MARRI LAXMAN REDDY
INSTITUTE OF TECHNOLOGY AND MANAGEMENT
(AN AUTONOMOUS INSTITUTION)
(Approved by AICTE, New Delhi & Affiliated to JNTUH, Hyderabad)
Accredited by NBA and NAAC with 'A' Grade & Recognized Under Section2(f) & 12(B)of the UGC act,1956

Department of Electronics & Communication Engineering

LABORATORY MANUAL

BASIC SIMULATION & DIGITAL SYSTEM DESIGN LABORATORY

MLRS-R24

II B.TECH(ECE) - I Semester

Academic Year: 2025-2026

Prepared by

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PREFACE

This laboratory lays the foundation for the Electronics and Communication Engineering students during second year of their course. BS&DSD LAB can be divided into 2 groups: Hardware & Software. In Hardware lab, the students design, even Parity Generator, MUX, decoders, adder, subtractor, BCD adder, 4 bit magnitude comparator circuit. Flip-flop, synchronous/asynchronous, up/down counter. In Software, the students will MATLAB is used in this lab to simulate signals.Basic concepts of signals are coded and simulated. Analyze the generation Various Signals and Sequences in MATLAB, including the operations on Signals and Sequences. Determine the Convolution and Correlation between Signals and systems.

BY
Mr.CH. NAGABABU, Asst. Professor
Dr.B.ASHOK NAYAK, Asst. Professor

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ACKNOWLEDGEMENT

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We are deeply indebted and gratefully acknowledge the constant support and valuable patronage of Dr.R.Murali Prasad, Principal, Marri Laxman Reddy Institute of technology & Management for giving us this wonderful opportunity for preparing the Basic simulation & Digital design lab laboratory manual.

We express our hearty thanks to Dr.P.Sridhar, Director, Marri Laxman Reddy Institute of technology & Management, for timely corrections and scholarly guidance.

At last, but not the least I would like to thanks the entire ECE Department faculty those who had inspired and helped us to achieve our goal.

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GENERAL INSTRUCTIONS

1. Students are instructed to come to Basic simulation & Digital design laboratory on time. Late comers are not entertained in the lab.
2. Students should be punctual to the lab. If not, the conducted experiments will not be repeated.
3. Students are expected to come prepared at home with the experiments which are going to be performed.
4. Students are instructed to display their identity cards before entering into the lab.
5. Students are instructed not to bring mobile phones to the lab.
6. Any damage/loss of equipments like transformers, transistors, CRO's etc., during the lab session, it is student's responsibility and penalty or fine will be collected from the student.
7. Students should update the records and lab observation books session wise. Before leaving the lab the student should get his lab observation book signed by the faculty.
8. Students should submit the lab records by the next lab to the concerned faculty members in the staffroom for their correction and return.
9. Students should not move around the lab during the lab session.
10. If any emergency arises, the student should take the permission from faculty member concerned in written format.
11. The faculty members may suspend any student from the lab session on disciplinary grounds.
12. Never copy the output from other students. Write down your own outputs.

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Department of Electronics & Communication Engineering

VISION AND MISSION OF THE INSTITUTE

INSTITUTE VISION:

To be a globally recognized institution that fosters innovation, excellence, and leadership in education, research, and technology development, empowering students to create sustainable solutions for the advancement of society.

INSTITUTE MISSION:

- To foster a transformative learning environment that empowers students to excel in engineering, innovation, and leadership.
- To produce skilled, ethical, and socially responsible engineers who contribute to sustainable technological advancements and address global challenges.
- To shape future leaders through cutting-edge research, industry collaboration, and community engagement.

QUALITY POLICY

The management is committed in assuring quality service to all its stakeholders, students, parents, alumni, employees, employers, and the community.

Our commitment and dedication are built into our policy of continual quality improvement by establishing and implementing mechanisms and modalities ensuring accountability at all levels, transparency in procedures, and access to information and actions.

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Department of Electronics & Communication Engineering

VISION AND MISSION OF THE DEPARTMENT

DEPARTMENT VISION:

To provide quality technical education in Electronics and Communication Engineering through research, innovation, striving for global recognition in specified domain, leadership, and sustainable societal solutions.

MISSION:

DM1: To create a transformative learning environment that empowers students in electronics and communication engineering, fostering excellence intechnical skills and leadership.

DM2: To drive innovation through cutting-edge research, deliver a transformative education grounded in ethical principles, and nurture the development of professionals

DM3: To cultivate strong industry partnerships, and engaging actively with the community for societal and technological progress.

PROGRAMME EDUCATIONAL OBJECTIVES

1. **PEO 1:** have successful **careers in Industry.**
2. **PEO 2:** show excellence in **higher studies/ Research.**
3. **PEO 3:** Show good competency towards **Entrepreneurship.**

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PROGRAM OUTCOMES

1	**Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2	**Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3	**Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4	**Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5	**Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6	**The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7	**Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8	**Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9	**Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10	**Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11	**Project management and finance**: Demonstrate knowledge and underst and ing of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12	**Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES	
PSO1	Analyze and design analog & digital circuits or systems for a given specification and function.
PSO2	Implement functional blocks of hardware-software co-design for signal processing and communication applications.

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COURSE STRUCTURE, OBJECTIVES

COURSE STRUCTURE

Laboratory subjects – Internal and external evaluation– Details of marks

Digital Signal Processing lab will have a continuous evaluation during 6th semester for 40 sessional marks and 60 end semester examination marks.

Out of the 40 marks for internal evaluation, day-to-day work in the laboratory shall be evaluated for 20 marks and internal practical examination shall be evaluated for 20 marks conducted by the laboratory teacher concerned.

The end examination will be evaluated for a maximum of 60 marks. The end semester examination shall be conducted with an external examiner and internal examiner. The external examiner shall be appointed by the principal / Chief Controller of examinations.

Course Objectives:

The students will try to learn

- Various signals and various operations on signals
- Laplace and Fourier transform of a signal and its frequency response
- Random process characteristics
- Algebraic expressions using logic gates
- Adder and subtractor circuits, flip flop operation & sequential circuits using flip flops
- Combinational circuits like mux, decoder, encoder

and Deep Learning, etc.

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2430472: BASIC SIMULATION & DIGITAL SYSTEM DESIGN LABORATORY

II Year B.Tech. ECE I – Sem.

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Couse Overview:

MATLAB plays a crucial role in Digital System Design Labs by providing essential tools and capabilities for simulation, algorithm development, testing, and education. Its versatility, ease of use, and integration with hardware platforms make it an indispensable tool for engineers and students alike in the field of digital system design. This Laboratory also serves as hardware implementation in various domains of digital system design, Signal and Image Processing, Data Visualization and Analysis, Control Systems Design, Machine Learning and Deep Learning, etc.

Course Objectives:

The students will try to learn

- Various signals and various operations on signals
- Laplace and Fourier transform of a signal and its frequency response
- Random process characteristics
- Algebraic expressions using logic gates
- Adder and subtractor circuits, flip flop operation & sequential circuits using flip flops
- Combinational circuits like mux, decoder, encoder

Course Outcomes:

After successful completion of the course, students shall be able to

- Examine the applications of signal analysis and system design
- Acquire the basic knowledge of digital logic levels and to design and verify basic digital electronics circuits
- Understand combinational and sequential circuit analysis and design
- Apply Laplace and Fourier transforms of a signal and also analyze its frequency response
- Design optimization methods using random logic gates, multiplexers, decoders, registers, counters.

List of Experiments:

•Basic Simulation Lab:

1. Generation of Various Signals and Sequences (Periodic and Aperiodic).
2. Operations on Signals and Sequences such as Addition, Multiplication, Scaling, Shifting, Folding, Computation of Energy and Average Power.
3. Convolution and for Correlation (ACF and CCF) Signals and sequences.
4. Verification of Linearity and Time Invariance Properties of a given Continuous/Discrete System.
5. Computation of Unit sample, Unit step and Sinusoidal responses of the given LTI system.
6. Gibbs Phenomenon Simulation.
7. Finding the Fourier Transform of a given signal and plotting its magnitude and phase spectrum.
8. Locating the Zeros and Poles and plotting the Pole-Zero maps in S-plane and Z-Plane for the given transfer function.
9. Verification of Sampling Theorem.
10. Checking a Random Process for Stationary in Wide sense.

• Digital System Design Lab:

1. Realization of Boolean expressions using gates.
2. Generation of clock using NAND / NOR gates.
3. Design a 4 – bit adder/subtractor.
4. Design and realization of a 4-bit gray to binary and binary to gray Converter.
5. Design and realization of an 8-bit parallel load and serial out shift register using flip-flops.
6. Design and realization of a synchronous and asynchronous counter using flip-flops.
7. Design and realization of 8x1 MUX using 2x1 MUX.
8. Design and realization of 4-bit comparator.
9. Design a Ring counter and Twisted ring counter using a 4-bit shift register
10. Design and Realization of a sequence detector-a finite state machine.

Note:

- All the Basic Simulation Lab experiments are to be simulated using MATLAB/SCI LAB or equivalent software.

Minimum of 14 experiments (7 from Basic Simulation and 7 from Digital System Design Lab) are to be completed.

EXPERMENT NO: 1

GENERATION OF VARIOUS SIGNALS&SEQUENCES

AIM: -To write a "MATLAB" Program to generate various signals and sequences, such as unit impulse, unit step, unit ramp, sinusoidal, square, saw tooth, triangular, sinc signals.

SOFTWARE REQURIED:-

1. MATLAB R2010a.
2. Windows XP SP2.

THEORY:-

One of the more useful functions in the study of linear systems is the "unit impulse function." An ideal impulse function is a function that is zero everywhere but at the origin, where it is infinitely high. However, the *area* of the impulse is finite. This is, at first hard to visualize but we can do so by using the graphs shown below.

Key Concept: Sifting Property of the Impulse

If b>a, then

$$\int_a^b \delta(t-T)\cdot f(t)dt = \begin{cases} f(T), & a < T < b \\ 0, & \text{otherwise} \end{cases}$$

Example: Another integral problem

Assume a<b, and evaluate the integral

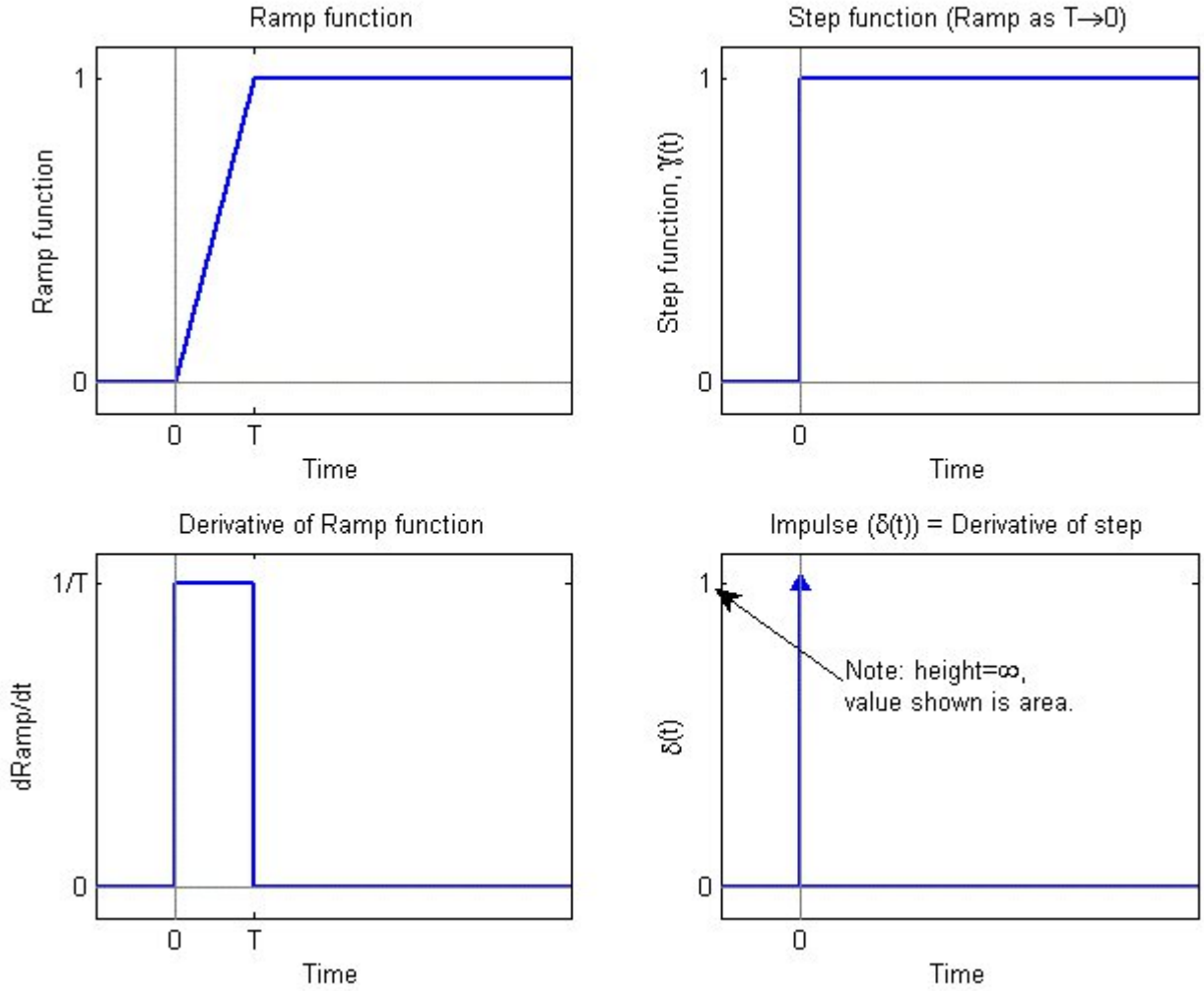
$$\int_a^b \delta(t)\cdot f(t-T)dt$$

Solution:

We now that the impulse is zero except at t=0 so

$$\delta(t)\cdot f(t-T) = \delta(t)\cdot f(0-T) = \delta(t)\cdot f(-T)$$

And



$$\int_a^b \delta(t)\cdot f(t-T)dt = \int_a^b \delta(t)\cdot f(-T)dt$$

$$= f(-T)\cdot\int_a^b \delta(t)dt$$

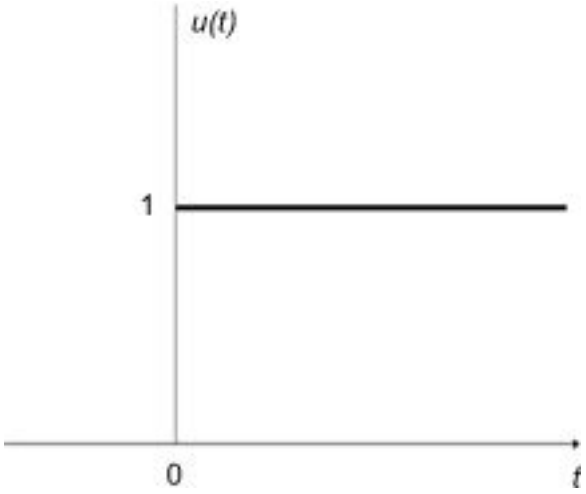
$$= \begin{cases} f(-T), & a < 0 < b \\ 0, & \text{otherwise} \end{cases}$$

Unit Step Function

The unit step function and the impulse function are considered to be fundamental functions in engineering, and it is strongly recommended that the reader becomes very familiar with both of these functions.

The unit step function, also known as the Heaviside function, is defined as such:

$$u(t) = \begin{cases} 0, & \text{if } t < 0 \\ 1, & \text{if } t > 0 \\ \frac{1}{2}, & \text{if } t = 0 \end{cases}$$



Sometimes, u(0) is given other values, usually either 0 or 1. For many applications, it is irrelevant what the value at zero is. u(0) is generally written as undefined.

Derivative

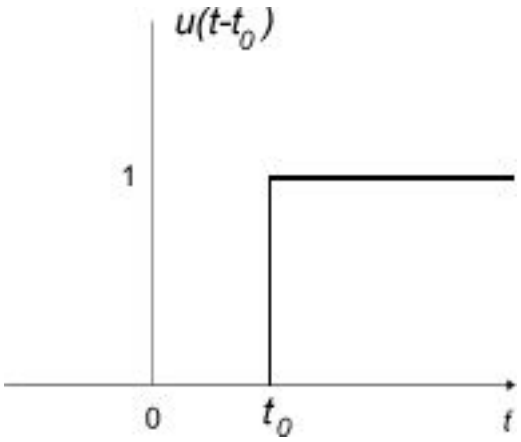
The unit step function is level in all places except for a discontinuity at t = 0. For this reason, the derivative of the unit step function is 0 at all points t, except where t = 0. Where t = 0, the derivative of the unit step function is infinite.

