function of one or more variables, which conveys information.

Multiplication of signal: Multiplication is a basic operation on signals. Let us consider $x_1(n)$ and $x_2(n)$ two discrete signals. Then the resultant signal $y(n)$ obtained by multiplication of $x_1(n)$ and $x_2(n)$ is defined by

$$y(n) = x_1(n) \cdot x_2(n)$$

Let us, consider two discrete signals as example and we have to multiply this two signal.

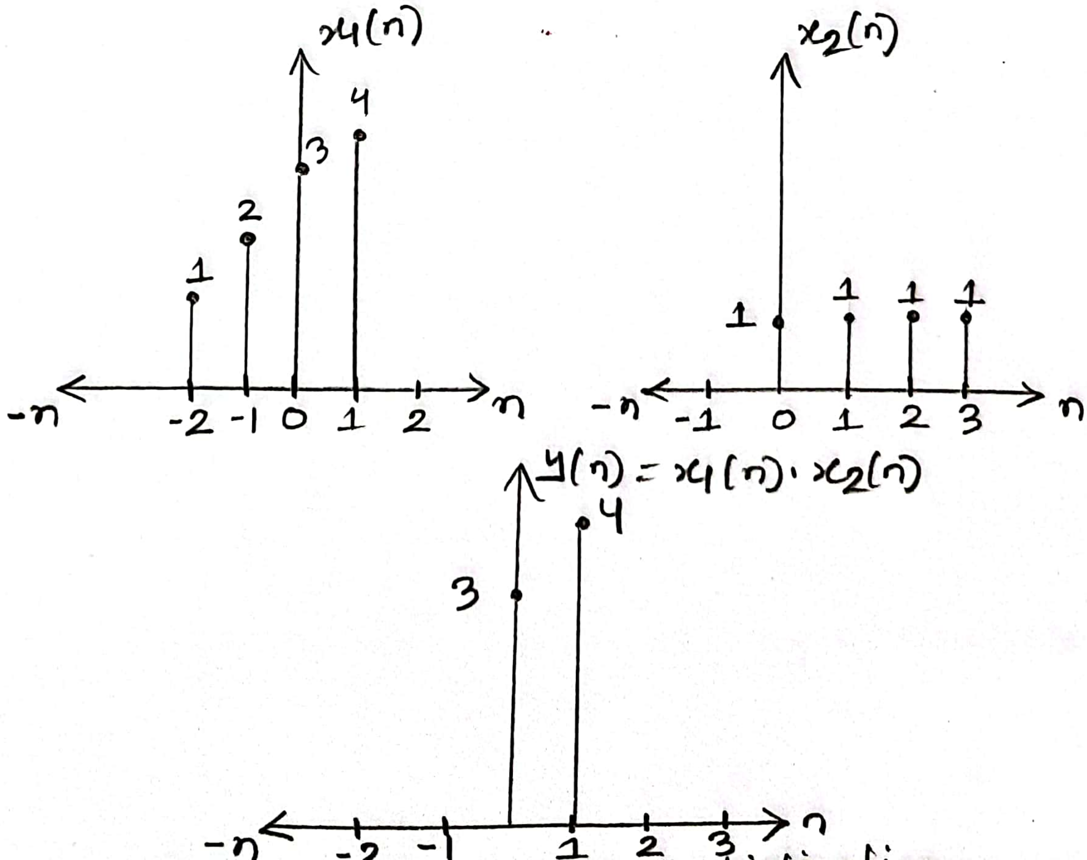



Figure: Signal Multiplication

**Shifting of Signal:** Let us consider $x(n)$ is a discrete time signal. Then the time shifting version of $x(n)$ is defined by, $y(n) = x(n-n_0)$

Here $n_0$ is the time shift.

If $n_0 > 0$, then waveform of $x(n)$ is shifted to right.

If $n_0 < 0$, then waveform of $x(n)$ is shifted to left.

