

# Jawaharlal Nehru Engineering College

## Laboratory Manual

### SIGNALS AND SYSTEMS

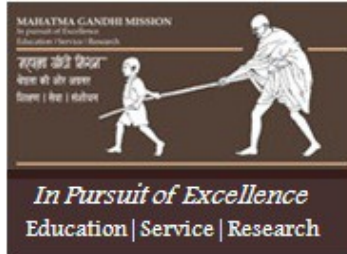
For

Second Year Students

Manual made by

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**MGM'S**

**Jawaharlal Nehru Engineering College  
N-6, CIDCO, Aurangabad  
Department of Electronics & Telecommunication**

**Vision of the Department:**

To develop **GREAT** technocrats and to establish centre of excellence in the field of **Electronics and Telecommunications**..\_

- ▶ **Global** technocrats with human values
- ▶ **Research** and lifelong learning attitude,
- ▶ **Excellent** ability to tackle challenges
- ▶ **Awareness** of the needs of society
- ▶ **Technical** expertise

**Mission of the Department:**

1. To provide good technical education and enhance technical competency by providing good infrastructure, resources, effective teaching learning process and competent, caring and committed faculty.
2. To provide various platforms to students for cultivating professional attitude and ethical values.
3. Creating a strong foundation among students which will enable them to pursue their career choice.

## Jawaharlal Nehru Engineering College

### Technical Document

This technical document is a series of Laboratory manuals of Electronics and Telecommunication Department and is a certified document of Jawaharlal Nehru Engineering College. The care has been taken to make the document error-free. But still if any error is found. Kindly bring it to the notice of subject teacher and HOD.

Recommended by,

HOD

Approved by,

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## FOREWORD

It is my great pleasure to present this laboratory manual for second year engineering students for the subject of Signals and Systems keeping in view the vast coverage required for visualization of concepts of Signals and Systems.

As a student, many of you may be wondering with some of the questions in your mind regarding the subject and exactly what has been tried is to answer through this manual.

Faculty members are also advised that covering these aspects in initial stage itself, will greatly relived them in future as much of the load will be taken care by the enthusiasm energies of the students once they are conceptually clear.

H.O.D.

## LABORATORY MANUAL CONTENTS

This manual is intended for the Second year students of engineering branches in the subject of Signals and Systems. This manual typically contains practical/Lab Sessions related Signals and Systems covering various aspects related to the subject to enhance understanding.

Students are advised to thoroughly go through this manual rather than only topics mentioned in the syllabus as practical aspects are the key to understanding and conceptual visualization of theoretical aspects covered in the books.

Good Luck for your Enjoyable Laboratory Sessions

Mr. V. V. Kashti

## SUBJECT INDEX

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### DOs and DON' Ts in Laboratory:

1. ~~Do not handle any equipment before~~ reading the instructions/Instruction manuals
2. Read carefully the power ratings of the equipment before it is switched on whether ratings 230 V/50Hz or 115V/60 Hz. For Indian equipments, the power ratings are normally 230V/50Hz. If you have equipment with 115/60 Hz ratings, do not insert power plug, as our normal supply is 230V/50 Hz, which will damage the equipment.
3. Observe type of sockets of equipment power to avoid mechanical damage
4. Do not forcefully place connectors to avoid the damage
5. Strictly observe the instructions given by the teacher/Lab Instructor

### Instruction for Laboratory Teachers::

1. Submission related to whatever lab work has been completed should be done during the next lab session.
2. The promptness of submission should be encouraged by way of marking and evaluation patterns that will benefit the sincere students.

## Pre-Lab

### Introduction to MATLAB

#### Questions:

- 1] What do you mean by MATLAB?
- 2] Describe all MATLAB windows in detail.(command window, Graphics window , Editor window, Workspace, command history, current directory)
- 3] Describe all basic MATLAB command with example.



## EXPERIMENT NO. 1

**AIM:** Program to generate basic elementary signals (Sinusoidal, unit-step, ramp, decaying exponential signal and impulse function).

**THEORY:** Write the theory about sinusoidal function, unit step, ramp, exponential function and unit step with diagrams and equations.