The derivative of a unit step function is called an **impulse function**. The impulse function will be described in more detail next.

Integral

The integral of a unit step function is computed as such:

$$\int_{-\infty}^{t} u(s)ds = \left\{ \begin{matrix} 0, & \text{if } t < 0 \\ \int_0^t ds = t, & \text{if } t \geq 0 \end{matrix} \right\} = tu(t)$$



Sinc Function

There is a particular form that appears so frequently in communications engineering, that we give it its own name. This function is called the "Sinc function" and is discussed below:

The Sinc function is defined in the following manner:

$$\operatorname{sinc}(x) = \frac{\sin(\pi x)}{\pi x} \text{ if } x \neq 0$$

And

Sinc(0)=1

The value of sinc(x) is defined as 1 at x = 0, since

$$\lim_{x \to 0} \operatorname{sinc}(x) = 1$$

This fact can be proven by noting that for x near 0,

$$1 > \frac{\sin(x)}{x} > \cos(x)$$

Then, since cos(0) = 1, we can apply the *Squeeze Theorem* to show that the sinc function approaches one as x goes to zero. Thus, defining sinc(0) to be 1 makes the sinc function continuous.

Also, the Sinc function approaches zero as x goes towards infinity, with the envelope of sinc(x) tapering off as 1/x.

Rect Function

The Rect Function is a function which produces a rectangular-shaped pulse with a width of 1 centered at t = 0. The Rect function pulse also has a height of 1. The Sinc function and the rectangular function form a Fourier transform pair.

A Rect function can be written in the form:

$$\operatorname{rect}\left(\frac{t - X}{Y}\right)$$

where the pulse is centered at X and has width Y. We can define the impulse function above in terms of the rectangle function by centering the pulse at zero (X = 0), setting it's height to 1/A and setting the pulse width to A, which approaches zero:

$$\delta(t) = \lim_{A \to 0} \frac{1}{A} \operatorname{rect}\left(\frac{t - 0}{A}\right)$$

We can also construct a Rect function out of a pair of unit step functions

$$\text{rect}\left(\frac{t-X}{Y}\right) = u(t-X+Y/2) - u(t-X-Y/2)$$

Here, both unit step functions are set a distance of Y/2 away from the center point of (t - X).

SAWTOOTH:-

The SAWTOOTH wave (or saw wave) is a kind of non-sinusoidal waveform. It is named a SAWTOOTH based on its resemblance to the teeth on the blade of a saw. The convention is that a SAWTOOTH wave ramps upward and then sharply drops. However, there are also SAWTOOTH waves in which the wave ramps downward and then sharply rises. The latter type of SAWTOOTH wave is called a 'reverse SAWTOOTH wave' or 'inverse SAWTOOTH wave'. As audio signals, the two orientations of SAWTOOTH wave sound identical. The piecewise linear function based on the floor function of time t, is an example of a SAWTOOTH wave with period 1.

$$x(t) = 2\left(\frac{t}{a} - \text{floor}\left(\frac{t}{a} + \frac{1}{2}\right)\right)$$

Triangle wave

A triangle wave is a non-sinusoidal waveform named for its triangular shape.Abandlimited triangle wave pictured in the time domain (top) and frequency domain(bottom). The fundamental is at 220 Hz (A2).Like a square wave, the triangle wavecontains only odd harmonics. However, the higher harmonics roll off much faster than in a square wave (proportional to the inverse square of the harmonic number as opposed to just the inverse).It is possible to approximate a triangle wave with additive synthesis by adding odd harmonics of the fundamental, multiplying every (4n−1)th harmonic by −1(or changing its phase by π), and rolling off the harmonics by the inverse square of their relative frequency to the fundamental. This infinite Fourier series converges to the triangle wave:

$$\begin{aligned} x_{\text{triangle}}(t) &= \frac{8}{\pi^2}\sum_{k=0}^{\infty}(-1)^k \frac{\sin\left((2k+1)\omega t\right)}{(2k+1)^2} \\ &= \frac{8}{\pi^2}\left(\sin(\omega t) - \frac{1}{9}\sin(3\omega t) + \frac{1}{25}\sin(5\omega t) - \cdots\right) \end{aligned}$$

where ω is the angular frequency.

Sinusoidal Signal Generation

The sine wave or sinusoid is a mathematical function that describes a smooth repetitive oscillation. It occurs often in pure mathematics, as well as physics, signal processing, electrical engineering and many other fields. Its most basic form as a function of time (t)is:

where:

•A, the amplitude, is the peak deviation of the function from its center position.

•ω, the angular frequency, specifies how many oscillations occur in a unit time

interval, in radians per second

•φ, the phase, specifies where in its cycle the oscillation begins at t = 0.

A sampled sinusoid may be written as:

$$x(n) = A\sin(2\pi \frac{f}{f_s} n + \vartheta)$$

Where f is the signal frequency, fs is the sampling frequency, θis the phase and A is the amplitude of the signal.

PROCEDURE:-

- Open MATLAB
- Open new M-file
- Type the program
- Save in current directory
- Compile and Run the program
- For the output see command window\ Figure window

PROGRAM:-

```
%unit impulse function%clc;

clear all;

close all;

t=-10:1:10;

x=(t==0);

subplot(2,1,1);

plot(t,x,'g');

x label('time');

y label('amplitude');

title ('unit impulse function');
```

```
subplot (2,1,2);
stem (t,x,'r');
xlabel('time');
ylabel('amplitude');
title('unit impulse discreat function');

%unit step function%

clc;
clear all;
close all;
N=100;
t=1:100;
x=ones(1,N);
subplot(2,1,1);
plot(t,x,'g');
xlabel('time');
ylabel('amplitude');
title('unit step function');
subplot(2,1,2);
stem(t,x,'r');
xlabel('time');
ylabel('amplitude');
title('unit step discreat function');

%unit ramp function%

clc;
```

```
clear all;
close all;
t=0:20;
x=t;
subplot(2,1,1);
plot(t,x,'g');
xlabel('time');
ylabel('amplitude');
title('unit ramp function');
subplot(2,1,2);
stem(t,x,'r');
xlabel('time');
ylabel('amplitude');
title('unit ramp discreat function');

%sinusoidal function%

clc;
clear all;
close all;
t=0:0.01:2;
x=sin(2*pi*t);
subplot(2,1,1);
plot(t,x,'g');
xlabel('time');
ylabel('amplitude');
title('sinusoidal signal');
subplot(2,1,2);
```

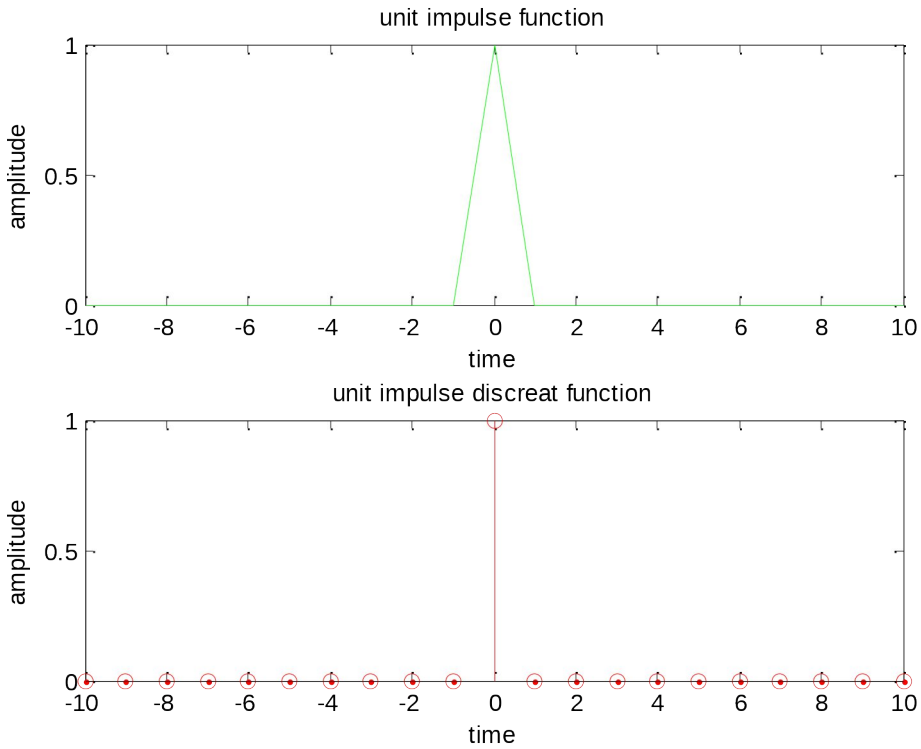
```
stem(t,x,'r');
xlabel('time');
ylabel('amplitude');
title('sinusoidal sequence');



%square function%


clc;
clear all;
close all;
t=0:0.01:2;
x=square(2*pi*t);
subplot(2,1,1);
plot(t,x,'g');
xlabel('time');
ylabel('amplitude');
title('square signal');
subplot(2,1,2);
stem(t,x,'r');
xlabel('time');
ylabel('amplitude');
title('square sequence');

%sawtooth function%
clc;
clear all;
close all;
```

```
t=0:0.01:2;
x=sawtooth(2*pi*5*t);
subplot(2,1,1);
plot(t,x,'g');
xlabel('time');
ylabel('amplitude');
title('sawtooth signal');
subplot(2,1,2);
stem(t,x,'r');
xlabel('time');
ylabel('amplitude');
title('sawtooth sequence');

%trianguler function%
clc;
clear all;
close all;
t=0:0.01:2;
x=sawtooth(2*pi*5*t,0.5);
subplot(2,1,1);
plot(t,x,'g');
xlabel('time');
ylabel('amplitude');
title('trianguler signal');
subplot(2,1,2);
stem(t,x,'r');
xlabel('time');
ylabel('amplitude');
```

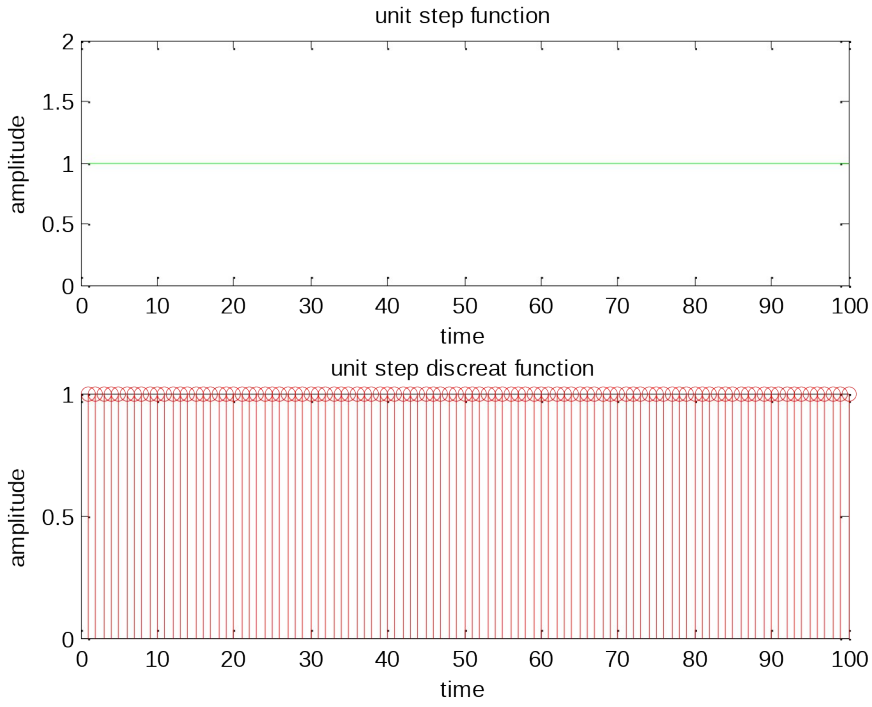
```
title('trianguler sequence');


%sinc function%
clc;
clear all;
close all;
t=linspace(-5,5);
x=sinc(t);
subplot(2,1,1);
plot(t,x,'g');
xlabel('time');
ylabel('amplitude');
title('sinc signal');
subplot(2,1,2);
stem(t,x,'r');
xlabel('time');
ylabel('amplitude');
title('sinc sequence')
```