Let us consider an example,

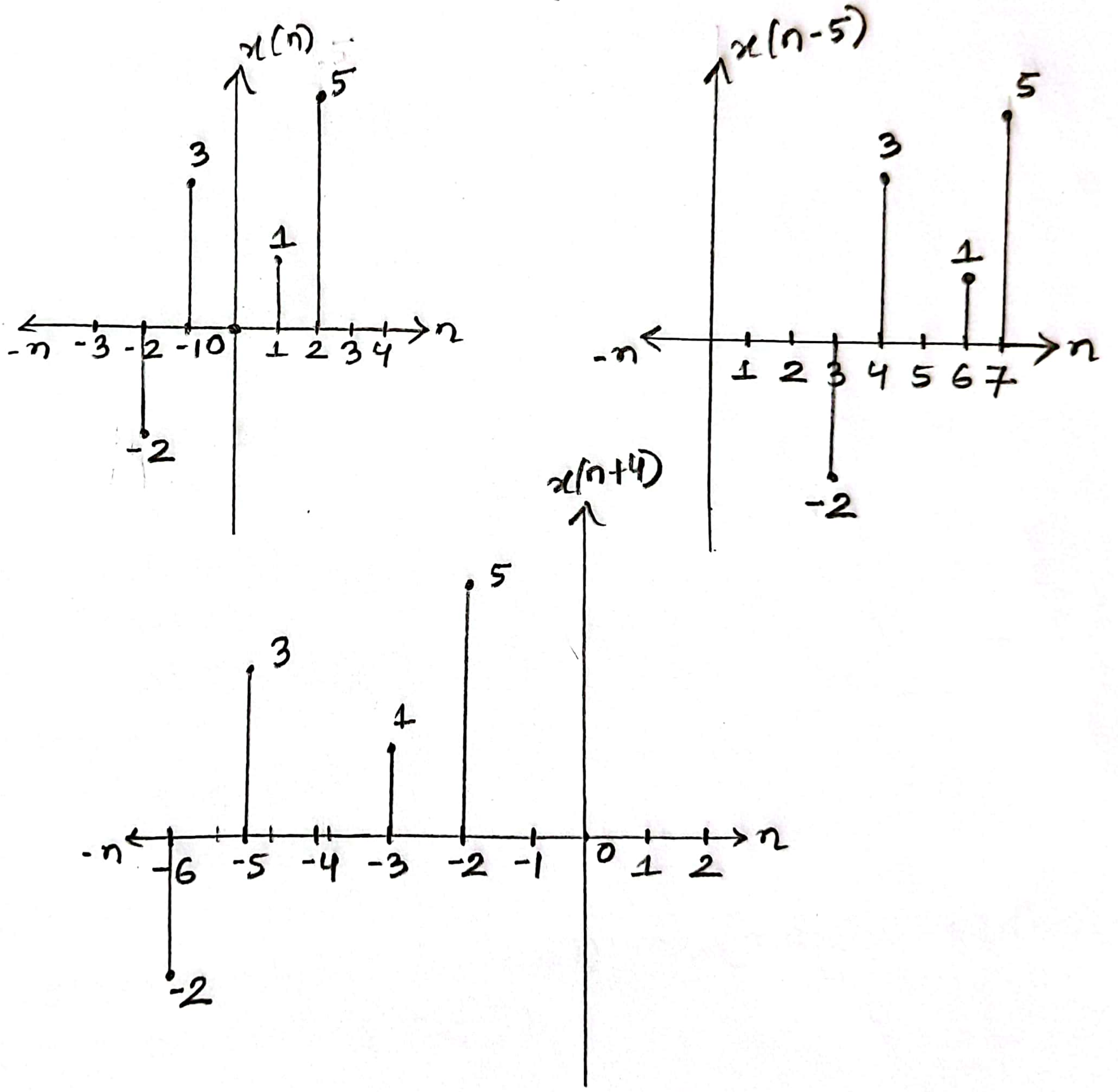
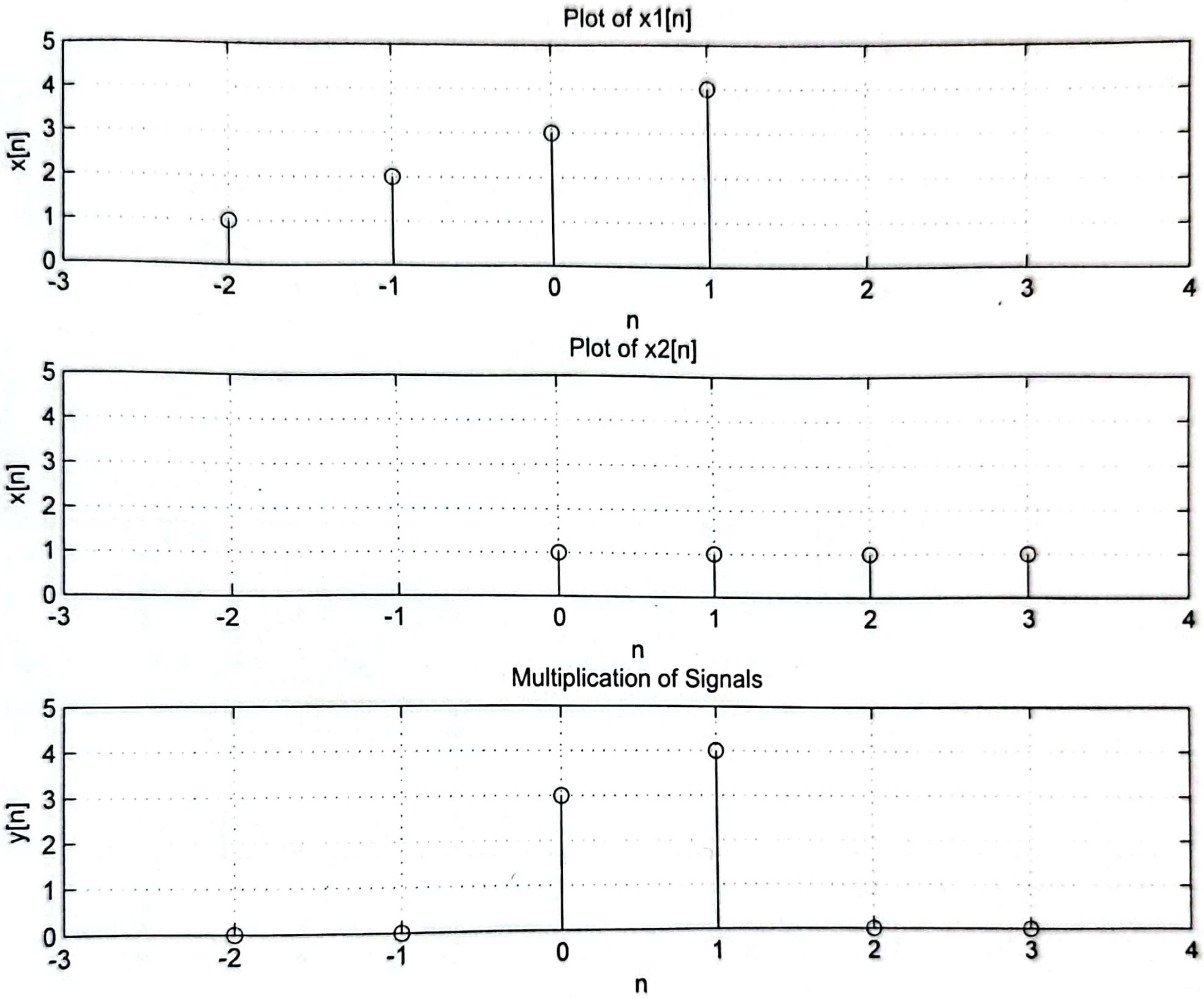