### PROGRAM:

```
clc; % clears the command window
clear all; % Removes all variables, functions leaving the workspace empty
close all; % closes figure window

% Continuous Time Sinusoidal Wave
t=0:0.1:10; % select the range of Time in the intervals
A=2; % assign value 2 to the variable A
yt=A*sin(2*pi*t/5); % sinusoidal function
subplot(421); % to plot multiple windows in single window (421)-> matrix
of->4 rows, 2 columns and 1st position
plot(t,yt,'r','linewidth',2); % Plot t vs yt along x-y axes
title('Continuous Time Sinusoidal Wave'); % Title the given Figure
xlabel('time'); % label X-axis
ylabel('amplitude'); % label Y-axis
grid on;

% Discrete Time Sinusoidal Wave
n=0:1:10;
yn=A*sin(2*pi*n/5);
subplot(422);

stem(n,yn,'r','linewidth',2); % plots the data sequence yn as stems that
extend from equally spaced
title('Discrete Time Sinusoidal Wave');
xlabel('n');
ylabel('amplitude');

grid on;

% Continuous Time Step Signal
t1=-10:0:10; % check the condition (t1>=0) and return true i.e., '1' to y1
y1=t1>=0;
subplot(423);
plot(t1,y1,'m','linewidth',2);
axis([-5 5 -0.5 1.5]); % manipulates commonly used axes properties
title('Continuous Time Step Signal');
xlabel('time');
ylabel('u(t)');
grid on;

% Discrete Time Step Signal
n1=-5:1:5;
yn1=n1>=0; subplot(424);
stem(n1,yn1,'s','m','linewidth',2);
axis([-5 5 -0.5 1.5]);
title('Discrete Time Step Signal');
```

```

xlabel('n');
ylabel('u(n)');
grid on;
% Continuous Time Ramp Signal
t2=0:0.1:10;
y2=t2; subplot(425);
plot(t2,y2,'g','linewidth',2);
title('Continuous Time Ramp Signal');
xlabel({'time'});
ylabel({'r(t)'});

grid on;

% Discrete Time Ramp Signal
n2=0:1:10;
yn2=n2; subplot(426);
stem(n2,yn2,'d','g','linewidth',2);
title('Discrete Time Ramp Signal');
xlabel({'time'});
ylabel({'r(n)'});

grid on;

% Continuous Time Decaying Exponential Signal
t3=0:0.1:10;
a=0.5;

y3=a.^t3; % assign y3 as a raise to the power t3
subplot(427);
plot(t3,y3,'linewidth',2);

title('Continuous Time Exponential Signal');
xlabel({'time'});

ylabel({'exp(t)'});
grid on;

% Discrete Time Decaying Exponential Signal
n3=0:1:10;
a=0.5;
yn3=a.^n3;
subplot(428);
stem(n3,yn3,'p','linewidth',2);
title('Continuous Time Exponential Signal');
xlabel({'n'});
ylabel({'exp(n)'});

grid on;

% part B
%to generate impulse

clc;
clear all;

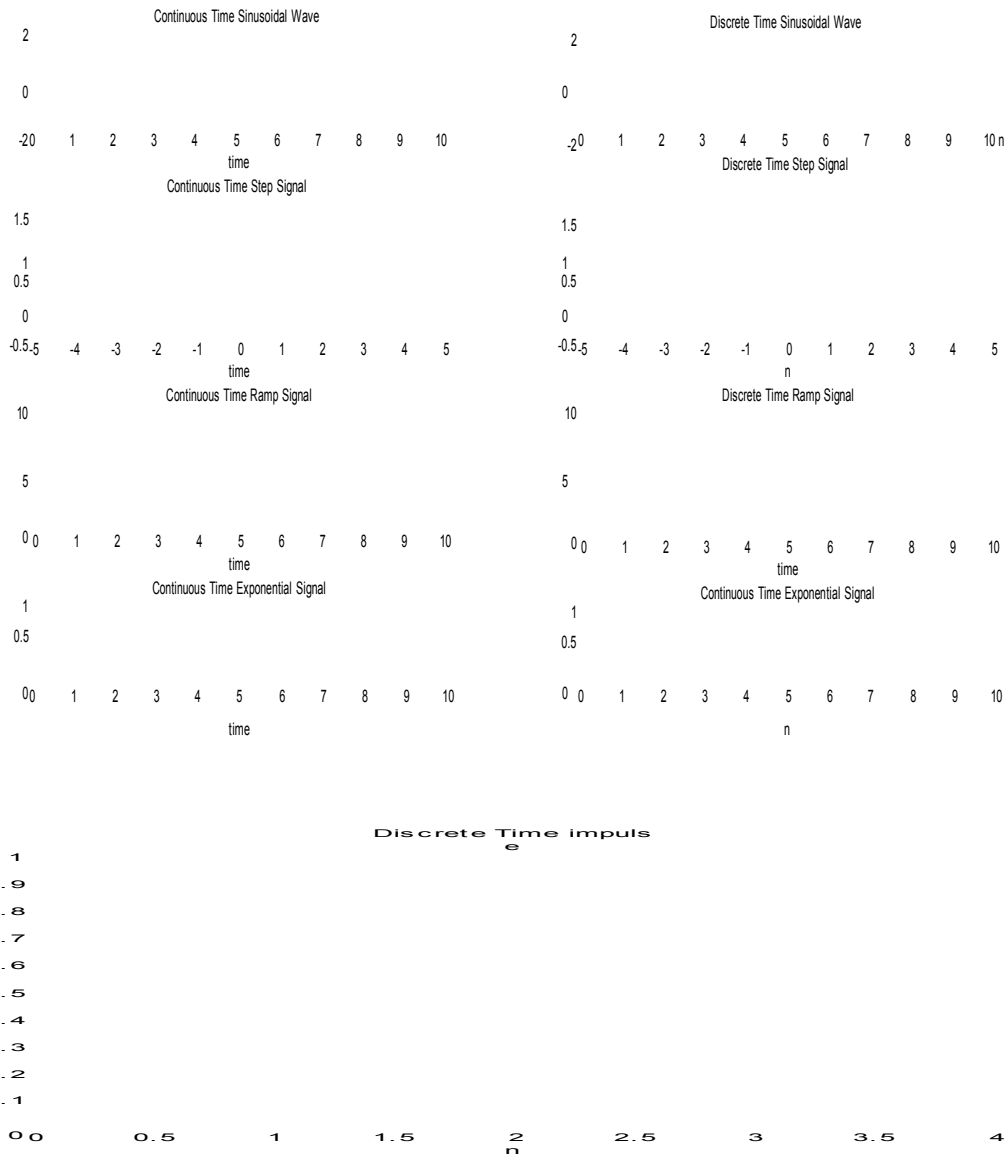
close all;
n=0:1:4;
y=[zeros(1,2),1,zeros(1,2)]; % assign zeros and 1 to the given array

stem(n,y,'p','linewidth',2);
title('Discrete Time impulse');
xlabel('n');