OUTPUT:-

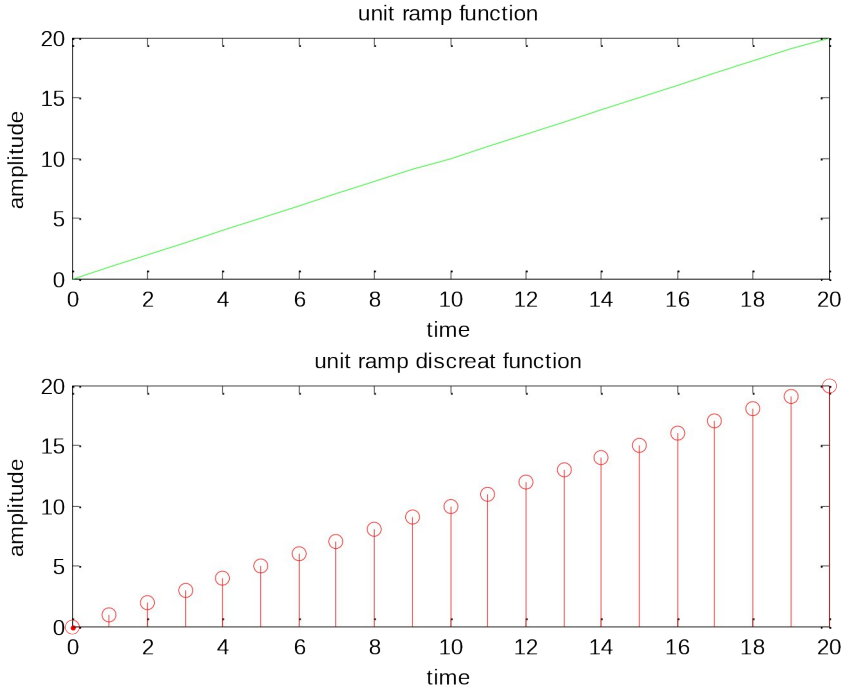
unit impulse function



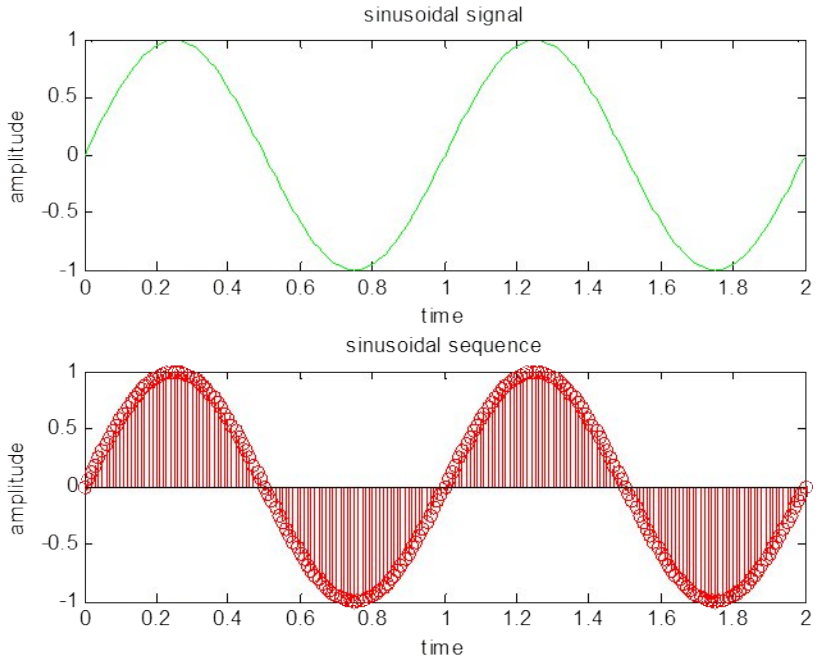
unit step function



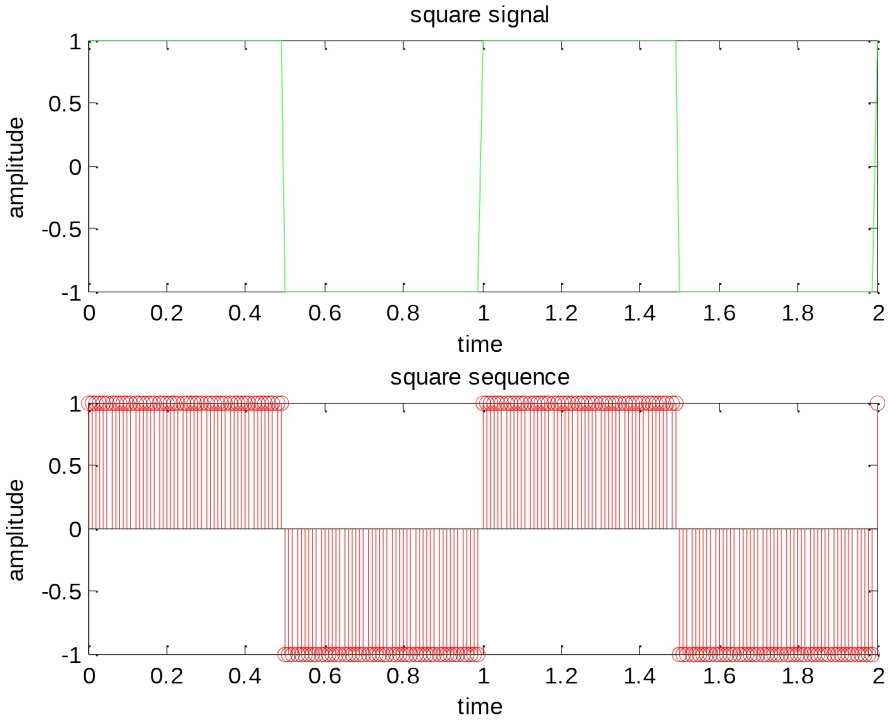
unit ramp function



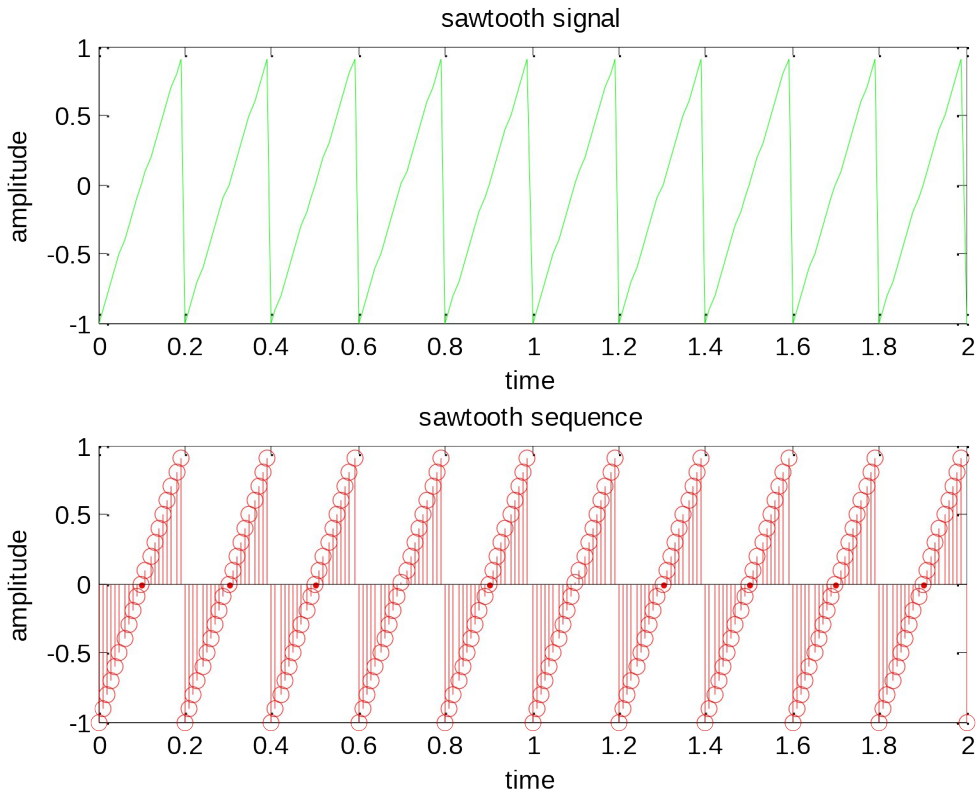
sinusoidal function



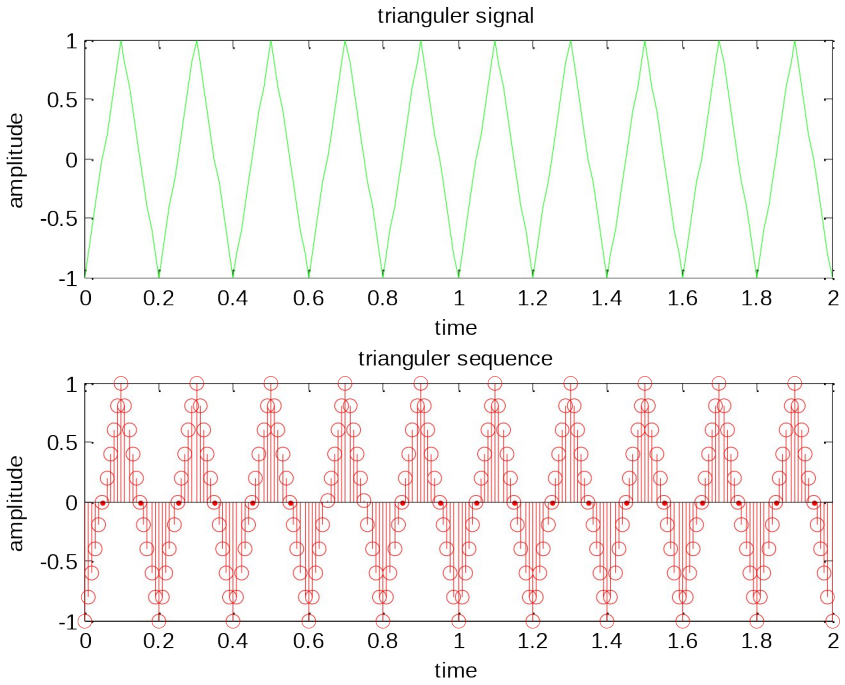
square function



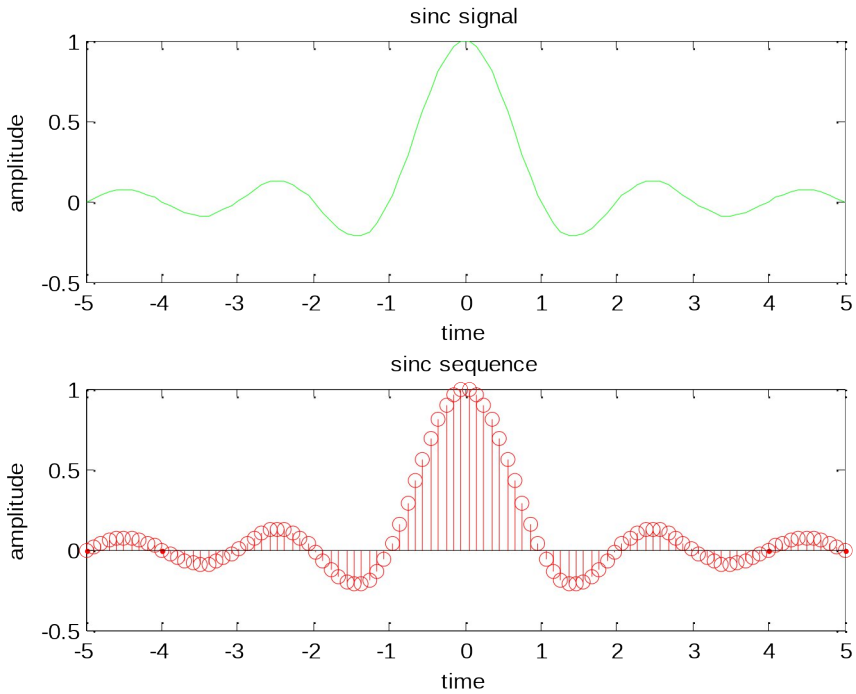
SAWTOOTH function



trianguler function



sinc function



RESULT: Thus the Generation of continuous time signals like unit step, sawtooth, triangular, sinusoidal, ramp and sinc functions are successfully completed by using MATLAB .

VIVA QUESTIONS:-

1. Define Symetric and Anti-Symmetric Signals?
2. Define Continuous and Discrete Time Signals?
3. What are the Different types of representation of discrete time signals?
4. What are the Different types of Operation performed on signals?
5. What is System?
6. Explain Even Signals?
7. Explain Odd signals?
8. Define Periodic signals?
9. Define Aperiodic signals?
10. Differentiate Energy and Power signals with examples?
11. What is Energy Signals?
12. What is Power signals?
13. Define Systems?
14. ..How to determine time period of Periodic signals?
15. Define Frequency of signals?
16. Write MATLAB command for subtraction of two signals?
17. Write MATLAB command for addition of two signals?
18. Write MATLAB command for multiplication of two signals?
19. Write MATLAB command amplitude scaling of a sequence?
20. Write MATLAB command time scaling of a sequence?
21. Write MATLAB command time shifting of a sequence?
22. Write MATLAB command right shifting of a sequence?

23.Write MATLAB command left shifting of a sequence?

24.How to calculate even part of a signal?

25.How to calculate odd part of a signal?

26.Write conditionfor physical realization system?

27.What is paley wiener criterion?

28.Write MATLAB command for division of two signals?

29.Write MATLAB command for left shift the signal to 8 times of the original signal

30Write MATLAB command for right shift the signal to 8 times of the original signal

31.Write MATLAB command for folding of a sequence?

32.Write MATLAB command for shift a positive time line signal to negative timeline signal

33.Write MATLAB command for shift a negative time line signal to positive timeline signal

34.Write MATLAB command for right shifting of a sequence to 8 times of the original signal

35.Write MATLAB command for left shifting of a sequence to 8 times of the original signal

36.Define complex exponential signal?

37.Define signum function?

38.Sketch the impulse signal?

39.Sketch the Double sided exponential signal?

40.Define real exponential signal?

41.Define step function?

42.What is the sinusoidal signal?

43.Bring out the analogy between vectors and signals?

44.What is orthonormal vector and orthonormal set of vectors?

45.Define orthogonal signal space?

46.Define mean square erroe?

47.Explain orthogonal function?

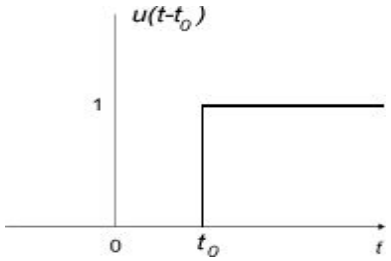
48.What is basis vectors ?

49.The relation ship between unit step function and signum function?

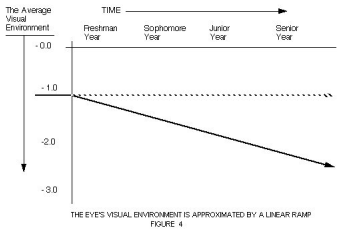
50.Define rectangular function

EXERCISE QUESTIONS

1. Generate rectangular pulse function by using MATLAB .
2. Write a MATLAB program to get the above output where $t_0 = 2$

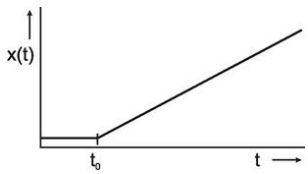


3. Write a program to get the result in signal
   r(t) = u(t) – 2*u(t+1)
4. Write a program to get the following output t = -1:-5



5. Write mat lab program to get the above output
   X(t) = 1; (0<t<2)

   = 10;(2<t<15) Note: Add ramp and unit



6. Write a MATLAB program to generate a sine wave with amplitude = 3, frequency 20Hz.
7. Write a MATLAB program to generate a cos wave with amplitude = 3, frequency 20Hz.
8. Write a MATLAB program to generate a triangular wave with amplitude = 8, frequency 10Hz.
9. Write a MATLAB program to generate a square wave with amplitude = 2, frequency 10kHz.
10. Write a MATLAB program to generate the signum function.
11. Write a MATLAB program to generate exponential growing signal.
12. Write a MATLAB program to generate exponential decaying signal.
13. Write a MATLAB program to generate a triangular wave with amplitude = 6,frequency 1Hz.
14. Write a MATLAB program to generate a square wave with amplitude = 5, frequency 5kHz.

15. Write a MATLAB program to generate a SAWTOOTH wave with amplitude = 8, frequency5Khz.
16. Write a MATLAB program to generate a sine wave with amplitude = 5, frequency 5Hz.
17. Write a MATLAB program to generate a cos wave with amplitude = 4, frequency 10Hz.
18. Write a MATLAB program to generate a triangular wave with amplitude = 5, frequency 4Hz.
19. Write a MATLAB program to generate a square wave with amplitude = 1, frequency 20kHz.
20. Write a MATLAB program to generate the signum function.
21. Write a MATLAB program to generate a square wave with amplitude = 4, frequency 5kHz.
22. Write a MATLAB program to generate a triangular wave with amplitude = 6, frequency 6Hz.
23. Write a MATLAB program to generate a triangular wave with amplitude = 8,frequency 2Hz.
24. Write a MATLAB program to generate a square wave with amplitude = 7, frequency 5kHz.
25. Write a MATLAB program to generate a SAWTOOTH wave with amplitude =10, frequency 10Khz.

Real Time Applications:

- Industrial control and automation (Control the velocity or position of an object)
- Examples: Controlling the position of a valve or shaft of a motor

EXPERMENT NO: 2

OPERATIONS ON SIGNALS&SEQUENCES

AIM:-

To performs operations on signals and sequences such as addition, multiplication, scaling, shifting, folding, computation of energy and average power.

SOFTWARE REQURIED:-

1. MATLAB R2010a.

2. Windows XP SP2.

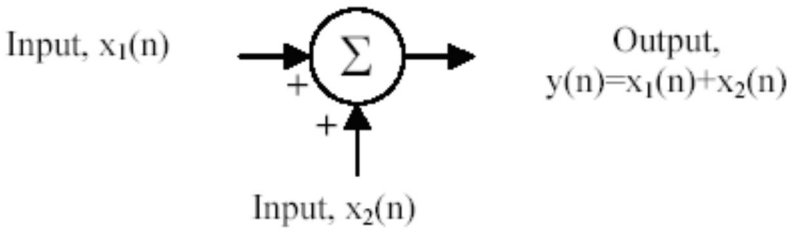
THEORY:-

Basic Operation on Signals:

Time shifting: y(t)=x(t-T)The effect that a time shift has on the appearance of a signal

If T is a positive number, the time shifted signal, x (t -T) gets shifted to the right, otherwise it gets shifted left.

Signal Shifting and Delay:



Shifting: y(n)={x(n-k)} ; m=n-k; y=x;

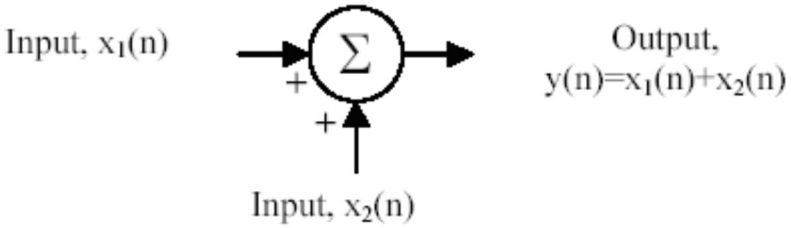
Time reversal: Y(t)=y(-t) Time reversal _ips the signal about t = 0 as seen in

Figure 1.