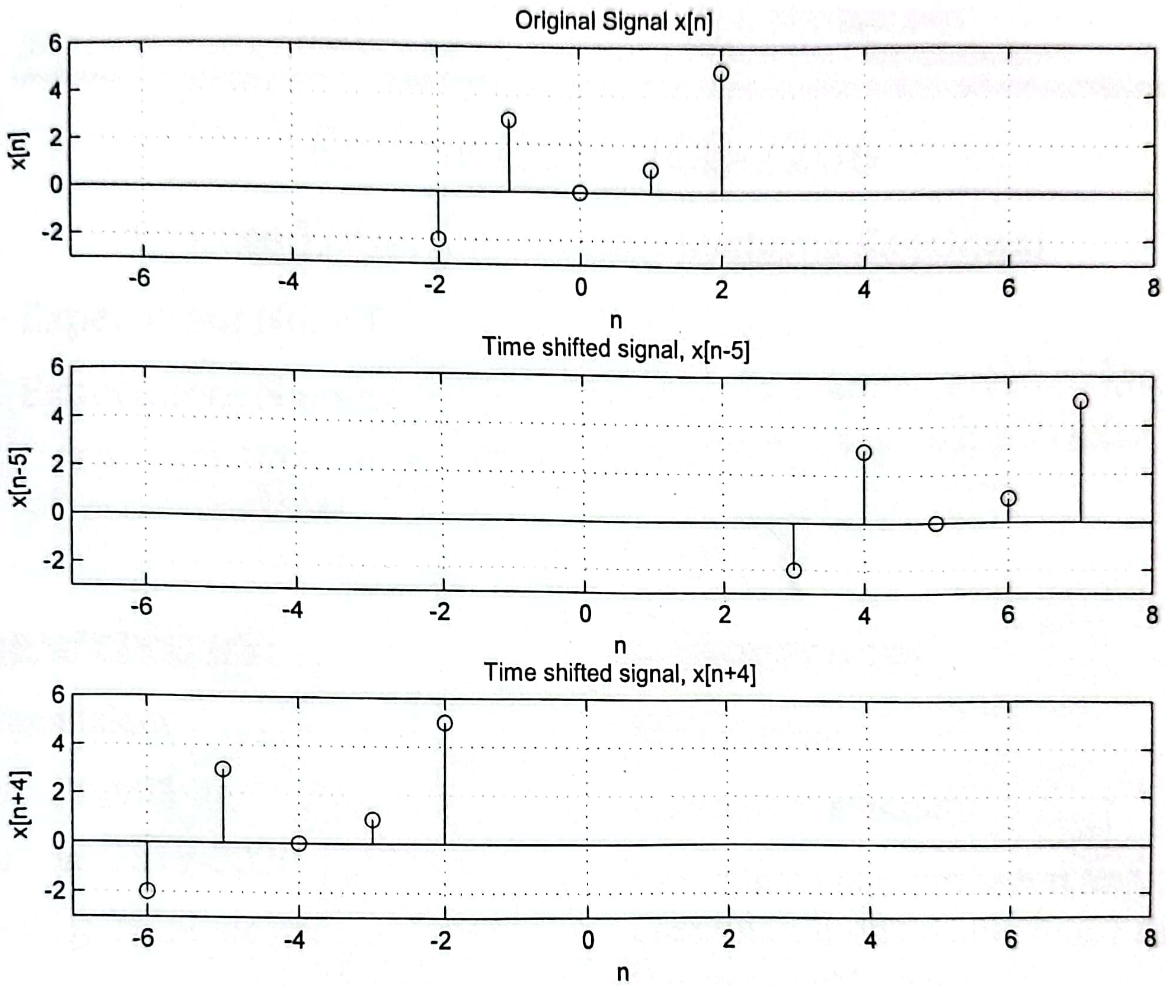

Figure-02: Time shifting of discrete signal

Source code:

```
clc;
clearall;
close all;
figure(1);
x1=[1,2 3 4]
n1 =-2:1;
subplot(3,1,1);
stem(n1,x1);
title('Plot of x1[n]');
xlabel('n');
ylabel('x[n]');
axis([-3,4,0,5]);
grid on;
x2 =[1 1 1 1];
n2 =0:3;
subplot(3,1,2);
stem(n2,x2);
title('Plot of x2[n]');
xlabel('n');
ylabel('x[n]');
axis([-3,4,0,5]);
grid on;
m= ~~sin~~ min(min(n1),min(n2)): max(max(n1),max(n2));
y1 = zeros(1, length(m));
temp =1;
for i=1: length(m)
    if(m(i) < min(n1) || m(i) > max(n1))
        y1(i) =0
```

```
ylabel('x[n]');
axis([-7,8,-3,6]);
grid on;
n1 =5;
a = n+n1;
suplpot(3,1,2);
stem(a,x);
title('Time sligted signal ; x[n-5]');
xlabel('n');
ylabel('x[n-5]');
axis[(-7, 8, -3,6]);
grid on;
n2 =4;
a = n-n2;
subplot(3,1,3);
stem(a,x);
title('Time shifted signal, x[n+4]);
xlabel('n');
ylabel('x(n+4)');
axis([-7, 8, -3, 6]);
grid on;
```