```

```
ylabel('delta(n)');
grid on;
```

**Result:**



**Conclusion:** Different basic elementary signals generation using MATLAB scripts have studied.

**Practice Work:** scaling, addition, subtraction, multiplication and division of the basic elementary signals.

## EXPERIMENT NO. 2

**AIM:** Program for sampling of continuous time signal.

**THEORY:** What is sampling? How to generate Discrete Time Signal from Continuous time signal?

### PROGRAM:

```
clear all;
close all;

% Program to generate sampling of a continuous time signal
t=0:0.001:10;
T=5;

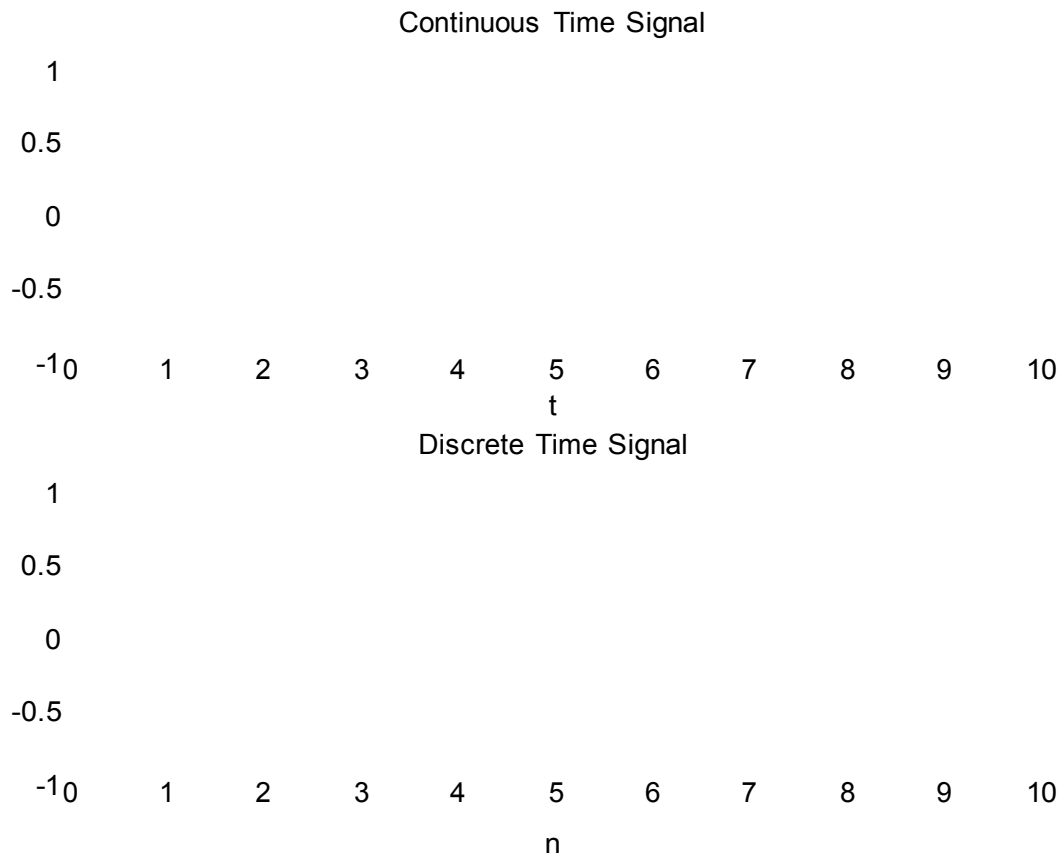
fm=1/T;
x=sin(2*pi*fm*t);
fs=5*fm;

n=0:10;

xn=sin(2*pi*n*fm/fs);
subplot(211);
plot(t,x);
xlabel('t');
ylabel('x(t)');
title('Continuous Time Signal');

subplot(212);
stem(n,xn);
xlabel('n');
ylabel('x(n)');
title('Discrete Time Signal');
```

**Result:**



**Conclusion:** Sampling of continuous time signal gives discrete time signal.

**Practice Work:** Check the results for different modulating and sampling frequencies and time periods of continuous time signals.

## EXPERIMENT NO. 3

**AIM:** Program for shifting of Discrete Time Signal.

**THEORY:** What are the basic operations on signals in time domain? Explain advancement and delay with examples in discrete and continuous time domain with signal waveforms.

### PROGRAM:

```
clc;
clear all;
close all;

x=input('enter the discrete signal sequence='); % displays and waits for
input from the keyboard
start=input('enter the starting position of sequence=');
n1=input('enter the sample delay number=');
n2=input('enter the sample advancement number=');

leng=length(x); % returns the size of the longest dimension of x
n=start:start+leng-1;

subplot(3,1,1);
stem(n,x);
axis([-5 8 -2 4]);
xlabel('n');
ylabel('x(n)');
title('Discrete time sequence');
grid on;

m=n+n1; y=x;
subplot(3,1,2);
stem(m,y);
axis([-5 8 -2 4]);
xlabel('n');
ylabel('x(n-n1)');
title('delayed signal');
grid on;

k=n-n2; z=x;
subplot(3,1,3);
stem(k,z);
axis([-5 8 -2 4]);
xlabel('n');
ylabel('x(n+n2)');
title('advanced signal');
grid on;
```

**command window:**

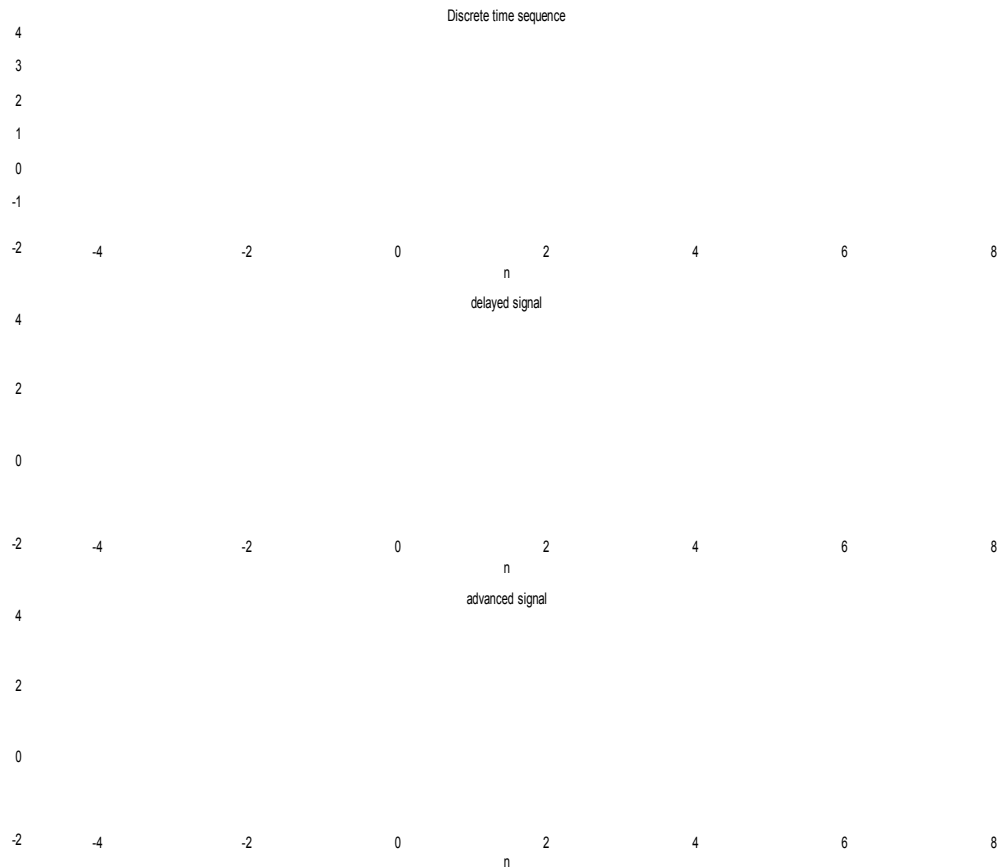
enter the discrete signal sequence=[1 0 -2 3 1]

enter the starting position of sequence=-1

enter the sample delay number=2

enter the sample advancement number=2

**Graph window:**



**Conclusion:** Advanced signal is appears before reference time and delayed signal appears after reference.

**Practice Work:** Check the results for different delay amount, signal pattern.



## EXPERIMENT NO. 4

**AIM:** Program for folding, folding-shifting and shifting-folding of a signal.

**THEORY:** What are basic operations on signals in time domain? Explain folding, folding shifting and shifting folding in discrete and continuous time domain with waveforms.