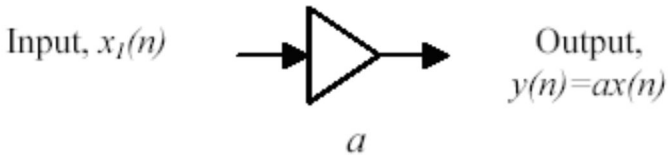
Signal Addition and Subtraction:

Addition: any two signals can be added to form a third signal,

z (t) = x (t) + y (t)



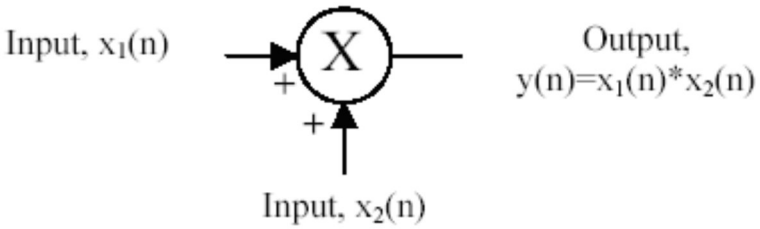
Signal Amplification/Attuation:



Multiplication/Division:

of two signals, their product is also a signal.

z (t) = x (t) y (t)



Folding:

y(n)={x(-n)} ; y=fliplr(x); n=-fliplr(n);

PROCEDURE:-

- Open MATLAB
- Open new M-file
- Type the program
- Save in current directory
- Compile and Run the program
- For the output see command window\ Figure window

PROGRAM:-

```
%Addition and multiplication of two signals%
clc;
clear all;
close all;
t=0:0.001:2;
s1=6*sin(2*pi*5*t);
subplot(4,1,1);
plot(t,s1,'g');
xlabel('time');
ylabel('amplitude');
title('first signal');
s2=8*sin(2*pi*5*t);
subplot(4,1,2);
plot(t,s2,'r');
xlabel('time');
ylabel('amplitude');
title('second signal');
s3=s1+s2;
subplot(4,1,3);
plot(t,s3,'g');
xlabel('time');
ylabel('amplitude');
title('sum of two signals');
s4=s1.*s2;
subplot(4,1,4);
plot(t,s4,'g');
xlabel('time');
```

```
ylabel('amplitude');

title('multiplication of two signals');

 %Amplitude scaling for signals%

clc;

clear all;

close all;

t=0:0.001:2;

s1=6*sin(2*pi*5*t);

subplot(3,1,1);

plot(t,s1,'g');

xlabel('time');

ylabel('amplitude');

title('sinusoidal signal');

s2=3*s1;

subplot(3,1,2);

plot(t,s2,'r');

xlabel('time');

ylabel('amplitude');

title('amplified signal');

s3=s1/3;

subplot(3,1,3);

plot(t,s3,'g');

xlabel('time');

ylabel('amplitude');

title('attenuated signal');
```

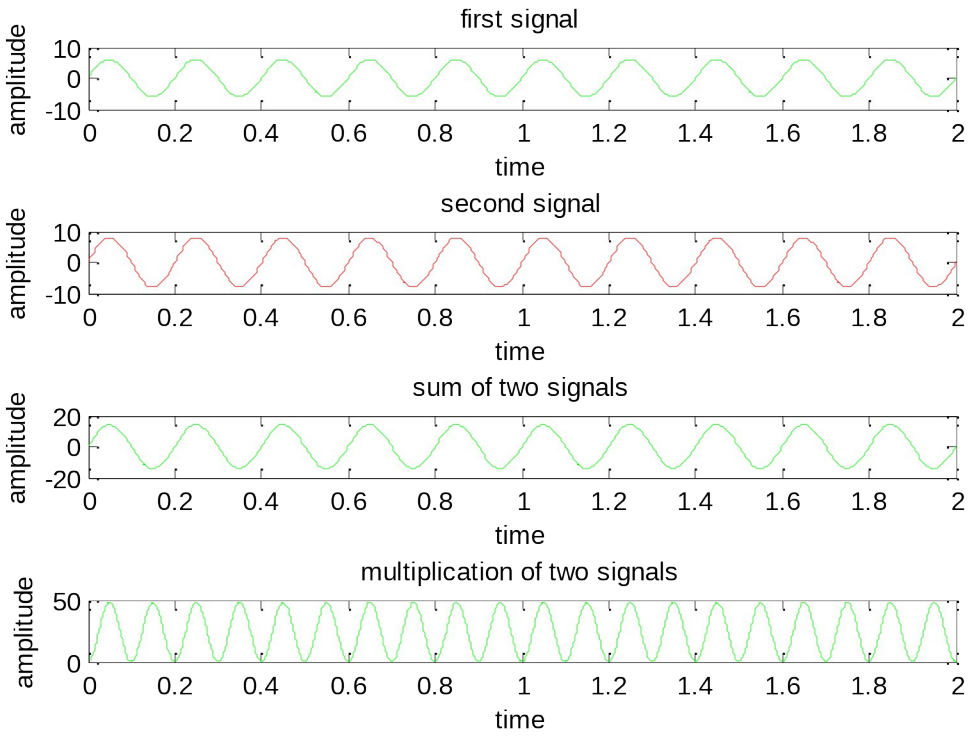
```
%Time scaling for signals%
clc;
clear all;
close all;
t=0:0.001:2;
s1=6*sin(2*pi*5*t);
subplot(3,1,1);
plot(t,s1,'g');
xlabel('time');
ylabel('amplitude');
title('sinusoidal signal');
t1=3*t;
subplot(3,1,2);
plot(t1,s1,'r');
xlabel('time');
ylabel('amplitude');
title('compressed signal');
t2=t/3;
subplot(3,1,3);
plot(t2,s1,'g');
xlabel('time');
ylabel('amplitude');
title('enlarged signal');
%Time shifting of a signal%
clc;
clear all;
close all;
t=0:0.001:3;
```

```
s1=6*sin(2*pi*5*t);
subplot(3,1,1);
plot(t,s1,'g');
xlabel('time');
ylabel('amplitude');
title('sinusoidal signal');
t1=t+10;
subplot(3,1,2);
plot(t1,s1,'r');
xlabel('time');
ylabel('amplitude');
title('right shift of the signal');
t2=t-10;
subplot(3,1,3);
plot(t2,s1,'g');
xlabel('time');
ylabel('amplitude');
title('left shift of the signal');
%Time folding of a signal%
clc;
clear all;
close all;
t=0:0.001:2;
s=sin(2*pi*5*t);
m=length(s);
n=[-m:m];
y=[0,zeros(1,m),s];
subplot(2,1,1);
```

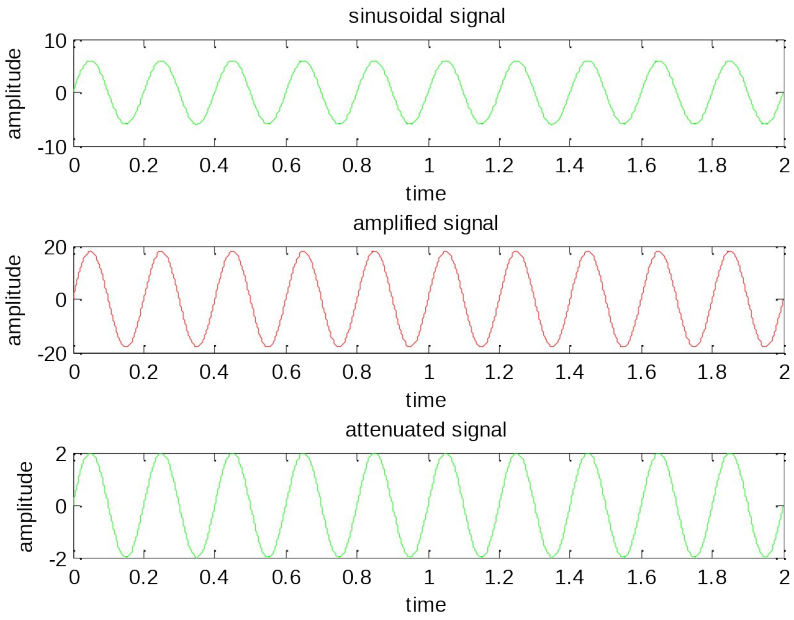
```
plot(n,y,'g');

xlabel('time');

ylabel('amplitude');

title('original signal');

y1=[fliplr(s),0,zeros(1,m)];

subplot(2,1,2);

plot(n,y1,'r');

xlabel('time');

ylabel('amplitude');

title('folded signal');
```

OUTPUT:-

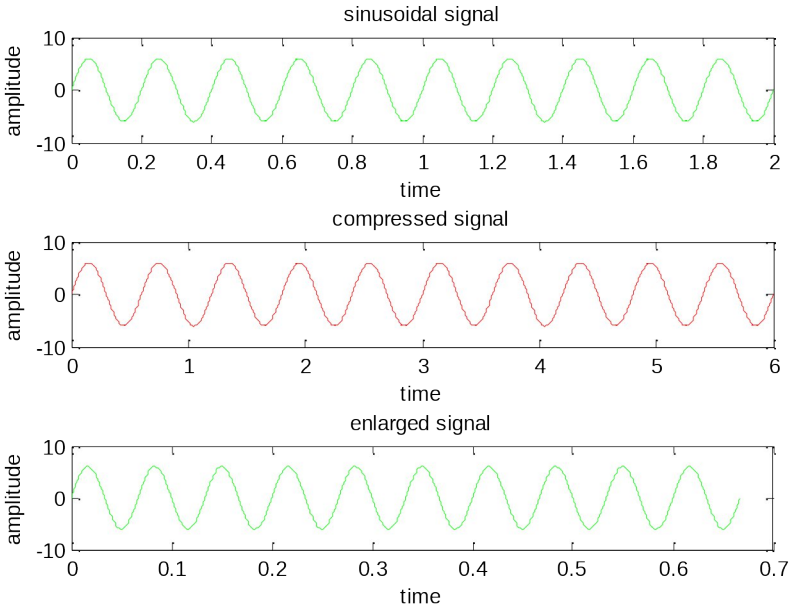
Addition and multiplication of two signals



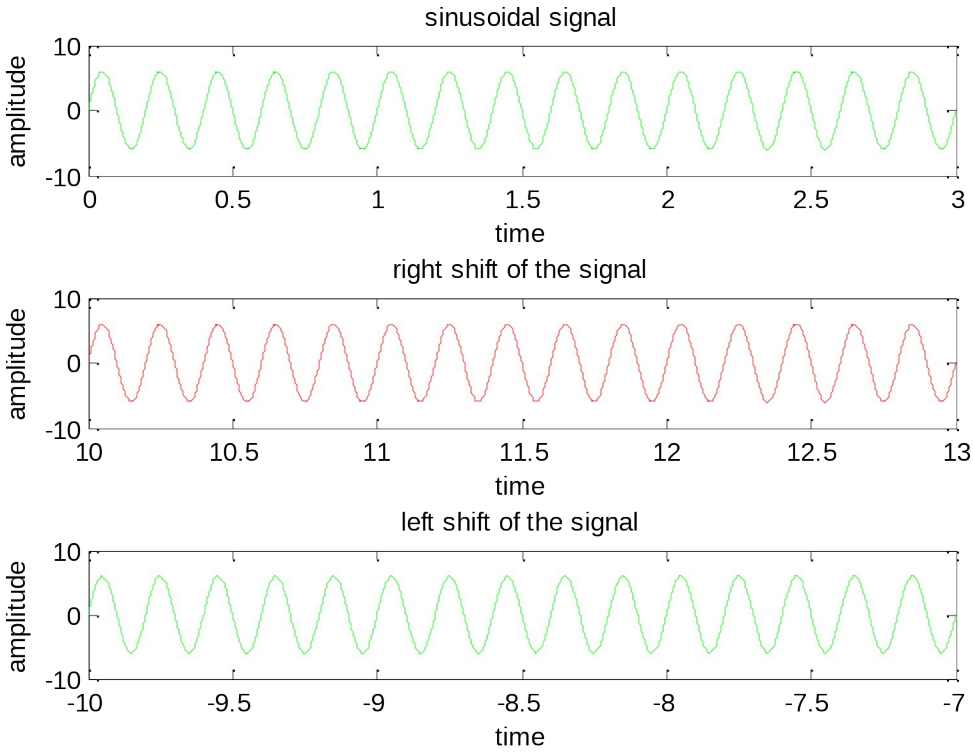
Amplitude scaling for signals



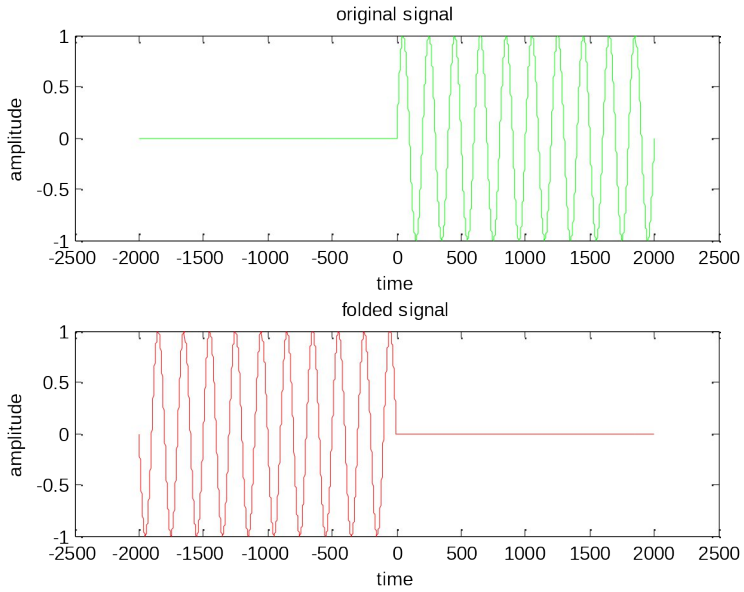
Time scaling for signals



Time shifting of a signal



Time folding of a signal



RESULT:- In this experiment the various oprations on signals have been Performed Using MATLAB have been demonstrated.

VIVA QUESTIONS:-

1. Define Symmetric and Anti-Symmetric Signals?

2. Define Continuous and Discrete Time Signals?

3. What are the Different types of representation of discrete time signals?

4. What are the Different types of Operation performed on signals?

5. What is System?

6.Explain Even Signals?

7. Explain Odd signals?

8.Define Periodic signals?

9. Define Aperiodic signals?

10.Differentiate Energy and Power signals with examples?

11.What is Energy Signals?

12.What is Power signals?

13.Define Systems?

14..How to determine time period of Periodic signals?

15.Define Frequency of signals?

16.Write MATLAB command for subtraction of two signals?

17.Write MATLAB command for addition of two signals?

18.Write MATLAB command for multiplication of two signals?

19.Write MATLAB command amplitude scaling of a sequence?

20.Write MATLAB command time scaling of a sequence?

21.Write MATLAB command time shifting of a sequence?

22.Write MATLAB command right shifting of a sequence?

23.Write MATLAB command left shifting of a sequence?

24.How to calculate even part of a signal?

25.How to calculate odd part of a signal?

26.Write condition for physical realization system?

27.What is paley wiener criterion?

28.Write MATLAB command for division of two signals?

29.Write MATLAB command for left shift the signal to 8 times of the original signal

30Write MATLAB command for right shift the signal to 8 times of the original signal

31.Write MATLAB command for folding of a sequence?

32.Write MATLAB command for shift a positive time line signal to negative timeline signal

33.Write MATLAB command for shift a negative time line signal to positive timeline signal

34.Write MATLAB command for right shifting of a sequence to 8 times of the original signal

35.Write MATLAB command for left shifting of a sequence to 8 times of the original signal

36.Define complex exponential signal?

37.Define signum function?

38.Sketch the impulse signal?

39.Sketch the Double sided exponential signal?

40.Define real exponential signal?

41.Define step function?

42.What is the sinusoidal signal?

43.Bring out the analogy between vectors and signals?

44.What is orthonormal vector and orthonormal set of vectors?

45.Define orthogonal signal space?

46.Define mean square error?

47.Explain orthogonal function?

48.What is basis vectors ?

49.The relationship between unit step function and signum function?