Plot of x1[n]
x[n]
n
Plot of x2[n]
x[n]
n
Multiplication of Signals
y[n]
n


Original Signal x[n]
x[n]
n
Time shifted signal, x[n-5]
x[n-5]
n
Time shifted signal, x[n+4]
x[n+4]
n

# PABNA UNIVERSITY OF SCIENCE AND TECHNOLOGY

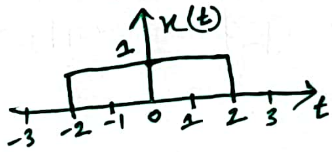
FACULTY OF ENGINEERING AND TECHNOLOGY
DEPARTMENT OF INFORMATION AND COMMUNICATION ENGINEERING

## Course Code: ICE-2206

### Course Tittle: Signals and Systems Sessional

**Experiment No:** 07

**Experiment Name:** Using MATLAB to plot the Fourier Transform of a time function, the aperiodic pulse shown below:





**SUBMITTED BY:**

**Naima Islam**

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Session: 2019-2020

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Department of Information and Communication Engineering, Pabna University of Science and Technology.


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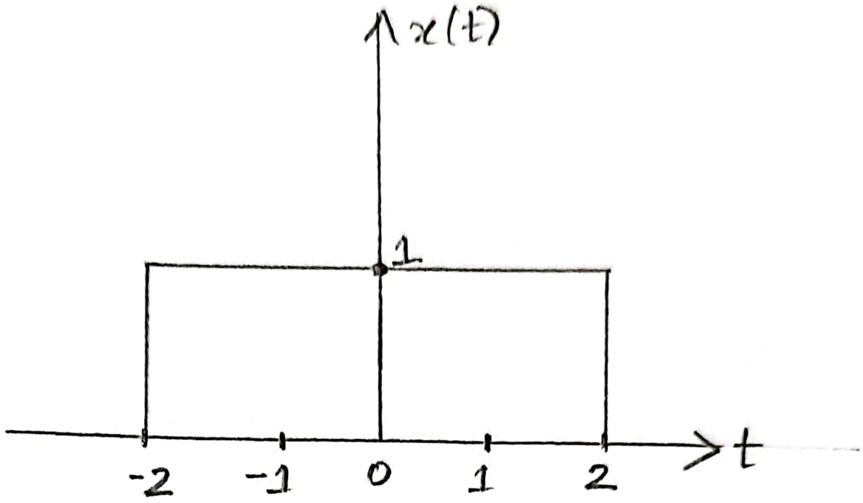
Experiment NO:07

Experiment name: Using matlab to plot the Fourier Transform of a time function, the aperiodic pulse shown bellow:

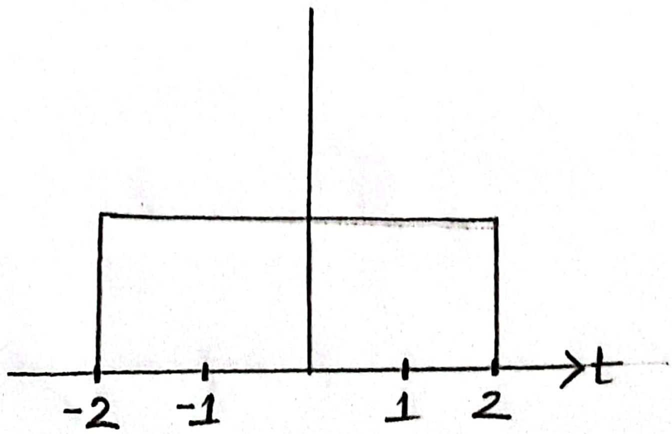



Theory: A Fourier Transform is a mathematical transform that decomposes function depending on time into function depending on frequency.

From the definition of continuous time Fourier transform, we know that

$$X(j\omega) = \int_{-\infty}^{\infty} x(t) e^{-j\omega t} dt$$

Let us consider the above given example,



By definition of Fourier Transform,

$$x(j\omega) = \int_{-\infty}^{\infty} x(t)\, e^{-j\omega t}\, dt$$

$$= \int_{-2}^{2} 1\, e^{-j\omega t}\, dt$$

$$= \left[ \frac{e^{-j\omega t}}{j\omega} \right]_{-2}^{2}$$

$$= \frac{e^{-2j\omega} - e^{-j\omega(-2)}}{-j\omega}$$

$$= \frac{e^{-2j\omega} - e^{2j\omega}}{-j\omega}$$

$$= \frac{2}{\omega} \frac{e^{2j\omega} - e^{-2j\omega}}{2j}$$

$$= \frac{2}{\omega} \sin(2\omega)$$

$$= \frac{2}{\omega} \sin\left(\frac{4\omega}{2}\right)$$

$$= \frac{\sin\left(\frac{4\omega}{2}\right)}{\frac{\omega}{2}}$$

$$= 4 \sin(4\omega/2) / (4\omega/2)$$

$$\cancel{\Rightarrow x[j\omega]}$$

$$\Rightarrow x[j\omega] = 4 \operatorname{sinc}\left(\frac{4\omega}{2}\right)$$

$$\Rightarrow x[jf] = 4 \operatorname{sinc}\left(\frac{4 \times 2\pi f}{2}\right)$$