### PROGRAM:

```
clc;
clear all;
close all;

x=input('enter the discrete signal sequence=');
s=input('enter the starting position of sequence=');
n1=input('enter the sample delay number=');
n2=input('enter the sample advancement number=');

l=length(x);
n=s:s+l-1;

subplot(411);
stem(n,x);
axis([-6 6 -5 5]);
xlabel('n');
ylabel('x(n)');
title('Discrete sequence');
grid on;

x_inv=fliplr(x);
n_inv=fliplr(-n);
subplot(412);
stem(n_inv,x_inv);
axis([-6 6 -5 5]);
xlabel('n');
ylabel('x(-n)');
title('Folded signal');
grid on;

m=n_inv+n1;
y=x_inv;
subplot(413);
stem(m,y);
axis([-6 6 -5 5]);
xlabel('n'); ylabel('x(-n+no)'); title('advance and fold'); grid on;

k=n_inv-n2;
z=x_inv;
subplot(414);
```

```

stem(k,z);
axis([-6 6 -5 5]);
xlabel('n');
ylabel('x(-n-no)');
title('delay and fold / fold and advance');
grid on;

```

### command window:

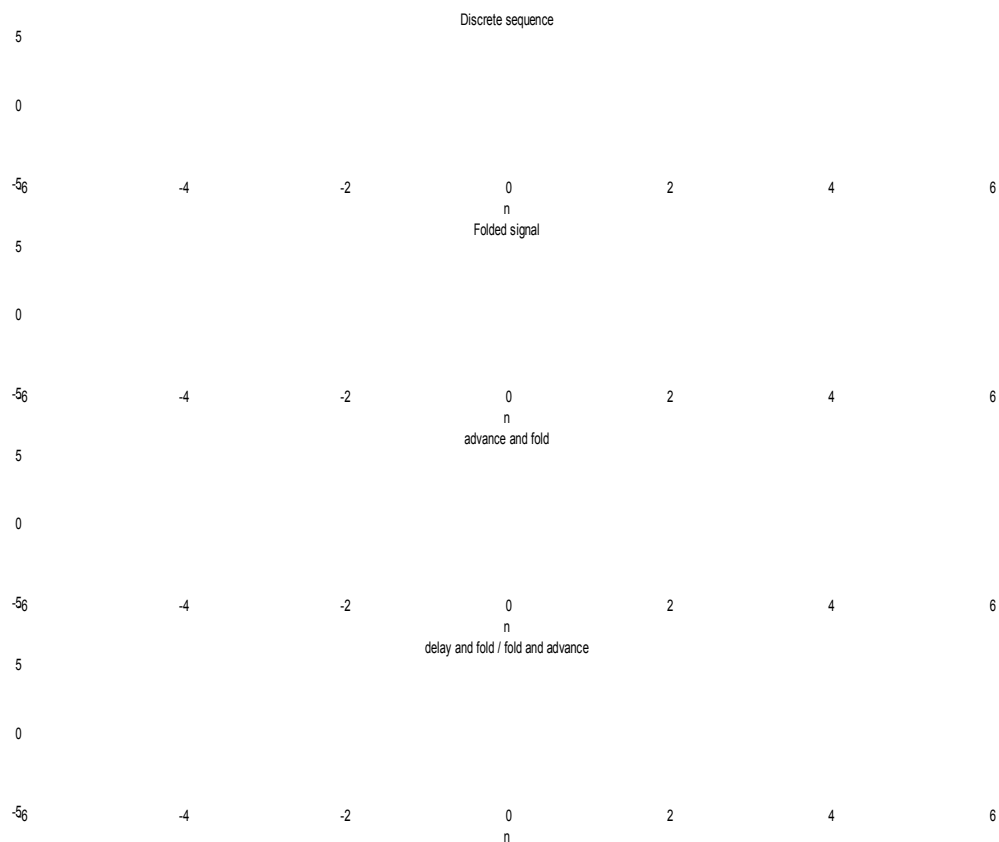
enter the discrete signal sequence=[1 0 -2 3 1]

enter the starting position of sequence=-1

enter the sample delay number=2

enter the sample advancement number=2

### Graph window:



**Conclusion:** We conclude, Folding followed by shifting and shifting followed by folding of the signal do not give same result.

## EXPERIMENT NO. 5

**AIM:** Program for convolution of two sequences.

**THEORY:** What is convolution? What are the methods to solve convolution, explain in detail with examples.

**PROGRAM:**

**Editor window:**

```
clc;
clear all;

% Program for convolution of two sequences:
startx=input('enter the starting position of sequence=');
x=input('enter the first sequence=');

starth=input('enter the starting position of sequence=');
h=input('enter the second sequence=');

lx=length(x);
lh=length(h);

nx=startx:startx+lx-1;
nh=starth:starth+lh-1;

subplot(221);
stem(nx,x,'linewidth',2);
xlabel('n');
ylabel('x(n)');
title('Discrete time first sequence');
grid on;

subplot(222);
stem(nh,h,'linewidth',2);
xlabel('n');
ylabel('h(n)');
title('Discrete time second sequence');
grid on;

y=conv(x,h); %convolve two sequences and return answer to y

n=startx+starth:1:startx+lx+starth+lh-2;
subplot(212);
stem(n,y,'linewidth',2);

xlabel('n');
ylabel('y(n)');

title('convolution of two sequences');
grid on;
```