50.Define rectangular function

EXERCISE PROGRAMS

1. Write a MATLAB program to generate amplitude scaling of a sequence.
2. Write a MATLAB program to subtract two sinusoidal signals.
3. Write a MATLAB program to subtract and multiply two sinusoidal signals.
4. Write a MATLAB program to right shift the signal to 5 times of the original signal.
5. Write a MATLAB program to left shift the signal to 8 times of the original signal.
6. Write a MATLAB program to add two different signals with 2 <t<5
7. Write a MATLAB program to shift a positive time line signal to negative timeline signal.
8. Write a MATLAB program to subtract co-sinusoidal signals.
9. Write a MATLAB program to subtract two sinusoidal signals
10. Write a MATLAB program to division and multiply two co-sinusoidal signals.
11. Write a MATLAB program to generate time scaling of a sequence.
12. Write a MATLAB program to generate time shifting of a sequence.
13. Write a MATLAB program to generate time folding of a sequence.
14. Write a MATLAB program to generate amplitude scaling of a sequence with amplitude 5.
15. Write a MATLAB program to generate time scaling of a sequence with time 2sec.
16. Write a MATLAB program to add two different signals with 4 <t<8
17. Write a MATLAB program to shift a negative time line signal to positive timeline signal.
18. Write a MATLAB program to subtract sinusoidal signals.
19. Write a MATLAB program to subtract and divide two sinusoidal signals
20. Write a MATLAB program to add and multiply two co-sinusoidal signals.

REAL TIME APPLICATIONS:

- Stream processing
- Block processing
- Vector processing

EXPERMENT NO: 3

CONVOLUTION AND AUTOCORRELATION AND CROSS CORRELATION BETWEEN SIGNALS AND SEQUENCES.

AIM: -

To find the output with linear convolution operation and compute auto correlation and cross correlation between signals and Sequences using MATLAB Software

SOFTWARE REQURIED:-

1.MATLAB R2010a.

2.Windows XP SP2.

THEORY:-

Linear Convolution involves the following operations.

1. Folding

2. Multiplication

3. Addition

4. Shifting

These operations can be represented by a Mathematical Expression as follows:

$$y[n] = \sum_{k=-\infty} x[k]h[n-k]$$

x[n]= Input signal Samples

h[n-k]= Impulse response co-efficient.

y[n]= Convolution output.

n = No. of Input samples

h = No. of Impulse response co-efficient.

Example : X(n)={1 2 -1 0 1}, h(n)={ 1,2,3,-1}.

In Signal processing, When the autocorrelation function is normalized by mean and variance, it is sometimes referred to as the autocorrelation coefficient. Given a signal f(t), the continuous auto correlation Rff(T) is most often defined as the continuous cross-correlation integral of f(t)with itself, at lag T

$$R_{ff}(\tau) = (f(t) * \overline{f}(-t))(\tau) = \int_{-\infty}^{\infty} f(t+\tau)\overline{f}(t)\,\mathrm{d}t = \int_{-\infty}^{\infty} f(t)\overline{f}(t-\tau)\,\mathrm{d}t$$

The discrete autocorrelation Rat lag j for a discrete signal x(n) is

$$R_{xx}(j) = \sum_{n} x_n\,\overline{x}_{n-j}.$$

In signal processing, cross-correlation is a measure of similarity of two waveforms as a function of a time-lag applied to one of them. This is also known as a sliding dot product or sliding inner-product. It is commonly used for searching a long signal for a shorter, known feature. It has applications in pattern recognition, single particle analysis, electron tomographic averaging, cryptanalysis, and neurophysiology.

For continuous functions f and g, the cross-correlation is defined as:

$$(f \star g)(\tau) \ \stackrel{\text{def}}{=} \int_{-\infty}^{\infty} f^*(t)\ g(t+\tau)\,dt,$$

where f* denotes the complex conjugate of f and t is the time lag.

Similarly, for discrete functions, the cross-correlation is defined as**:**

$$(f \star g)[n] \ \stackrel{\text{def}}{=} \sum_{m=-\infty}^{\infty} f^*[m]\ g[m+n].$$

PROCEDURE:-

- Open MATLAB
- Open new M-file
- Type the program
- Save in current directory
- Compile and Run the program
- For the output see command window\ Figure window

PROGRAM:-

```
%Convolution of two signals%
clc;
clear all;
 close all;
t=0:0.001:10;
x=sin(t);
h=square(t);
subplot(3,1,1);
plot(t,x,'g');
xlabel('time');
ylabel('amplitude');
title('sinusoidal signal');
subplot(3,1,2);
plot(t,h,'r');
xlabel('time');
ylabel('amplitude');
title('square function');
y=conv(x,h);
subplot(3,1,3);
plot(y);
xlabel('time');
ylabel('amplitude');
title('convolution signal');
```

```
%Convolution of two sequences%clc;
clear all;
close all;
L=input('enter the length of 1st sequence');
M=input('enter the length of 2nd sequence');
x=input('enter the first sequence:x(n)=');
h=input('enter the second sequence:y(n)=');
N=0:(L+M-1);
y=conv(x,h);
subplot(3,1,1);
stem(x,'g');
xlabel('discrete time');
ylabel('x(n)');
title('1st sequence');
subplot(3,1,2);
stem(h,'r');
xlabel('discrete time');
ylabel('h(n)');
title('second sequence');
subplot(3,1,3);
stem(y);
xlabel('discrete time');
ylabel('y(n)');
title('convolution of two sequences');
```

PROGRAM:-

```
%Auto correlation for a signal%
clc;
clear all;
```

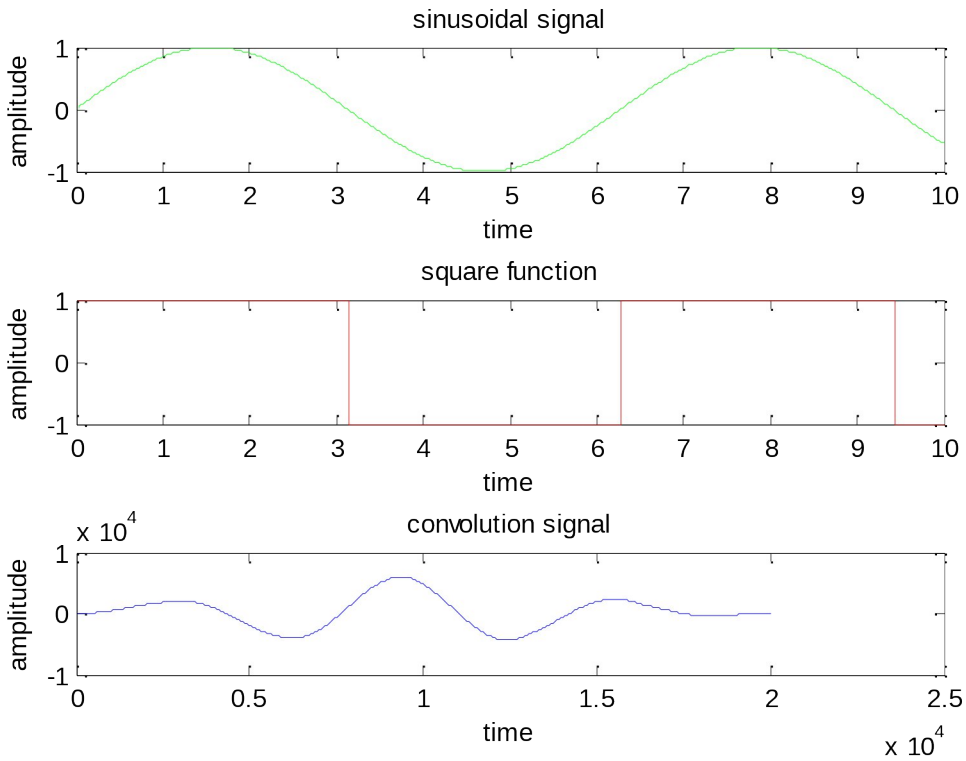
```
close all;
t=0:0.001:1;
x=cos(2*pi*3*t);
a=xcorr(x);
subplot(2,1,1);
plot(t,x,'g');
xlabel('time');
ylabel('amplitude');
title('input signal');
subplot(2,1,2);
plot(a,'r');
xlabel('time');
ylabel('amplitude');
title('auto correlation signal');
 %cross correlation for a signal%
clc;
clear all;
close all;
t=0:0.001:1;
x=cos(2*pi*3*t);
y=cos(2*pi*5*t);
a=xcorr(x,y);
subplot(3,1,1);
plot(t,x,'g');
xlabel('time');
ylabel('amplitude');
title('1st signal');
subplot(3,1,2);
```

```
plot(t,y,'r');
xlabel('time');
ylabel('amplitude');
title('2nd signal');
subplot(3,1,3);
plot(a,'r');
xlabel('time');
ylabel('amplitude');
title('cross correlation signal');\
 %Auto correlation for a sequence%
clc;
clear all;
close all;
x=input('enter sample values')
a=xcorr(x);
subplot(2,1,1);
stem(x,'g');
xlabel('time');
ylabel('amplitude');
title('input sequence');
subplot(2,1,2);
stem(a,'r');
xlabel('time');
ylabel('amplitude');
title('auto correlation sequence');
%cross correlation for asequence%
clc;
clear all;
```

```
close all;

x=input('enter first sequence');

y=input('enter second sequence');

a=xcorr(x,y);

subplot(3,1,1);

stem(x,'g');

xlabel('time');

ylabel('amplitude');

title('1st sequence');

subplot(3,1,2);

stem(y,'r');

xlabel('time');

ylabel('amplitude');

title('2nd sequence');

subplot(3,1,3);

stem(a,'r');

xlabel('time');

ylabel('amplitude');

title('cross correlation sequence');
```

OUTPUT:-

Convolution of two signals



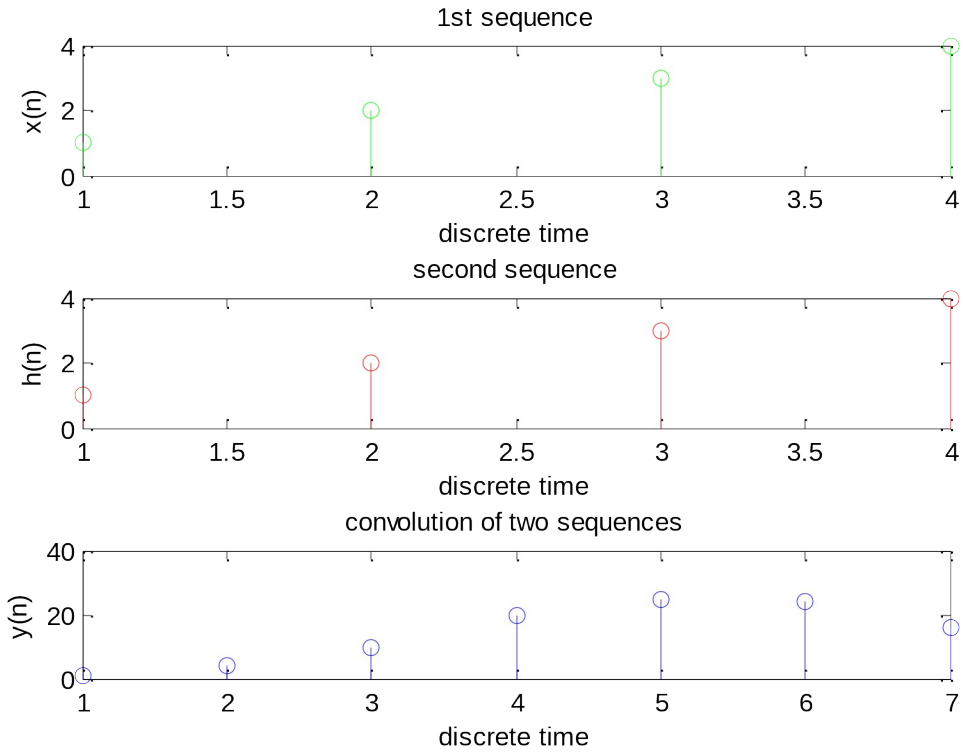
Convolution of two sequences

enter the length of 1st sequence4

enter the length of 2nd sequence4

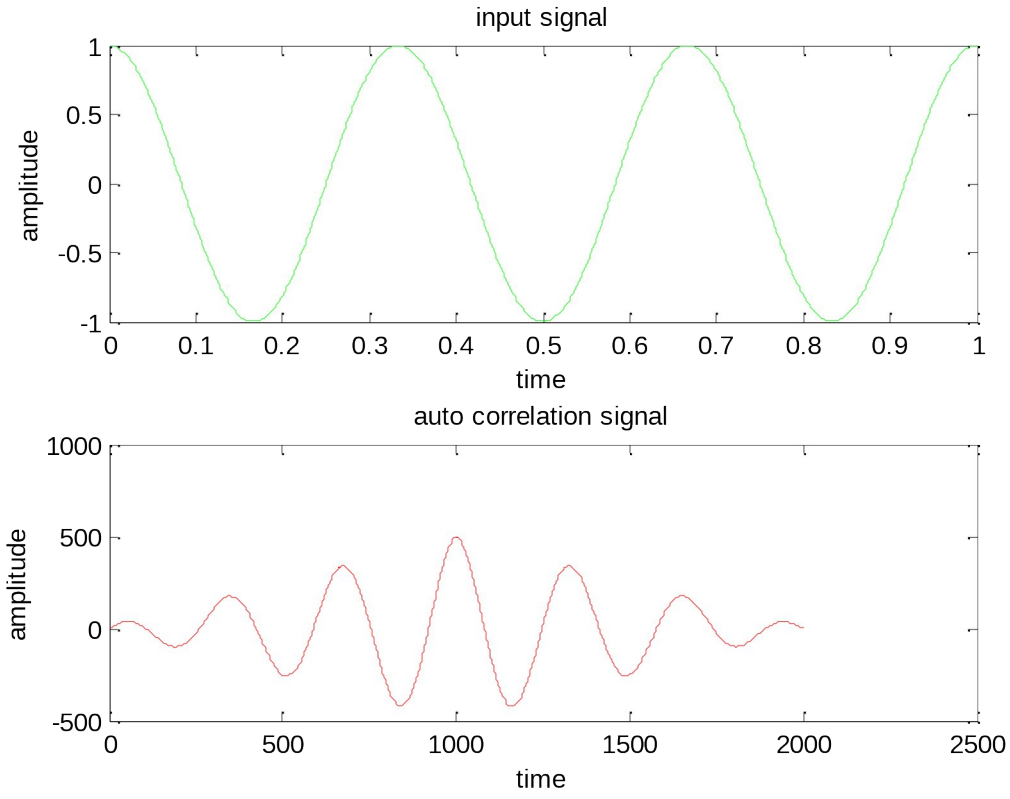
enter the first sequence:x(n)=[1 2 3 4]

enter the second sequence:y(n)=[1 2 3 4]