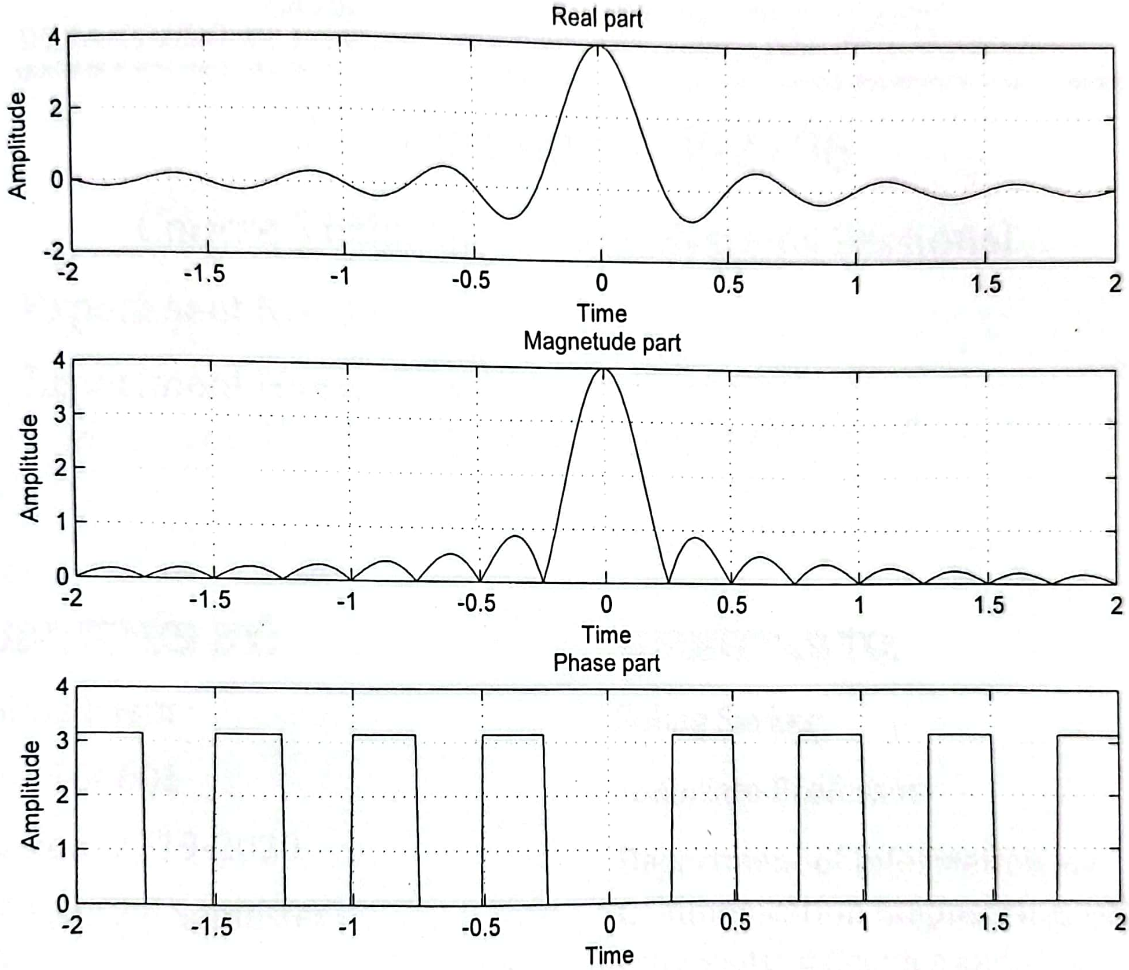
$$\Rightarrow x(jf) = 4 \operatorname{sinc}(4\pi f)$$

∴ The aperiodic pulse shown above has a fourier transform

$$x(jf) = 4 \operatorname{sinc}(4\pi f)$$

source code:

```
clc;
clear all;
close all;
f =-2;0.01;2;
x=4*sinc(4*f);
subplot(3,1,1);
plot(f,x);
xlabel('Time');
ylabel('Amplitude');
title('Real Part');
grid on;
subplot(3,1,2);
plot(t, angle(x));
xlabel('Time');
ylabel('Amplitude');
title('Phase part');
grid on;
subplot(3,1,3);
plot(t, abs(x));
xlabel('Time');
ylabel('Amplitude');
title('Magnetude part');
grid on;
```


Real part
Amplitude
Time
Magnetude part
Amplitude
Time
Phase part
Amplitude
Time

# PABNA UNIVERSITY OF SCIENCE AND TECHNOLOGY

**FACULTY OF ENGINEERING AND TECHNOLOGY**
**DEPARTMENT OF INFORMATION AND COMMUNICATION ENGINEERING**

## Course Code: ICE-2206

### Course Tittle: Signals and Systems Sessional

**Experiment No:** 08

**Experiment Name:** Explain and generate sinusoidal wave with different frequency MATLAB


**SUBMITTED BY:**

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Roll: **200601**

Session: 2019-2020

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**SUBMITTED TO:**

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Department of Information and Communication Engineering, Pabna University of Science and Technology.


**SIGNATURE**

Experiment NO: 08

Experiment Name: Explain and generate sinusoidal wave with different frequency using matlab.

Theory: A sinusoidal wave, also known as a sine wave, is a type of periodic wave that has a smooth, repetitive oscillation resembling a trigonometric sine function.

A sinusoidal wave can be characterized by its amplitude, frequency and phase. The amplitude refers to the maximum displacement of the wave from its equilibrium position, while the frequency represents the number of cycles per unit time, measured in Hz (hertz). The phase describes the displacement of the wave relative to a reference position, often expressed in degrees or radians.

Sinusoidal waves are commonly used to represent various physical phenomena, including sound waves, electromagnetic waves and mechanical waves. They are also used extensively in signal processing, communications and electronics, where they can be used to carry information, modulate other signals and filter unwanted noise or interference.