**command window:**

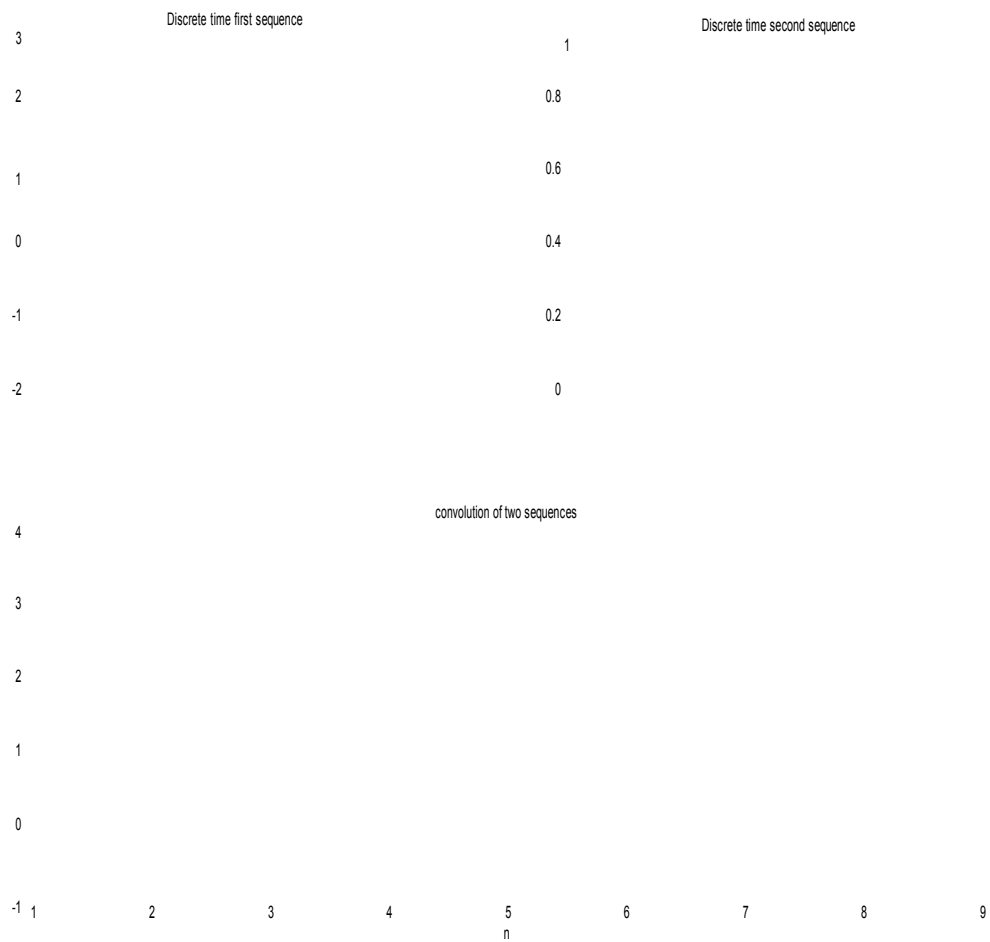
enter the starting position of sequence=-1

enter the first sequence=[1 0 -2 3 1]

enter the starting position of sequence=2

enter the second sequence=[1 1 1 1 1]

**Graph window:**



**Conclusion:** Convolution of two discrete time sequences has studied.

## EXPERIMENT NO. 6-A

**AIM:** Program for auto-correlation of two sequences.

**THEORY:** What is correlation? Explain with an example.

### PROGRAM:

```
clc;
clear all;

close all;

% Program for autocorrelation of a sequence:
startx=input('enter the starting position of sequence=');
x=input('enter the sequence=');

lx=length(x);

nx=startx:startx+lx-1;

subplot(211);
stem(nx,x,'linewidth',2);
xlabel('n');
ylabel('x(n)');
title('Discrete time sequence');

y=xcorr(x,x); %command to correlate the sequences

low=min(nx);
high=max(nx);

n_flip=fliplr(-nx);

low1=min(n_flip);
high1=max(n_flip);

n=low+low1:high+high1;

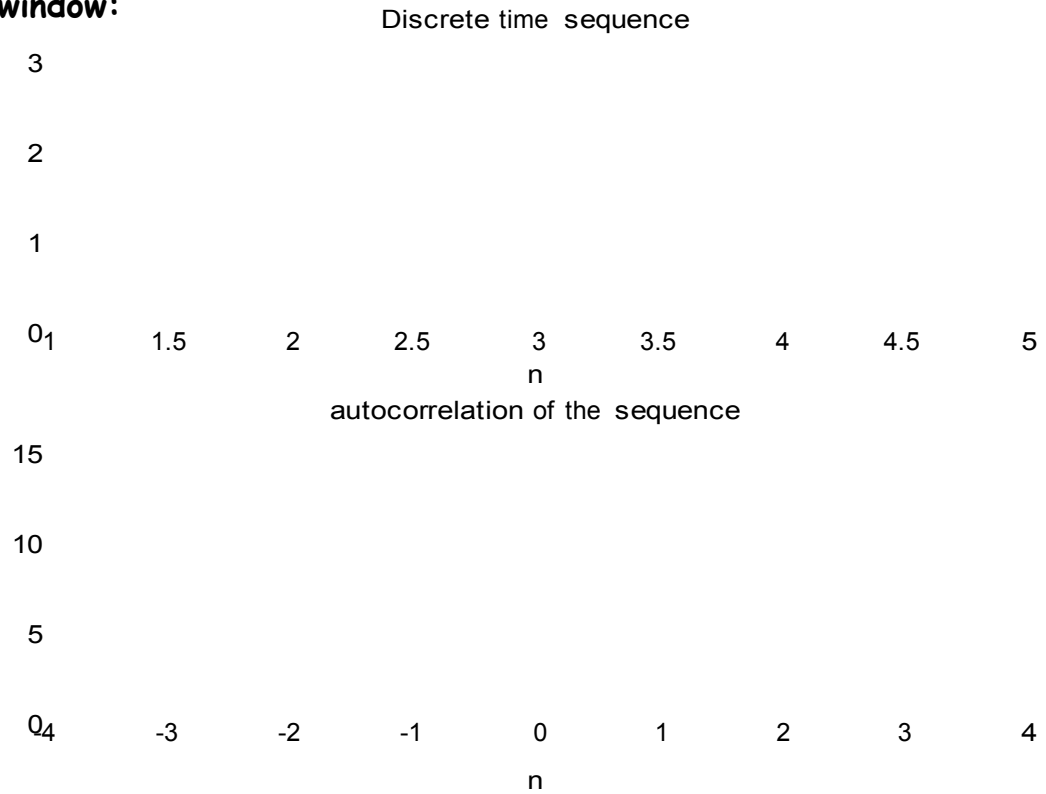
subplot(212);
stem(n,y,'linewidth',2);
xlabel('n');
ylabel('Y(n)');
title('autocorrelation of the sequence');
```

### Command window:

enter the starting position of sequence=1

enter the sequence=[1 0 1 3 1]