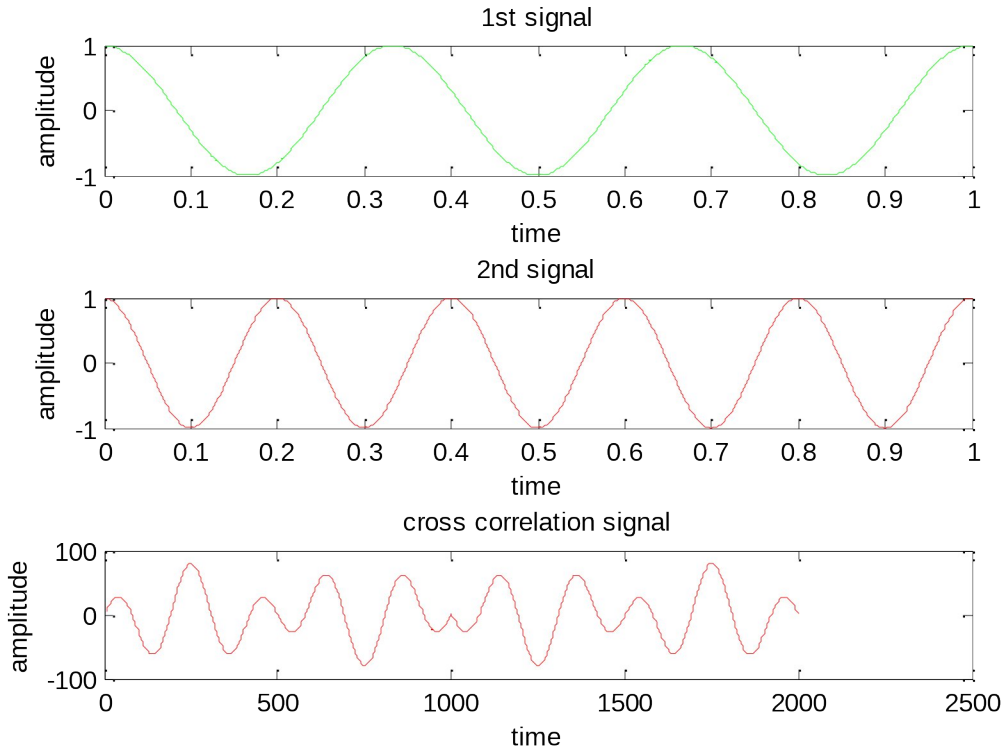


OUTPUT:-

Auto correlation for a signal



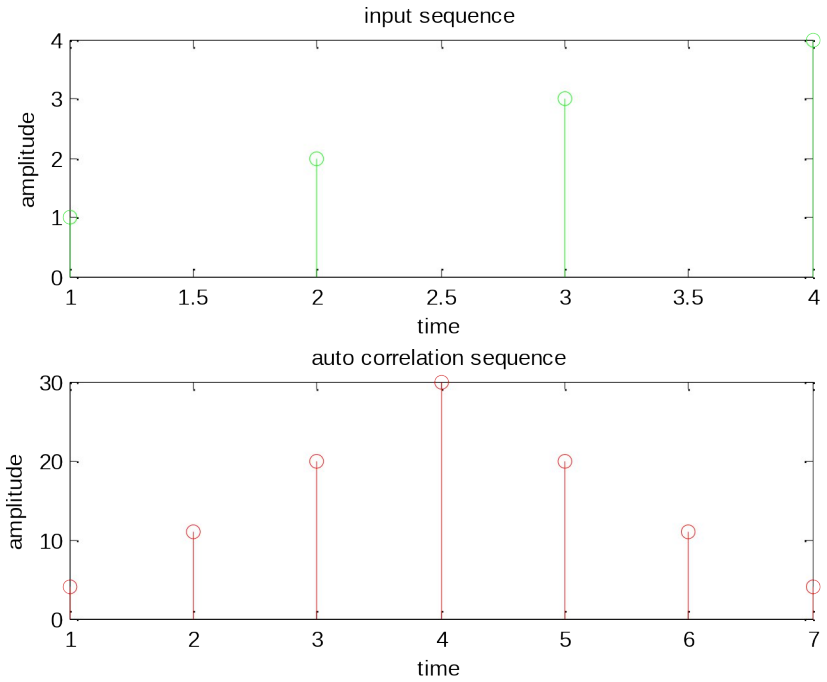
cross correlation for a signal



Auto correlation for a sequence

enter sample values[1 2 3 4]

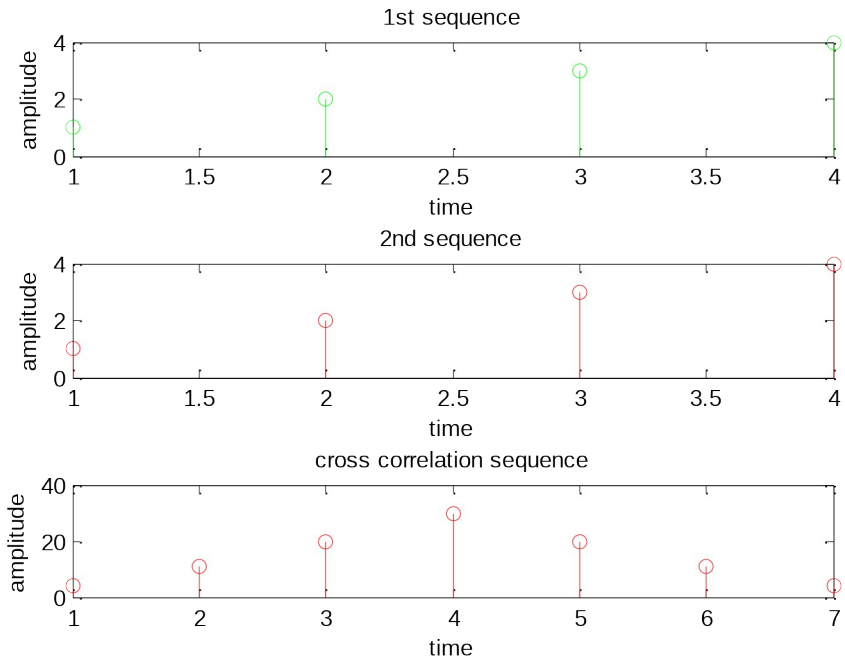
x = 1 2 3 4



cross correlation for asequence

enter first sequence[1 2 3 4]

enter second sequence[1 2 3 4]



RESULT:-

In this experiment output with linear convolution operation and compute auto correlation and cross correlation between signals and Sequences have been performed Using MATLAB .

VIVA QUESTIONS:-

1. Define Convolution?
2. Define Properties of Convolution?
3. What is the Difference Between Convolution& Correlation?
4. What are Dirchlet Conditions of Fourier Series?
5. What is Half Wave Symmetry?
6. Define Linear Convolution?
7. Define Properties of Convolution in time domain?
8. What is the Difference Between Linear Convolution &Circular Correlation?
9. What are Dirchlet Conditions for Fourier Transform?
10. What is Full Wave Symmetry?
11. What is Correlation?
12. What is the importance of correlation?
13. What is the difference b/w correlation and convolution?
14. What is Auto Correlation?
15. What is Cross Correlation?
16. Relation between convolution and correlation?
17. State the commutative property of convolution?
18. State the associative property of convolution?
19. State the distributive property of convolution?
20. what is convolution integral?
21. What is quarter wave symmetry?
22. What is impulse response?
23. What is step response?
24. What is ramp response?
25. What is parabolic response?
26. How to calculate DC component of periodic signal?
27. How to calculate a_n component of periodic signal?

28.How to calculate b_n component of periodic signal?

29.Relation between energy and correlation?

30.Defne amplitude and phase spectrum?

31.Explain hidden symmetry?

32.Explain Gibbs phenomenon?

33.What are the Dirichlet conditions?

34.Write the parsevals theorem?

35.What is rotation symmetry?

36.What is power spectrum?

37.What is compact form fourier series?

38.What is fourier transform of impulse signal?

39.What is fourier transform of step signal?

40.What is fourier transform of ramp signal?

41.What is fourier transform of signum function?

42.What is fourier transform of SINC function?

43.When a periodic is said to have a half wave symmetry?

44.When a periodic is said to have a quater wave symmetry?

45.When a periodic is said to have a odd symmetry?

46.When a periodic is said to have a even symmetry?

47.What is the relationship between cosine and trigonometric representation?

48.What is the condition for half wave symmetry?

49.What is the condition for quater wave symmetry?

50.What is the condition for odd symmetry?

EXERCISE PROGRAMS

1.Write the MATLAB program to perform convolution between the following sequences

X(n)=[1 -1 4], h(n) = [-1 2 -3 1].

2. Write a mat lab program to perform the convolution between sinusoidal and ramp function and see how mat lab reacts to it.

3. Write a MATLAB program to perform convolution between square and step signal and see how mat lab reacts to it.

4. Write a MATLAB program to perform convolution between sinusoidal and ramp signal and see how mat lab reacts to it.

5. Write a MATLAB program to perform the convolution between X (n) = [1 2 3 5] and y (n) = [- 1 – 2] and see how MATLAB reacts to it.

6. Write a MATLAB program to perform the convolution between X (n) = [1 -3 5] and y (n) = [1 2 3 4] and see how MATLAB reacts to it.

7. Write a MATLAB program to perform the convolution between X (n) = [1 0 1 1] and y (n) = [1 0 0 0 0] and see how MATLAB reacts to it.

8.Write a MATLAB program to perform the convolution between X (n) = [1 1 1 1 0 0 0 0] and y (n) = [1 0 1 0 1 0 1 0] and see how MATLAB reacts to it.

9.Write a MATLAB program to perform the convolution between X (n) = [1 1 0 0] and y (n) = [1 1 1 1] and see how MATLAB reacts to it.

10.Write a MATLAB program to perform the convolution between X (n) = [6 7 8 9 10] and y (n) = [5 4 3 2 1] and see how MATLAB reacts to it.

11.Write the MATLAB program to perform convolution between the following sequences

X(n)=[2 -232, h(n) = [-24 -52].

12. Write a mat lab program to perform the convolution between step and ramp function and see how mat lab reacts to it.

13. Write a MATLAB program to perform convolution between square and step signal and see how mat lab reacts to it.

14. Write a MATLAB program to perform convolution between sinusoidal and square signal and see how mat lab reacts to it.

15. Write a MATLAB program to perform the convolution between X (n) = [234 5] and y (n) = [-2 –4] and see how MATLAB reacts to it.

16. Write a MATLAB program to perform the convolution between X (n) = [3 -46] and y (n) = [2686] and see how MATLAB reacts to it.

17. Write a MATLAB program to perform the convolution between X (n) = [3120] and y (n) = [2434 5] and see how MATLAB reacts to it.

18.Write a MATLAB program to perform the convolution between X (n) = [22 1 0211 0] and y (n) = [1 1 1 2 1 0 1 0] and see how MATLAB reacts to it.

19.Write a MATLAB program to perform the convolution between X (n) = [2 1 21] and y (n) = [1 2 1 2] and see how MATLAB reacts to it.

20.Write a MATLAB program to perform the convolution between X (n) = [56987] and y (n) = [12 3 2 1] and see how MATLAB reacts to it.

21.Write the MATLAB program to perform convolution between the following sequences

X(n)=[4 -651], h(n) = [-13 -43].

22. Write a mat lab program to perform the convolution between ramp and step function and see how mat lab reacts to it.

23. Write a MATLAB program to perform convolution between square and step signal and see how mat lab reacts to it.

24. Write a MATLAB program to perform convolution between sinusoidal and step signal and see how mat lab reacts to it.

25. Write a MATLAB program to perform the convolution between X (n) = [1 5 6 5] and y (n) = [-3 –6] and see how MATLAB reacts to it.

Real Time Applications:

1.The convolution is to determine the response y[n] of a system of a known impulse response h[n] for a given input signal x[n] to obtain y[n].

2. Correlation is used to extract second (and higher) order statistics from any random signal.

EXPERMENT NO: 4

VERIFICATION OF LINEARITY AND TIME INVARIANCE

PROPERTIES OF A GIVEN CONTINUOUS /DISCRETE SYSTEM

AIM: -

To compute linearity and time invariance properties of a given continuous /discrete System.

SOFTWARE REQURIED:-

1.MATLAB R2010a.

2.Windows XP SP2.

THEORY:-

LINEARITY PROPERTY

satisfies the principle of superposition

$$L[a_1x_1(n)+a_2x_2(n)]=a_1L[x_1(n)]+a_2L[x_2(n)]$$
$$\forall a_1,a_2,x_1(n),x_2(n)$$

The output y(n) of a linear system to an arbitrary input x(n)

$$y(n)=L[x(n)]=L\left[\sum_{n=-\infty}^{+\infty}x(k)\delta(n-k)\right]=\sum_{n=-\infty}^{+\infty}x(k)L[\delta(n-k)]$$

$L[\delta(n-k)]$ is called impulse response, and is denoted by h(n,k)

$$y(n)=\sum_{n=-\infty}^{+\infty}x(k)h(n,k)$$

LINEAR TIME INVARIENT SYSTEMS(LTI)

A linear system in which an input-output pair is invariant to a shift n in time is called a linear times-invariant system

y(n) = L[x(n)] ---→ y(n-k) = L[x(n-k)]

$$h(n,k) = L[\delta(n-k)] = h(n-k)$$

The output of a LTI system is call a *linear convolution sum*

$$y(n) = LTI[x(n)] = \sum_{k=-\infty}^{+\infty} x(k)k(n-k) \overset{\Delta}{=} x(n) * h(n)$$

An LTI system is completely characterized in the time domain by the impulse response h(n).

$$n=-\infty$$

PROCEDURE:-

- Open MATLAB
- Open new M-file
- Type the program
- Save in current directory
- Compile and Run the program
- For the output see command window\ Figure window

PROGRAM:-

```
%Program1:%

clc;

clear all;

close all;

n=0:40; a=2; b=1;

x1=cos(2*pi*0.1*n);

x2=cos(2*pi*0.4*n);

x=a*x1+b*x2;

y=n.*x;

y1=n.*x1;

y2=n.*x2;
```

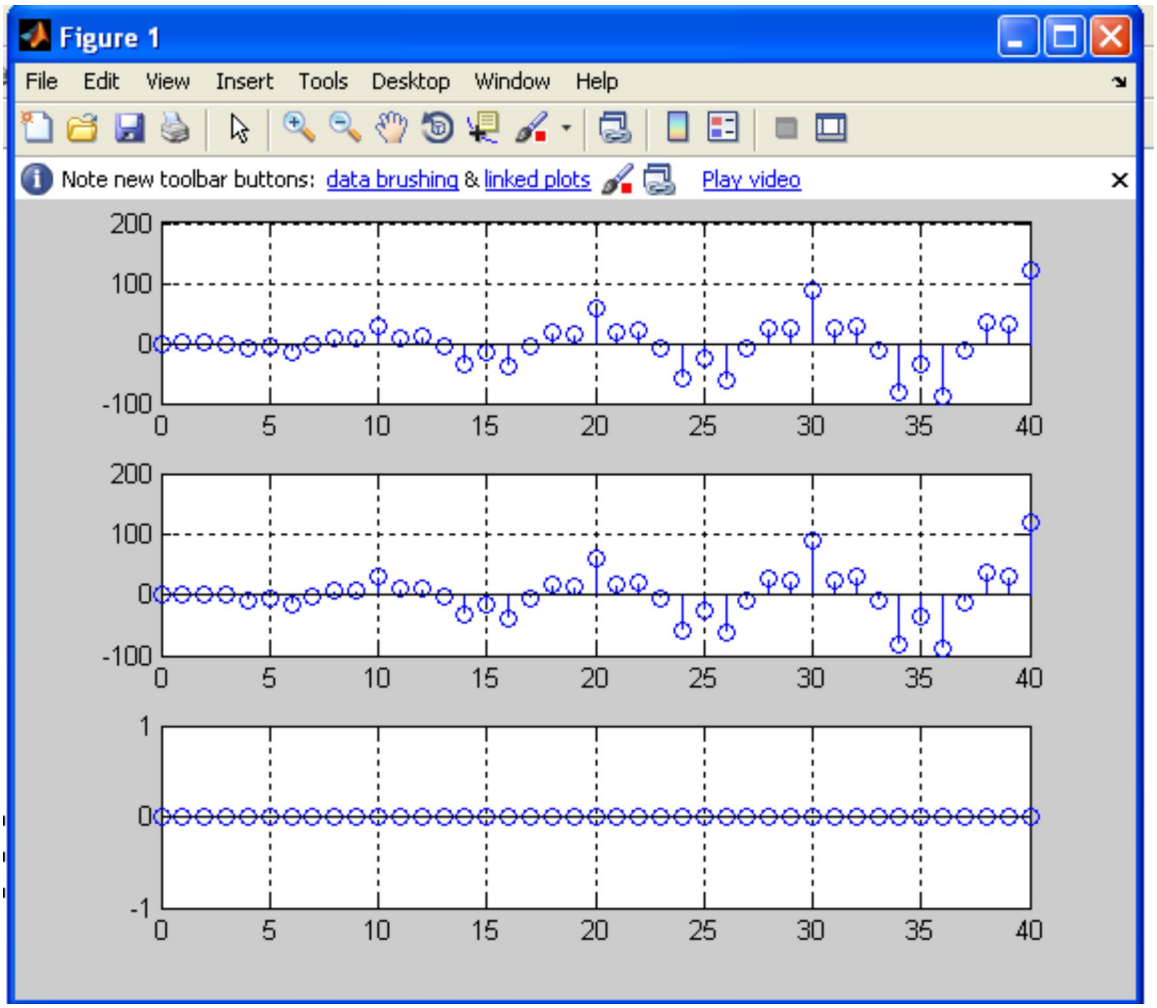
```
yt=a*y1+b*y2;

d=y-yt;

d=round(d)

if d

disp('Given system is not satisfy linearity property');

else

disp('Given system is satisfy linearity property');

end

subplot(3,1,1), stem(n,y);

 grid;

subplot(3,1,2), stem(n,yt);

grid;

subplot(3,1,3), stem(n,d);

grid;

%Program2:%

clc;

clear all;

close all;

n=0:40; a=2; b=-3;

x1=cos(2*pi*0.1*n);

x2=cos(2*pi*0.4*n);

x=a*x1+b*x2;

y=x.^2;

y1=x1.^2;

y2=x2.^2;

yt=a*y1+b*y2;

d=y-yt;

d=round(d);
```

```
if d
disp('Given system is not satisfy linearity property');
else
disp('Given system is satisfy linearity property');
end
subplot(3,1,1), stem(n,y);
grid;
subplot(3,1,2), stem(n,yt);
 grid;
subplot(3,1,3), stem(n,d);
grid;
%Program3:%
clc;
close all;
clear all;
n=0:40;
D=10;
x=3*cos(2*pi*0.1*n)-2*cos(2*pi*0.4*n);
xd=[zeros(1,D) x];
y=n.*xd(n+D);
n1=n+D;
yd=n1.*x;
d=y-yd;
if
disp('Given system is not satisfy time shifting property');
else
disp('Given system is satisfy time shifting property');
end
```