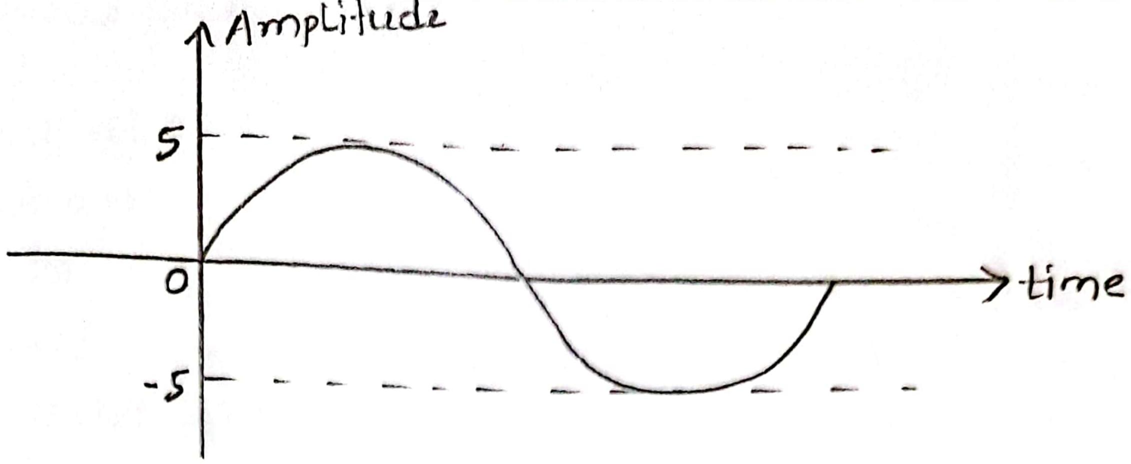



Figure-01: Sine wave

The equation of the sinusoidal curve is,

$$y = A_m \sin \omega t$$
$$= A_m \sin 2\pi f t$$

where,

$A_m$ = Amplitude

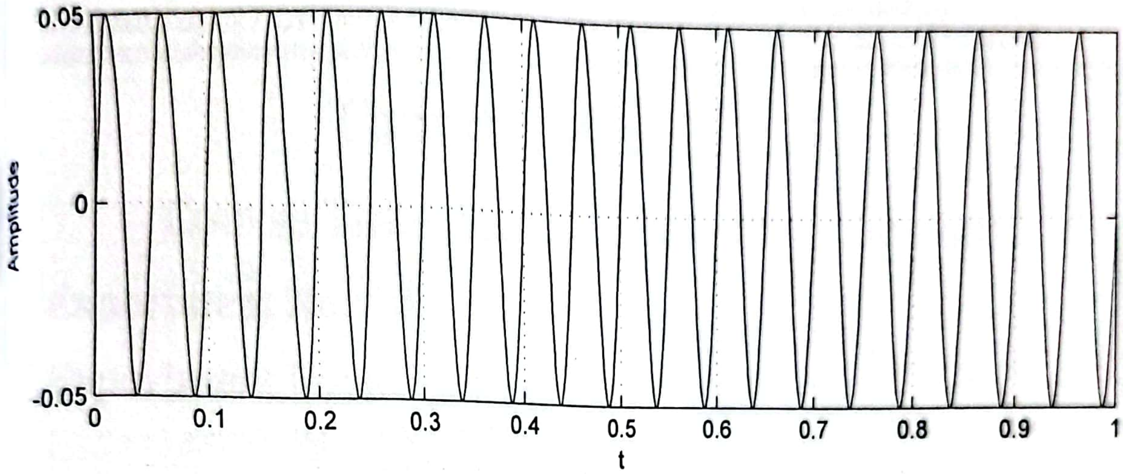
$f$ = frequency

$t$ = Period

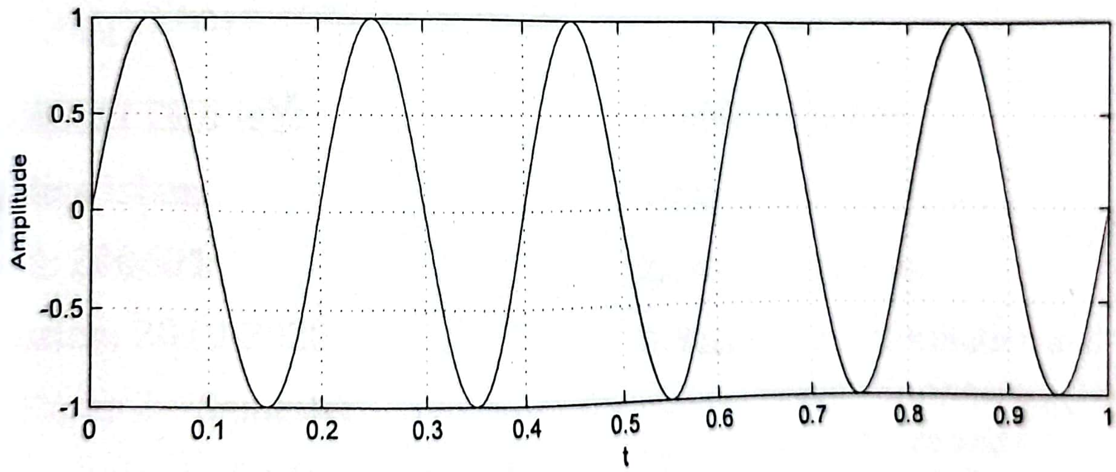
phase, $\theta = 0$

source code:

```
clc;
clear all;
close all;
f =20
t= 1/f
t1 = 0:t/100:1;
a=t
y =a*sin(2*pi*f * t1);
subplot(2,1,1)
plot(t1,y);
xlabel('time');
ylabel('Amplitude');
grid on;
Am=1
fm =5;
t = 0:0.001:1;
wm =2* pi *fm;
msg-sig = Am*sin(wm *t);
subplot(2,1,2);
plot(t , msg-sig);
xlabel ('time');
ylabel('Amplitude');
grid on;
```