**Graph window:**



**Conclusion:** Autocorrelation of a sequence is maximum value at the center.

## EXPERIMENT NO. 6-B

**AIM:** Program for cross-correlation of two sequences.

**THEORY:** What is cross-correlation? Explain with an example using some method.

### PROGRAM:

```
clear all;
close all;

% Program for cross-correlation of two sequences:
startx=input('enter the starting position of first sequence=');
x=input('enter the first sequence=');

starth=input('enter the starting position of second sequence=');
h=input('enter the second sequence=');

lx=length(x);
lh=length(h);

nx=startx:startx+lx-1;
nh=starth:starth+lh-1;

subplot(221);
stem(nx,x,'linewidth',2);
xlabel('n');
ylabel('x(n)');
title('Discrete time first sequence');

subplot(222);
stem(nh,h,'linewidth',2);
xlabel('n');
ylabel('h(n)');
title('Discrete time second sequence');

y=xcorr(x,h);

low=min(nx);
high=max(nx);

n_flip=fliplr(-nh);

low1=min(n_flip);
high1=max(n_flip);

n=low+low1:high+high1;

subplot(212);
stem(n,y,'linewidth',2);
xlabel('n');
ylabel('y(n)');
```



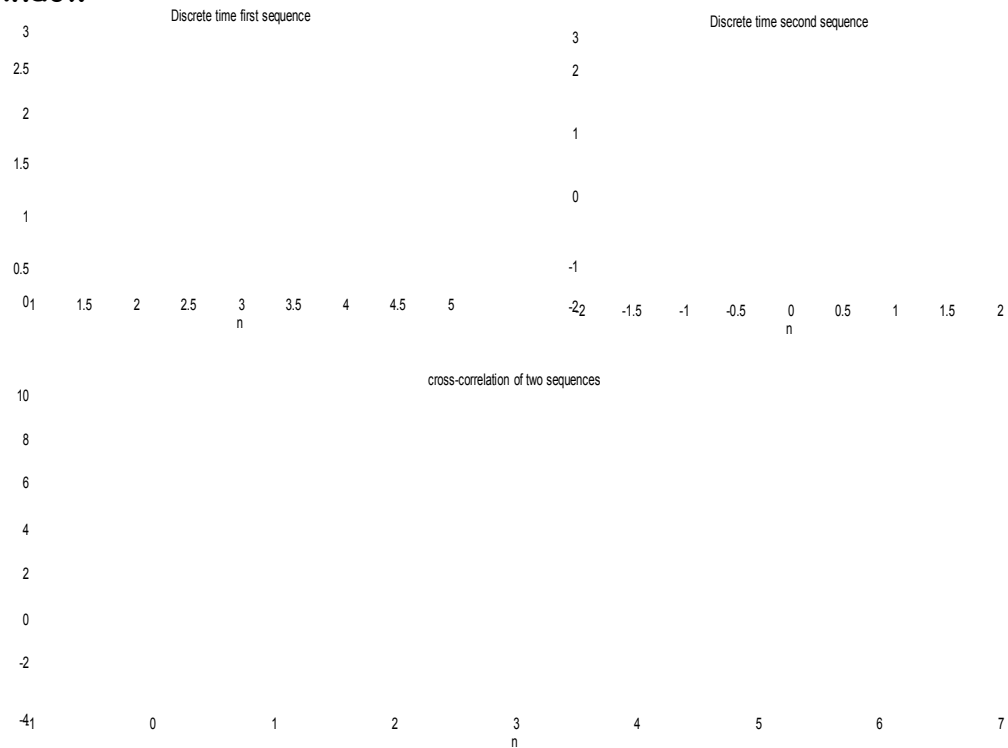
```
title('cross-correlation of two sequences');
```

### Command window:

enter the starting position of sequence=1

enter the sequence=[1 0 1 3 1]

### Graph window:



**Conclusion:** Cross-correlation of two sequences is maximum at the center.

## EXPERIMENT NO. 7

**AIM:** Program for generation of Discrete Time Impulse and to find impulse response.

**THEORY:** What is impulse? What do you mean by impulse response?

**PROGRAM:**

```
clc;
h=[1;zeros(99,1)];
stem(h);
xlabel('n');
ylabel('x(n)');
title('generation of discrete time impulse');
```

**Graph window:**

**Impulse Response:**

**Editor window:**

```
clc;
b=[1];
a=[1 -0.9];
```

```
imp=[1;zeros(49,1)];  
h=filter(b,a,imp);  
fvtool(b,a);
```

**Graph Window:**

**Conclusion:** Generation of Impulse and Impulse response has studied.

## EXPERIMENT NO. 8

**AIM:** Program to separate even and odd part of a signal.

**THEORY:** classify the signals? Explain the separation of even and odd part of a signal.

### PROGRAM:

```
n=-3:3;
x = [0 0 0 1 1 1 1];
xN = fliplr(x); % or xN=[1 1 1 1 0 0 0];
xN = x(length(x):-1:1);
xe =(x+xN)/2;
xo =(x-xN)/2;
subplot(4,1,1);
stem(n,x);
axis([-4 4 -0.5 1.5]);
grid;
ylabel('x(n)');
title('Demonstration of even-odd decomposition');
subplot(4,1,2);
stem(n,xN);
axis([-4 4 -0.5 1.5]);
grid;
ylabel('x[-n]') ;
subplot(4,1,3);
stem(n,xe);
axis([-4 4 -0.5 1.5]);
grid;
ylabel('xe[n]');
subplot(4,1,4);
stem(n,xo);
axis([-4 4 -0.5 1.5]);
grid;
ylabel('xo[n]');
xlabel('n');
```

**Graph window:**

**Conclusion:** The signal can be separation in its even and odd part and for even signals its odd part is zero and vice-versa.

**Practice Work:** Check the result for the following signal.

$$\begin{array}{ll} [0 \ 0 \ 1 \ 1 \ 1 \ 0 \ 0] & [0 \ 1 \ 1 \ 1 \ 1 \ 1 \ 0] \\ [0 \ 0 \ -1 \ 0 \ 1 \ 0 \ 0] & [0 \ -1 \ -1 \ 0 \ 1 \ 1 \ 0] \end{array}$$

## EXPERIMENT NO. 9

**AIM:** Program for linear convolution using Discrete Fourier Transform (DFT). **THEORY:** Define Fourier Transform? Explain its properties with examples.