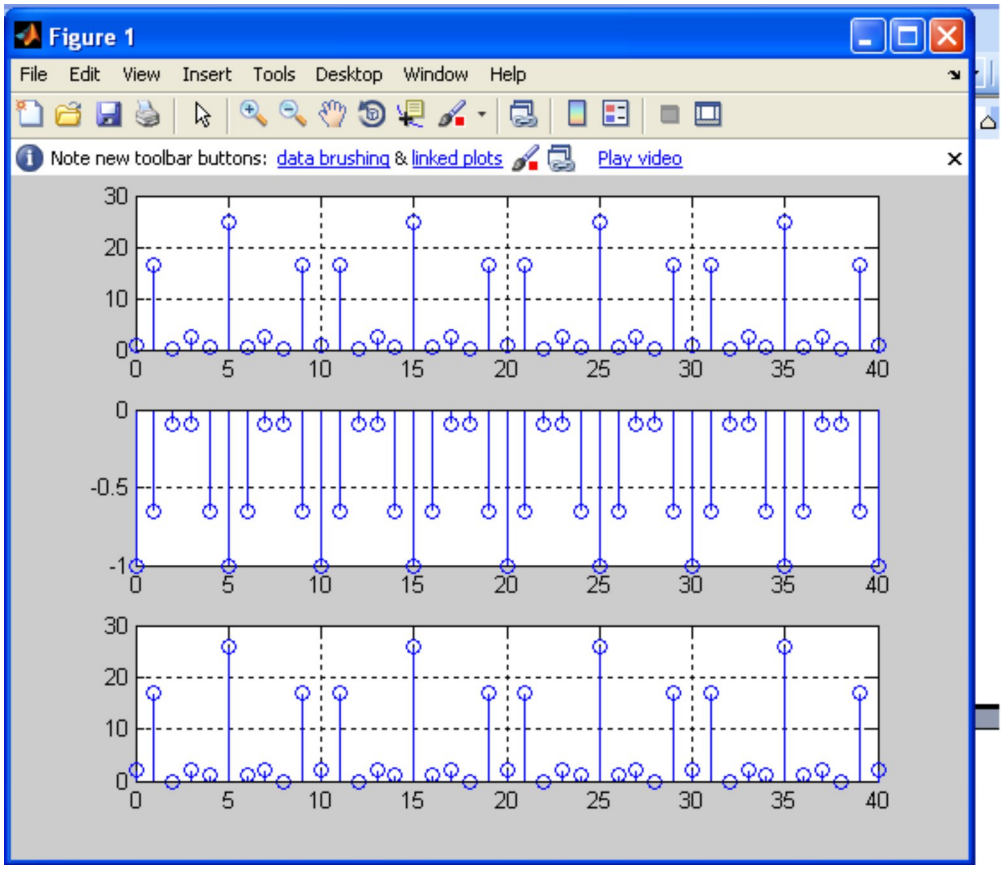
```
subplot(3,1,1),stem(y),grid;

subplot(3,1,2),stem(yd),grid;

subplot(3,1,3),stem(d),grid;
```

OUTPUT:-

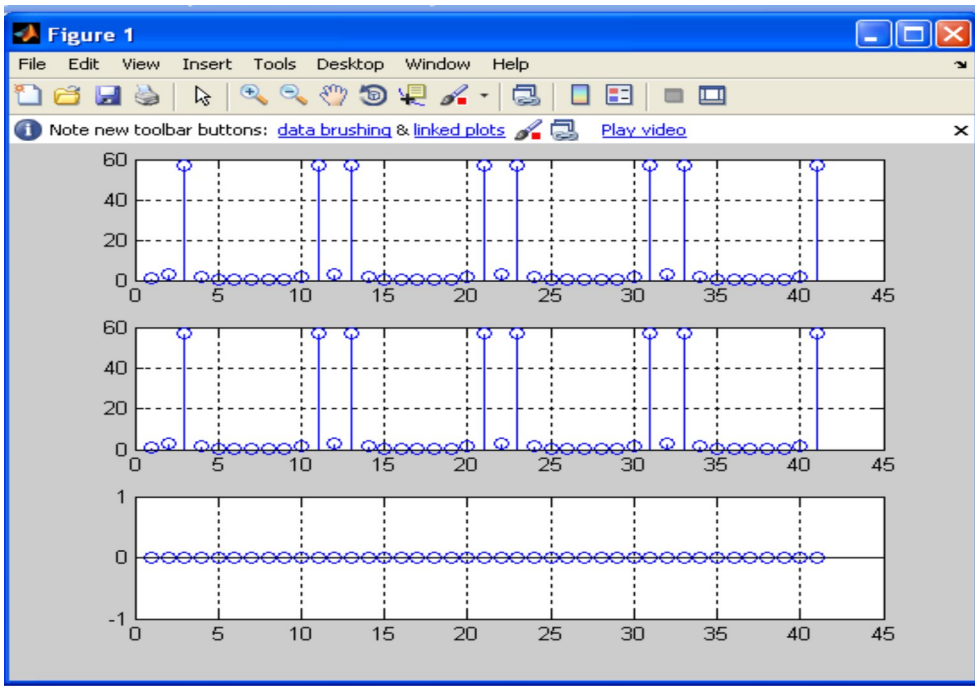
Program1:



Program2:



Program3:



VIVA QUESTIONS :

1. Define Systems?

2. What is LTI Systems?

3. Describe LTV Systems?

4.Summarize importance of Linear Systems?

5 Differentiate b/w Linear and Non-Linear Systems?

6. Summarize Properties of LTI Systems?

7.Explain two Properties of LTV Systems?

8.Appraise Superposition Principal?

9. Compare between CT and DT systems?

10.Memorize Causality of LTI Systems?

11.State Properties Of Convolution?

12.List the Applications Of Correlation?

13.Locate DFT ?

14.List classification of Continuous Time Signals? Name Them?

15Revise Examples of Causal Signal?

16.Apraise Amplitude Scaling And Time Scaling?

17.Classify Discrete Time Signal?

18.What is meant by Step Response Of The Dt System?

19.Define Impulse Response of a Dt System?

20.State The Significance of Difference Equations?

21.Write The Difference Equation For Discrete Time System?

22.What are the Properties of Convolution?

23.State the Commutative Properties of Convolution?

24.State the Associative Properties of Convolution?

25.Memorize Causal Lti Dt System?

26.What are the properties of continous Time fourier series.

27.State laplace transform.

28.Report the condition for convergance of L.T?

29. State region of convergance ?

30.State shifting property of L.T?

31.Memorize transfer function?

32.Memorize convolution property of L.T?

33.Define Time Variant And Time Invariant System?

34.State The Methods For Evaluating Inverse Z-transform.?

35.How to obtain The output Sequence of Linear Convolution through Circular Convolution?

36.What is Zero Padding?what Are Its Uses?

37.Define Sectional Convolution?

38.Why FFT Is Needed?

39.Distinguish Between Linear Convolution And Circular Convolution Of Two Sequences?

40.Justify Differences And Similarities Between Dif And Dit Algorithms?

41.What are The Different Types Of Filters Based On Impulse Response?

42.What are The Different Types Of Filters Based On Frequency Response?

43.What is Power signals?

44.Define Systems?

45.How to determine time period of Periodic signals?

46.Define Frequency of signals?

47.What is the difference b/w stem & plot?

48.What is Energy Signals?

49.What is Power signals?

50.Define Systems?

EXCERCISE QUESTIONS

1.Write a MATLAB program to verify the linearity property of the following sequency x1= sin(2*pi*1*n);x2= sin(2*pi*2*n), and chech whether it satisfies the linearity property or not.

2.Write a MATLAB program to verify the linearity property of the following sequency x1= sin(2*pi*1*n);x2= sin(2*pi*2*n), and chech whether it satisfies the linearity property or not

3.Write a MATLAB program to verify the linearity property of the following sequency x1= sin(2*pi*0.1*n); cos(2*pi*0.3*n),and chech whether it satisfies the linearity property or not

4.Write a MATLAB program to verify the time invariance property of the following sequency x1= sin(2*pi*1*n);x2= sin(2*pi*2*n), and chech whether it satisfies the time invariance property or not.

5.Write a MATLAB program to verify the time invariance property of the following sequency x1= sin(2*pi*1*n);x2= sin(2*pi*2*n), and chech whether it satisfies the time invariance property or not

6.Write a MATLAB program to verify the time invariance property of the following sequency x1= sin(2*pi*0.1*n); cos(2*pi*0.3*n),and chech whether it satisfies the time invariance property or not.

7.Write a MATLAB program to verify the time variance property of the following sequency x1= sin(2*pi*0.1*n); cos(2*pi*0.3*n),and chech whether it satisfies the time invariance property or not.

8.Write a MATLAB program to verify the non linearity property of the following sequency x1= sin(2*pi*0.1*n); cos(2*pi*0.3*n),and chech whether it satisfies the linearity property or not

9.Write a MATLAB program to verify the time variance property of the following sequency x1= sin(2*pi*1*n);x2= sin(2*pi*2*n), and chech whether it satisfies the time invariance property or not.

10.Write a MATLAB program to verify the non linearity property of the following sequency x1= sin(2*pi*1*n);x2= sin(2*pi*2*n), and chech whether it satisfies the linearity property or not.

11.Write a MATLAB program to verify the linearity property of the following sequency x1= sin(2*pi*1*n);x2= sin(2*pi*2*n), and chech whether it satisfies the linearity property or not.

12.Write a MATLAB program to verify the linearity property of the following sequency x1= sin(2*pi*1*n);x2= sin(2*pi*2*n), and chech whether it satisfies the linearity property or not

13.Write a MATLAB program to verify the linearity property of the following sequency x1= sin(2*pi*0.1*n); cos(2*pi*0.3*n),and chech whether it satisfies the linearity property or not

14.Write a MATLAB program to verify the time invariance property of the following sequency x1= sin(2*pi*1*n);x2= sin(2*pi*2*n), and chech whether it satisfies the time invariance property or not.

15.Write a MATLAB program to verify the time invariance property of the following sequency x1= sin(2*pi*1*n);x2= sin(2*pi*2*n), and chech whether it satisfies the time invariance property or not

16.Write a MATLAB program to verify the time invariance property of the following sequency x1= sin(2*pi*0.1*n); cos(2*pi*0.3*n),and chech whether it satisfies the time invariance property or not.

17.Write a MATLAB program to verify the time variance property of the following sequency x1= sin(2*pi*0.1*n); cos(2*pi*0.3*n),and chech whether it satisfies the time invariance property or not.

18.Write a MATLAB program to verify the non linearity property of the following sequency x1= sin(2*pi*0.1*n); cos(2*pi*0.3*n),and chech whether it satisfies the linearity property or not

19.Write a MATLAB program to verify the time variance property of the following sequency x1= sin(2*pi*1*n);x2= sin(2*pi*2*n), and chech whether it satisfies the time invariance property or not.

20.Write a MATLAB program to verify the non linearity property of the following sequency x1= sin(2*pi*1*n);x2= sin(2*pi*2*n), and chech whether it satisfies the linearity property or not

Real Time Applications:

1. Wave Propagation such as sound and electromagnetic waves.

2. Electrical circuits composed of resistors, capacitors and inductors.

EXPERMENT NO: 5

COMPUTATION OF UNIT SAMPLE, UNIT STEP AND SINUSOIDAL RESPONSE OF THE GIVEN LTI SYSTEM

AIM: -

To Unit Step And Sinusoidal Response Of The Given LTI System And Verifying Its Physical Realizability And Stability Properties.

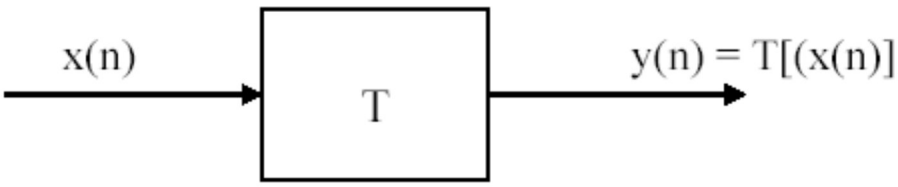
SOFTWARE REQURIED:-

1.MATLAB R2010a.

2.Windows XP SP2.

THEORY:-

A discrete time system performs an operation on an input signal based on predefined criteria to produce a modified output signal. The input signal x(n) is the system excitation, and y(n) is the system response. The transform operation is shown as,



If the input to the system is unit impulse i.e. $x(n) = \delta(n)$ then the output of the system is known as impulse response denoted by h(n) where,

$h(n) = T[\delta(n)]$

we know that any arbitrary sequence x(n) can be represented as a weighted sum of discrete impulses. Now the system response is given by,

$$y(n) = T[x(n)] = T\left[\sum_{k=-\infty}^{\infty} x(k)\,\delta(n-k)\right]$$

For linear system (1) reduces to

$$y(n) = \sum_{k=-\infty}^{\infty} x(k)\,T[\delta(n-k)]$$

$$H(Z) = \frac{\sum_{k=0}^{M} b_k X(n-k)}{\sum_{k=1}^{N} a_k X(n-k)}$$

$$H(z) = \frac{b_0 + b_1 Z^{-1} + b_2 Z^{-2} + \ldots\ldots\ldots\ldots b_{N-1} Z^{(N-1)} + b_N Z^{-N}}{1 + a_1 Z^{-1} + a_2 Z^{-2} + \ldots\ldots\ldots\ldots a_{N-1} Z^{(N-1)} + a_N Z^{-N}}$$

PROCEDURE:-

- Open MATLAB
- Open new M-file
- Type the program
- Save in current directory
- Compile and Run the program
- For the output see command window\ Figure window