0.05
0
-0.05
Amplitude
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
t

1
0.5
0
-0.5
-1
Amplitude
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
t

# ABNA UNIVERSITY OF SCIENCE AND TECHNOLOGY

পাবনা বিজ্ঞান ও প্রযুক্তি বিশ্ববিদ্যালয়

PABNA UNIVERSITY OF SCIENCE AND TECHNOLOGY

**FACULTY OF ENGINEERING AND TECHNOLOGY**
**DEPARTMENT OF INFORMATION AND COMMUNICATION ENGINEERING**

# Course Code: ICE-2206

## Course Tittle: Signals and Systems Sessional

**Experiment No:** 09

**Experiment Name:** Explain and implementation of follo
Elementary Discrete signal using MATLAB.
(i) The unit sample sequency, (ii) Unit step signal
(iii) Unit ramp signal.


**BMITTED BY:**

ima Islam

ll: 200601

ssion: 2019-2020

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iversity of Science and
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Associate Professor

Department of Information and
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University of Science and
Technology.


**SIGNATURE**

Experiment NO:09

Experiment Name: Explain and implementation of following elementary Discrete signal using matlab.
(i) Unit sample sequence, (ii) Unit step signal and (iii) Unit ramp signal.

Theory:

Unit sample sequence: Unit sample sequence is also called as unit impulse. The unit sample sequence is a sequence of discrete samples that has unit magnitude at origin and zero magnitude in all other samples at any instants.

The discrete time version of unit impulse is defined by $\delta(n) = \begin{cases} 1, & n=0 \\ 0, & n \neq 0 \end{cases}$

Impulse function has zero duration infinite amplitude and unit area under it.

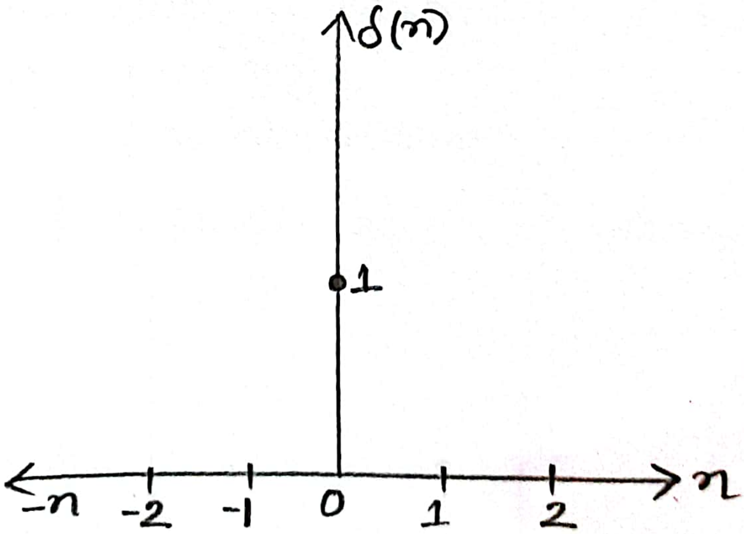



Figure-01: Graphical Representation of the unit sample signal.

**Unit step signal:** The discrete time unit step signal is denoted as $u(n)$ and is defined by

$$u(n) = \begin{cases} 1, & n \geq 0 \\ 0, & \text{otherwise} \end{cases}$$

The graphical representation of unit step function is,

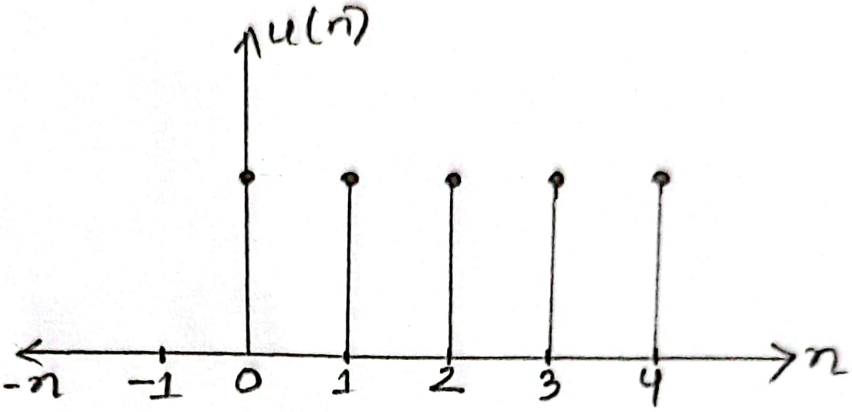



Figure-02: Graphical representation of unit step signal.