### PROGRAM:

```
clc;
clear all;

close all;
x=input('enter the first sequence=');
h=input('enter the second sequence=');

xa=[x zeros(1,length(h)-1)];
ha=[h zeros(1,length(x)-1)];

X=fft(xa); %computes fourier transform
H=fft(ha);
Y=X.*H;

y=ifft(Y); % computes inverse fourier transform

disp('New Sequence');
disp(real(y));

subplot(221);
stem(x);
xlabel('n');
ylabel('x(n)');
title('Discrete time first sequence');

subplot(222);
stem(h);
xlabel('n');
ylabel('h(n)');
title('Discrete time second sequence');

subplot(212);
stem(y);
xlabel('n');
ylabel('y(n)');
title('Discrete time convolution sequence');
```

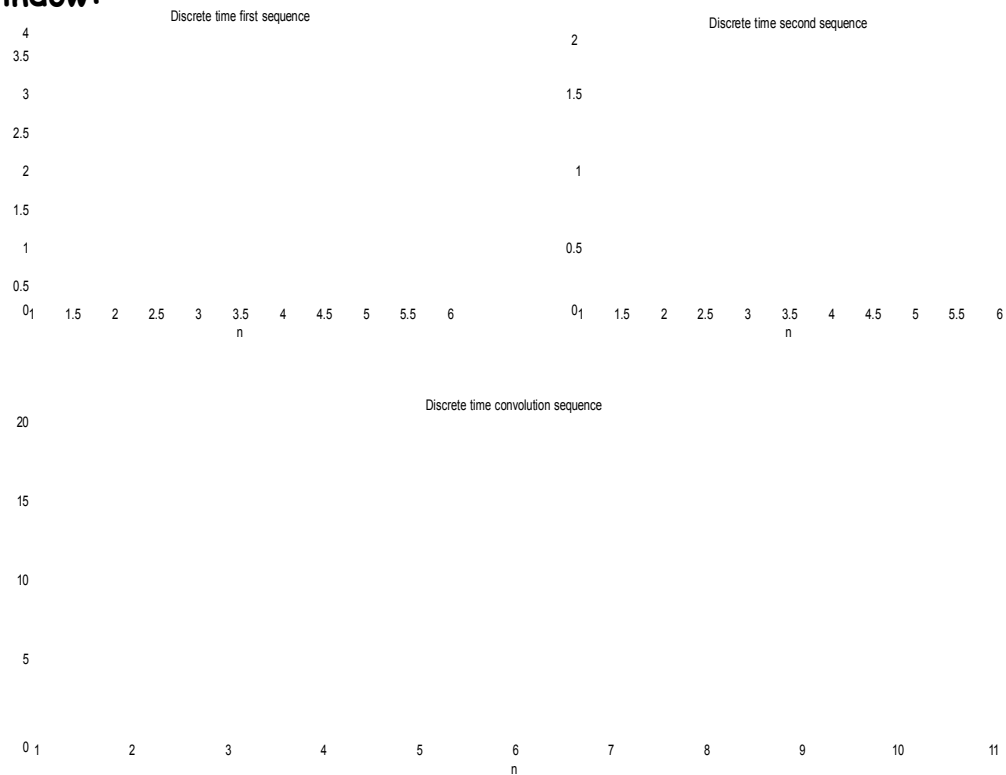
### Command window:

enter the first sequence=[2 1 3 4 2 1]

enter the second sequence=[1 2 2 1 1 1]

New Sequence

## Graph window:



**Conclusion:** Convolution in time domain is equivalent to multiplication in frequency domain and vice-versa.

**Practice Work:** Check the convolution using time domain convolution sum equation and check whether it is equivalent to the above result.

## 4. APPENDIX:

### *What is MATLAB?*

**MATLAB** is a high-performance language for technical computing. It integrates computation, visualization, and programming in an easy-to-use environment where problems and solutions are expressed in familiar mathematical notation.

The name MATLAB stands for *matrix laboratory*. MATLAB was originally written to provide easy access to matrix.

### **Starting and Quitting MATLAB**

--To start MATLAB, double-click the MATLAB shortcut icon on your Windows desktop. You will know MATLAB is running when you see the special ">>" prompt in the MATLAB Command Window.

--To end your MATLAB session, select Exit MATLAB from the File menu in the desktop, or type quit (or exit) in the Command Window, or with easy way by click on close button in control box.

### **Desktop Tools**

- **Command Window:** Use the Command Window to enter variables and run functions and M-files.
- **Command History:** Statements you enter in the Command Window are logged in the Command History. In the Command History, you can view previously run statements, and copy and execute selected statements.
- **Current Directory Browser:** MATLAB file operations use the current directory reference point. Any file you want to run must be in the current directory or on the search path.
- **Workspace:** The MATLAB workspace consists of the set of variables (named arrays) built up during a MATLAB session and stored in memory.

- **Editor/Debugger Window:** Use the Editor/Debugger to create and debug M-files



## Basic Commands

**clear Command:** Removes all variables from workspace.

**clc Command:** Clears the Command window and homes the cursor.

**help Command:** help displays help about that Topic if it exist.

**lookfor Command:** Provides help by searching through all the first lines of MATLAB help topics and returning those that contains a key word you specify.

**edit Command:** enable you to edit (open) any M-file in Editor Window. This command doesn't open built-in function like, sqrt. See also type Command.

**more command:** more on enables paging of the output in the MATLAB command window, and more off disables paging of the output in the MATLAB command window.

```
>> a=3 >> a=3; can you see the effect of semicolon " ; "
```

```
>> a+5 assign the sum of a and 5 to ans
```

```
>> b=a+5 assign the sum of a and 5 to b
```

```
>> clear a
```

```
>> a can you see the effect of clear command
```

```
>> clc clean the screen
```

```
>> b
```

## Working with Matrices

### *Entering Matrix*

The best way for you to get started with MATLAB is to learn how to handle matrices. You only have to follow a few basic conventions:

- Separate the elements of a row with blanks or commas.
- Use a semicolon ( ; ) to indicate the end of each row.
- Surround the entire list of elements with square brackets, [ ].

For Example >> A = [16 3 2 13; 5 10 11 8; 9 6 7 12; 4 15 14 1]

MATLAB displays the matrix you just entered.

```
A =  
16 3 2 13  
5 10 11 8  
9 6 7 12  
4 15 14 1
```

Once you have entered the matrix, it is automatically remembered in the MATLAB workspace. You can refer to it simply as A. Also you can enter and change the values of matrix elements by using workspace window.

### Subscripts

The element in row i and column j of A is denoted by A(i,j). For example, A(4,2) is the number in the fourth row and second column. For the above matrix, A(4,2) is 15. So to compute the sum of the elements in the fourth column of A, type

```
>> A(1,4) + A(2,4) + A(3,4) + A(4,4)  
ans = 34
```

You can do the above summation, in simple way by using sum command. If you try to use the value of an element outside of the matrix, it is an error.

```
>> t = A(4,5)
```

??? Index exceeds matrix dimensions.

On the other hand, if you store a value in an element outside of the matrix, the size increases to accommodate the newcomer. The initial values of other new elements are zeros.

```
>> X = A;  
>> X(4,5) = 17
```

```
X = 16 3 2 13 0  
5 10 11 8 0  
9 6 7 12 0  
15 14 1 17 17
```

The colon ":" is one of the most important MATLAB operators. It occurs in several different forms. The expression

```
>> 1:10 is a row vector containing the integers from 1 to 10  
1 2 3 4 5 6 7 8 9 10
```

To obtain nonunit spacing, specify an increment. For example,

```
>> 100:-7:50 100 93 86 79 72 65 58 51
```

Subscript expressions involving colons refer to portions of a matrix.

```
>> A(1:k,j) is the first k elements of the jth column of A
```

The colon by itself refers to all the elements in a row or column of a matrix and the keyword end refers to the last row or column. So

```
>> A(4,:) or >> A(4,1:end) give the same action  
ans = 4 15 14 1  
>> A(2,end) ans = 8
```

### Expressions

Like most other programming languages, MATLAB provides mathematical expressions, but unlike most programming languages, these expressions involve entire matrices. The building blocks of expressions are:

**1-Variable      2- Numbers      3- Operators      4- Functions**

### Variable

MATLAB does not require any type declarations or dimension statements. When MATLAB encounters a new variable name, it automatically creates the variable and allocates the appropriate amount of storage. If the variable already exists, MATLAB changes its contents and, if necessary, allocates new storage. For

example,

`num_students = 25` creates a 1-by-1 matrix named `num_students` and stores the value 25 in its single element.

Variable names consist of a letter, followed by any number of letters, digits, or underscores. MATLAB uses only the first 31 characters of a variable name. MATLAB is case sensitive; it distinguishes between uppercase and lowercase letters. `A` and `a` are not the same variable.

### Numbers

MATLAB uses conventional decimal notation, with an optional decimal point and leading plus or minus sign, for numbers. Scientific notation uses the letter ( `e` ) to specify a power-of-ten scale factor. Imaginary numbers use either `i` or `j` as a suffix. Some examples of legal numbers are

`3 -99 0.0001 9.6397238 1.60210e-20 6.02252e23 1i 3+5j`

Arithmetic Operator	Operator	Description
	<code>+</code>	Plus
	<code>-</code>	Minus
	<code>*</code>	Matrix multiply
	<code>.*</code>	Array multiply
	<code>^</code>	Matrix power
	<code>.^</code>	Array power
	<code>\</code>	Backslash or left matrix divide
	<code>/</code>	Slash or right matrix divide
	<code>.\</code>	Left array divide
	<code>/</code>	Right array divide
	<code>()</code>	Specify evaluation order

### Examples of Expressions

```
>> x = (1+sqrt(5))/2
```

```
x = 1.6180
```

```
>> a = abs(3+4i) a = 5
```

```
>> y=sin(pi/3)+cos(pi/4)-2*sqrt(3)
```

```
y = -1.8910
```

## 5. Quiz on the Subject

$x(n)$  is periodic with fundamental period

1) The discrete-time signal  $x(n] = (-$

- A) 6                      B) 4                      C) 2                      D) 0

2) The frequency of a continuous time signal  $x(t)$  changes on transformation from  $x(t)$  to  $x(\alpha t)$ ,  $\alpha > 0$  by a factor

- A)  $\alpha$                       B)  $1/\alpha$                       C)  $\alpha$                       D)

3) A useful property of the unit impulse  $\delta(t)$  is that

- A)  $\delta(at) = a \delta(t)$    B)  $\delta(at) = \delta(t)$    C)  $\delta(at) = (1/a)\delta(t)$    D)  $\delta(at) = [\delta(t)]_a$

4) The continuous time version of the unit impulse  $\delta(t)$  is defined by the pair of relations

$$\int_{-\infty}^{\infty} \delta(t) f(t) dt = f(0)$$

- A)  $\int_{-\infty}^{\infty} \delta(t) dt = 1$                       B)  $\delta(t) = 1, t=0$  and  $\delta(t) = 0, t \neq 0$

- C)  $\delta(t) = 0, t \neq 0$  and  $\int_{-\infty}^{\infty} \delta(t) dt = 1$                       D)

5) The Fourier transform of the exponential signal  $e^{j\omega_0 t}$  is

- A) a constant                      B) a rectangular gate                      C) an impulse                      D) a series of impulses

6) The auto-correlation function of a rectangular pulse of duration  $T$  is

- A) a rectangular pulse of duration  $T$                       B) a rectangular pulse of duration  $2T$   
 C) a triangular pulse of duration  $T$                       D) a triangular pulse of duration  $2T$

7) The Laplace transform of  $u(t)$  is

- A)  $1/s$                       B)  $s^2$                       C)  $s$                       D)  $1/s^2$

8) The function which has its Fourier transform, Laplace transform, and Z transform unity is

- A) Gaussian                      B) impulse                      C) Sinc                      D) pulse

9) The Fourier transform of impulse function is

- A)  $\delta(\omega)$                       B)  $2\pi\omega$                       C) 1                      D) sinc  $f$

10) Any Transform converts convolution of time signals to

- A) addition                      B) subtraction                      C) multiplication                      D) division

11) Finite length signals are generally \_\_\_\_\_ signals.

- A) energy                      B) power                      C) both E & P                      D) none

12) Power of energy signal is \_\_\_\_\_ and Energy of Power signal is \_\_\_\_\_.

A)  $\infty$  and 0                      B) 0 and  $\infty$                       C) both 0                      D) both  $\infty$

13) The signals which can be represented mathematically and whose value at any instance can be calculated are

A) random                      B) deterministic    C) non-deterministic    D) deterministic and non-deterministic

14) Integration of square wave is

A) impulse                      B) ramp                      C) triangular                      D) step

15) Which statement is TRUE

A) All static systems are causal but not all causal systems are static.

B) All causal systems are static but not all static systems are causal.

C) Both statements false

D) static and causal cannot be related

## **6. Conduction of VIVA-VOCE**

### **Examinations:**

Teacher should conduct oral exams of the students with full preparation. Normally the objective questions with guess are to be avoided. To make it meaningful, the questions should be such that depth of the student in the subject is tested. Oral Exams are to be conducted in co-cordial situation. Teachers taking oral exams should not have ill thoughts about each other & courtesies should be offered to each other in case of opinion, which should be critically suppressed in front of the students.

## **7. Evaluation and marking system:**

Basic honesty in the evaluation and marking system is essential and in the process impartial nature of the evaluator is required in the exam system. It is a primary responsibility of the teacher to see that right students who really put their effort & intelligence are correctly awarded.

The marking pattern should be justifiable to the students without any ambiguity and teacher should see that students are faced with just circumstance.