**Unit ramp signal:** The discrete time unit ramp signal is denoted as $r(n)$ and is defined as

$$r(n) = \begin{cases} n, & n \geq 0 \\ 0, & \text{otherwise} \end{cases}$$

Graphical representation of ramp signal is,

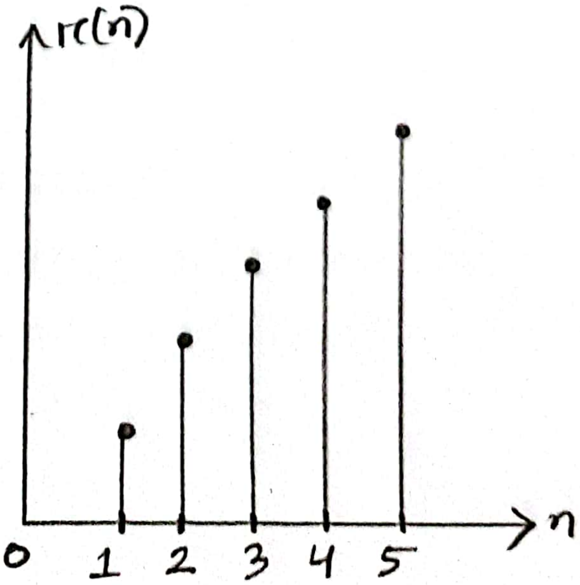
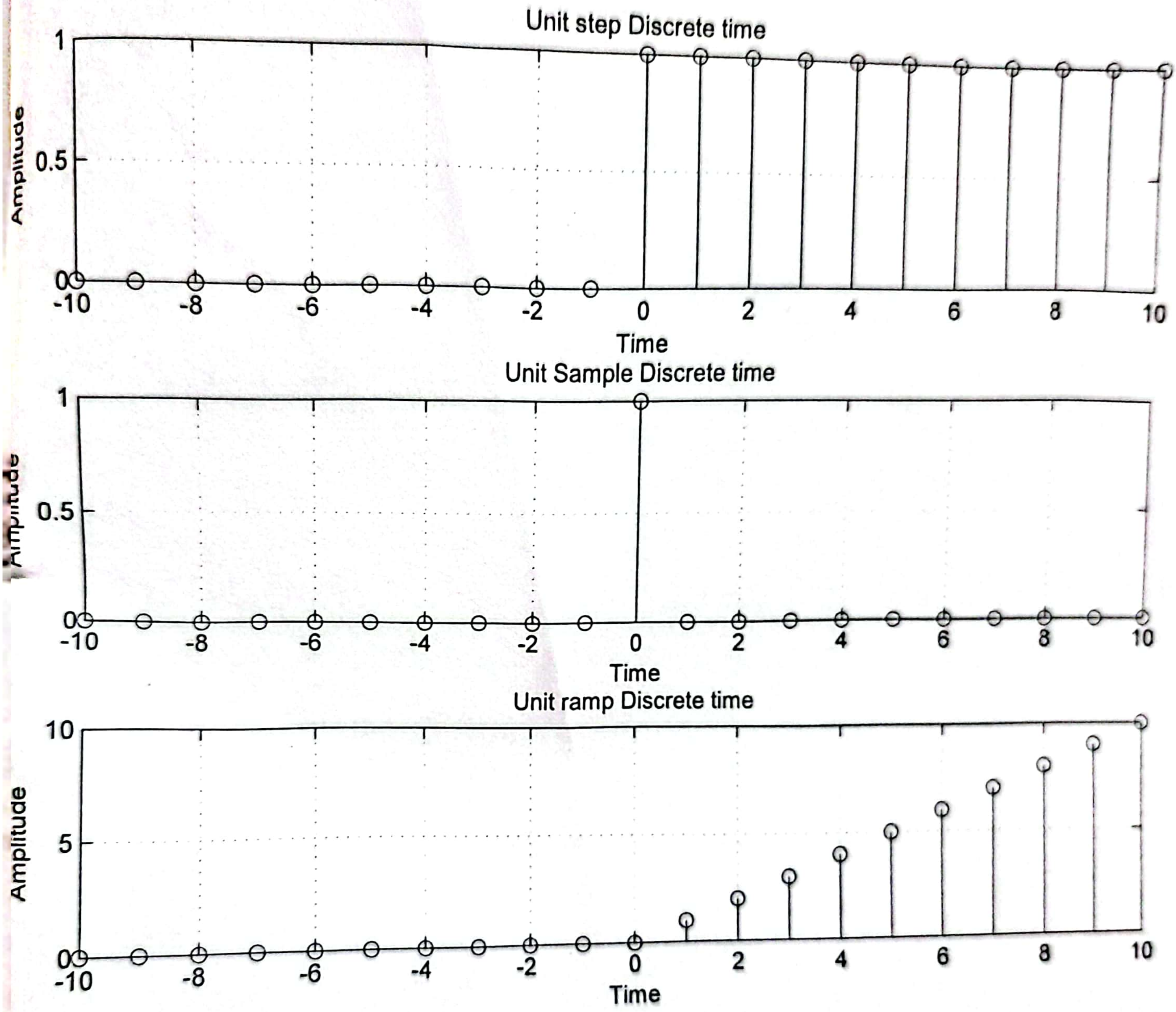



Figure-03: Graphical represantation of ramp-

source code:

```
clc;
close all;
clear all;
t=-10:1;10;
unitstep=t>=0;
unit sample=t==0;
unit-ramp=t.*unitstep;
subplot(3,1,1);
stemp(t, unitstep);
xlabel('Time');
Ylabel('Amplitude');
title('Unitstep Discrete time');
grid on;
subplot(3,1,2);
stem(t,unitsample);
xlabel('Time');
ylabel('Amplitude');
title('Unit sample Discrete time signal');
grid on;
subplot(3,1,3);
stem(t,unit-ramp);
xlabel('Time');
ylabel('Amplitude');
title('Unit ramp Discrete time');
grid on;
```


Unit step Discrete time
Amplitude
1
0.5
0
-10
-8
-6
-4
-2
0
2
4
6
8
10
Time
Unit Sample Discrete time
Amplitude
1
0.5
0
-10
-8
-6
-4
-2
0
2
4
6
8
10
Time
Unit ramp Discrete time
Amplitude
10
5
0
-10
-8
-6
-4
-2
0
2
4
6
8
10
Time