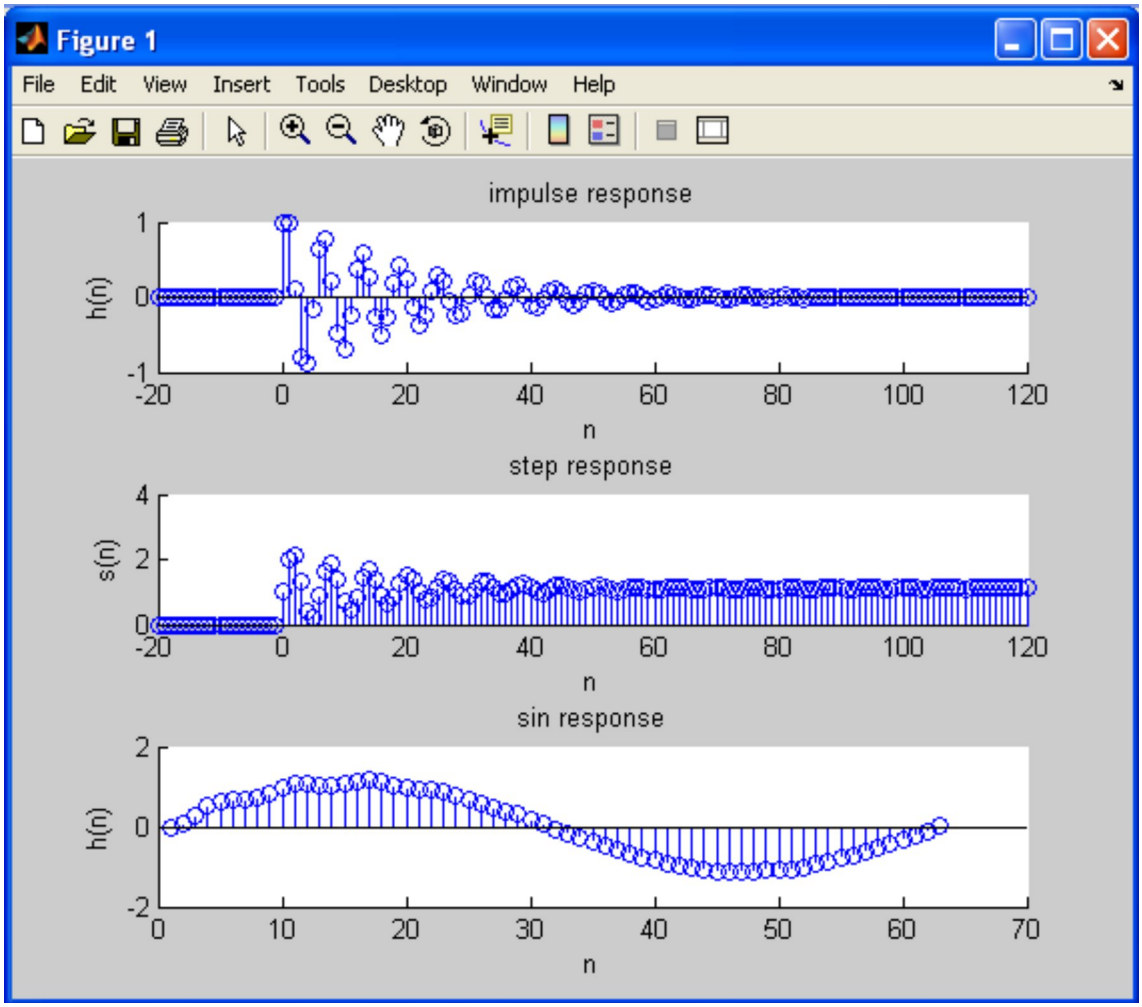
PROGRAM:-

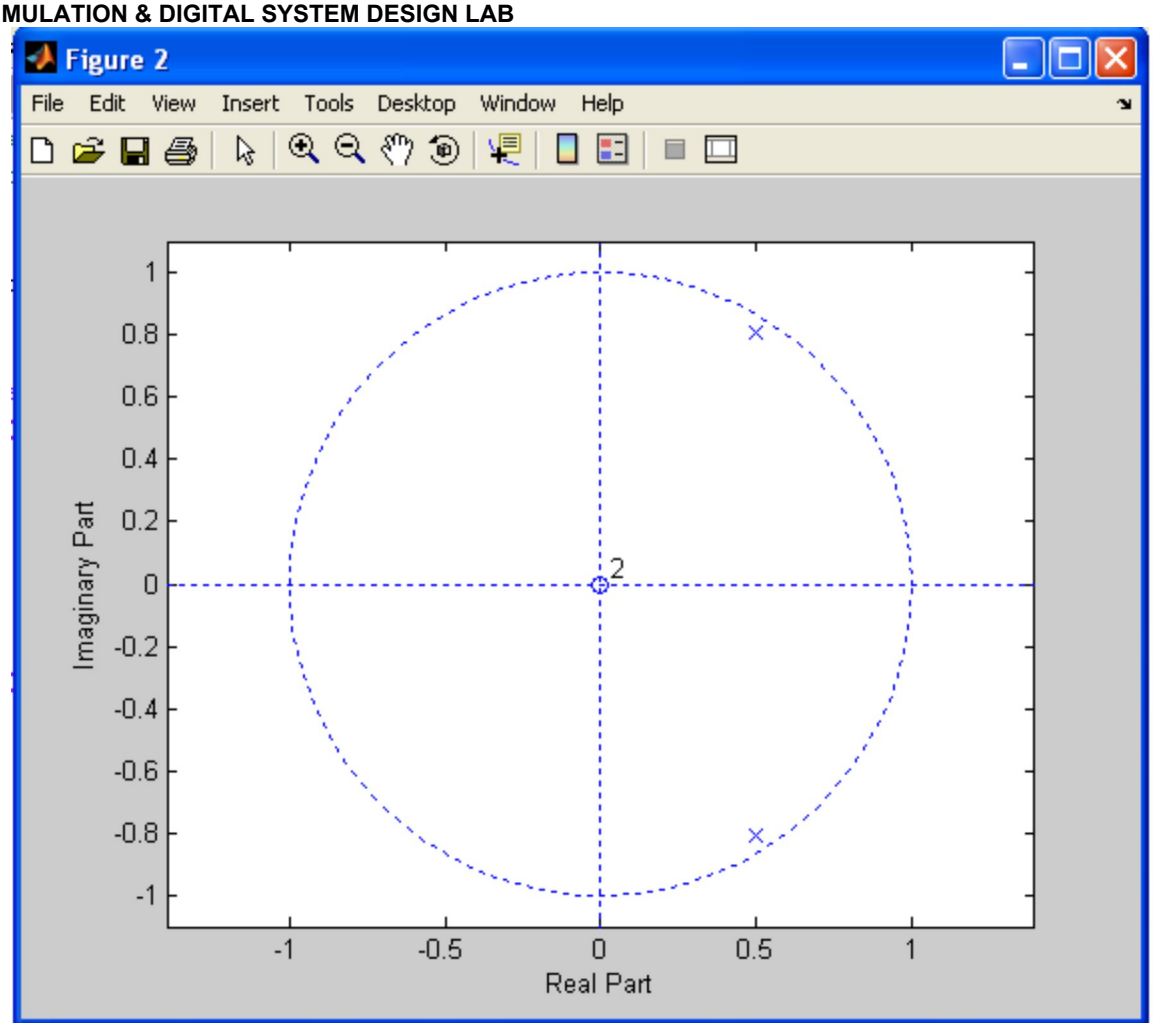
```
%calculate and plot the impulse response and step response%clc;

clear all;

close all;

b=[1];

a=[1,-1,.9];

x=impseq(0,-20,120);

n = [-20:120];

h=filter(b,a,x);
```

```
subplot(3,1,1);stem(n,h);
title('impulse response');
xlabel('n');ylabel('h(n)');
=stepseq(0,-20,120);
s=filter(b,a,x);
s=filter(b,a,x);
subplot(3,1,2);
stem(n,s);
title('step response');
xlabel('n');ylabel('s(n)')
t=0:0.1:2*pi;
x1=sin(t);
 %impseq(0,-20,120);
 n = [-20:120];
h=filter(b,a,x1);
subplot(3,1,3);stem(h);
title('sin response');
xlabel('n');ylabel('h(n)');
figure;
zplane(b,a);
```

OUTPUT:-

plot the impulse response and step response





RESULT:-

In this experiment computation of unit sample, unit step andsinusoidal response of the given LTI system and verifying its physical realizabilityandstability properties Using MATLAB .

VIVA QUESTIONS:-

1.List out operations that can be performed on signals and sequence?

2.State causality?

3.Define scaling property and give its importance?

4.Judge shifting property and give its importance?

5.Memorize folding property and give its importance?

6.Define stability?

7.Evaluate the importance of Causality?

8.Give the importance of Stability?

9.Define Impulse Response?

10.Locate Step Response?

11.What is meant by Step Response of the DT System?

12.Define Impulse Response of a DT System?

13.State the Significance of Difference Equations?

14.Write the Difference Equation For Discrete Time System?

15.What are the Properties of Convolution?

16.Memorizethe Commutative Properties of Convolution?

17.State the Associative Properties of Convolution?

18.Locate Causal LTI DT System?

19. Define Causal LTI DT System?

20.Memorize stability?

21.State Reliability?

22.Relate stability nad realiabilty of a signal?

23.compare stability nad realiabilty of a sequence?

24.What are the classification of the System based on Unit Sample Response?

25.Memorize is Recursive System?

26.State is Non-Recursive System?

27.What Is Natural Response?

28.Locate Is Zero Input Response?

29.Define Is Forced Response?

30.Examine Complete Response?

31. Relation between ramp and parabolic signal?

32.Define orthogonality between signals?

33. State properties of convolution?

34.Give some examples of causal system?

35. State superposition theorem?

36.How the DT system is represented?

37.What is folding operation?

38.State is shifting operation?

39.Locateis time scaling operation?

40. Define is SINC function?

41.What is amplitude scaling operation?

42.Memorize sampling function?

43.justify summation operation?

44.What is multiplication operation?

45.List some examples of random signal?

46. Relate stability nad realiabilty of a signal?

47. Justify of feedback system?

48.Memorize conditions for distortion less transmission system?

49.Formulate expression for rectangular function?

50.Write expression for tringular function?

EXERCISE PROGRAM:-

1. Write a MATLAB program for generating u(n)-u(n-1).

2. Write a MATLAB program for generating delayed unit step response

3.Write a MATLAB program for generating delayed impulse response

4. Write a MATLAB program for generating u(n)+u(n-1) and verify how MATLAB reacts to it.

5. write a MATLAB program to find the energy & power of the signal x(t)=10sin(10t).

6. write a MATLAB program to find the even & odd of the signal x(t)=e^2t.

7. write a MATLAB program to find the even & odd of the signal x(t)=sin(t).

8. write a MATLAB program to find the even & odd of the signal x(t)=cos(t).

9. write a MATLAB program to find the energy & power of the signal x(t)=sin(t).

10. write a MATLAB program to find the energy & power of the signal x(t)=e^2t.

11. Write a MATLAB program for generating u(n-2)-u(n-1).

12. Write a MATLAB program for generating delayed step response with magnitude 2

13.Write a MATLAB program for generating delayed impulse response with magnitude

14. Write a MATLAB program for generating u(n+1)+u(n-1) and verify how MATLAB reacts to it.

15. Write a MATLAB program to find the energy & power of the signal x(t)=20sin(5t).

16. Write a MATLAB program to find the even & odd of the signal x(t)=e^3t.

17. Write a MATLAB program to find the even & odd of the signal x(t)=sin(t)+cos(t).

18. Write a MATLAB program to find the even & odd of the signal x(t)=cos(t)-sin(t).

19. Write a MATLAB program to find the energy & power of the signal x(t)=sin(t)-cos(t).

20. Write a MATLAB program to find the energy & power of the signal x(t)=e^4t.

21. Write a MATLAB program for generating u(n+2)-u(n-1).

22. Write a MATLAB program for generating delayed unit step response

23.Write a MATLAB program for generating delayed impulse response

24. Write a MATLAB program for generating u(n-3)+u(n-1) and verify how MATLAB reacts to it.

25. Write a MATLAB program to find the energy & power of the signal x(t)=5sin(20t).

Real Time Applications:

1. Electronic Circuits such as amplifiers and filters.
2. Mechanical motion from the interaction of masses, springs and dashpots (dampers).

EXPERMENT NO: 6

DEMONSTRATION OF GIBBS PHENOMENON

AIM: -

To demonstrate Gibbs Phenomenon using MATLAB.

SOFTWARE REQURIED:-

1.MATLAB R2010a.

2.Windows XP SP2.

THEORY:-

Gibbs Phenomenon:

The peculiar manner in which the Fourier series of a piecewise continuously differentiable periodic function behaves at a jump discontinuity: the nth partial sum of the Fourier series has large oscillations near the jump, which might increase the maximum of the partial sum above that of the function itself. The overshoot does not die out as the frequency increases, but approaches a finite limit.

The Gibbs phenomenon involves both the fact that Fourier sums overshoot at a jump discontinuity, and that this overshoot does not die out as the frequency increases.

The best known version of the Gibbs phenomenon is the overshoot that arises when a discontinuous function is represented by a truncated set of Fourier expansion terms. The situation is similar if the truncated Fourier expansion is instead obtained by means of interpolation on an equispaced grid.

PROCEDURE:-

- Open MATLAB
- Open new M-file
- Type the program
- Save in current directory
- Compile and Run the program
- For the output see command window\ Figure window

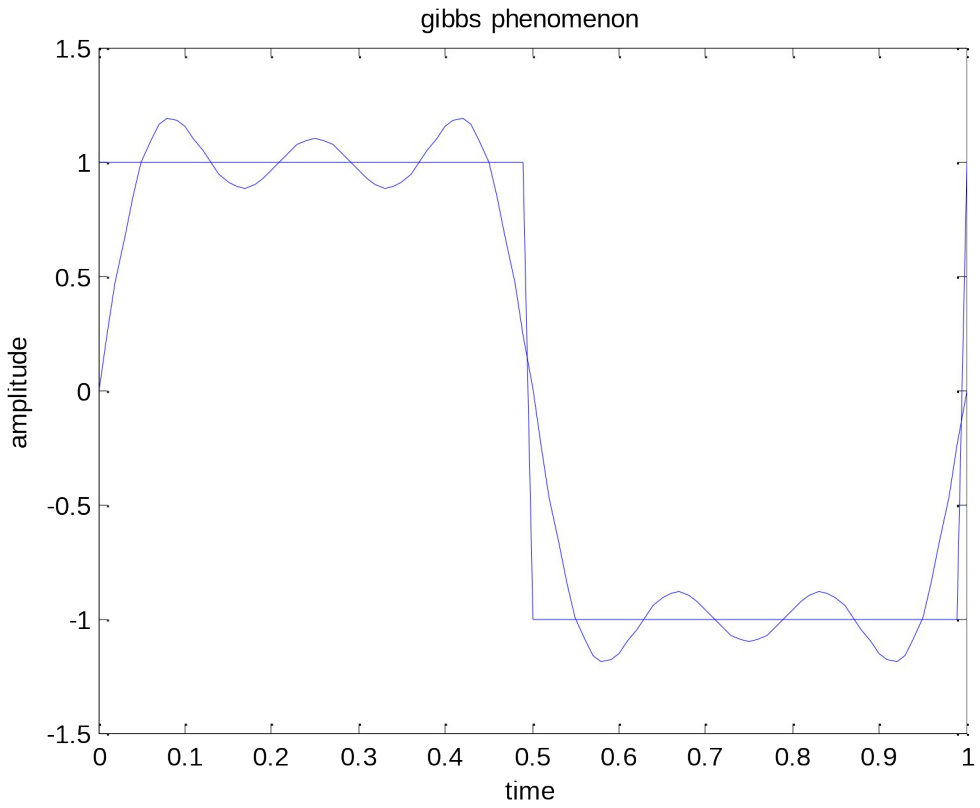
PROGRAM:-

```
%Gibbs phenomenon%
clc;
clear all;
close all;
t=0:0.01:1;
N=input('enter no of harmonics');
x=square(2*pi*t);
plot(t,x);
hold on;
gp=0;
for n=1:2:N;
    gp=gp+(4/(n*pi))*sin(2*pi*n*t);
end;
plot(t,gp);
hold off;
xlabel('time');
ylabel('amplitude');
title('gibbs phenomenon');
```

OUTPUT:-

Gibbs phenomenon

enter no of harmonics 5



RESULT:-

In this experiment Gibbs phenomenon have been demonstrated Using MATLAB .

EXERCISE PROGRAM:-

1.Write the MATLAB program to perform convolution between the following sequencesX(n)=[1 8 9 3], h(n) = [2 4 5 9].

2. Write a mat lab program to perform the convolution between sinusoidal and ramp function and see how mat lab reacts to it.

3. Write a MATLAB program to perform convolution between square and step signal and see how mat lab reacts to it.

4. Write a MATLAB program to perform convolution between sinusoidal and ramp signal and see how mat lab reacts to it.

5. Write a MATLAB program to perform the convolution between X (n) = [8 5 6 9] and y (n) = [- 1 – 2] and see how MATLAB reacts to it.

6. Write a MATLAB program to perform the convolution between X (n) = [1 -3 4 5] and y (n) = [1 2 3 4] and see how MATLAB reacts to it.

7. Write a MATLAB program to perform the convolution between X (n) = [1 0 1 1] and y (n) = [1 0 0 0 0] and see how MATLAB reacts to it.

8.Write a MATLAB program to perform the convolution between X (n) = [1 1 1 1 0 0 0 0] and y (n) = [1 0 1 0 1 0 1 0] and see how MATLAB reacts to it.

9.Write a MATLAB program to perform the convolution between X (n) = [1 1 0 0] and y (n) = [1 1 1 1] and see how MATLAB reacts to it.

10.Write a MATLAB program to perform the convolution between X (n) = [6 9 7 5 2] and y (n) = [8 5 6 4 2] and see how MATLAB reacts to it.

11.Write the MATLAB program to perform convolution between the following sequencesX(n)=[2 4 9 3], h(n) = [1 3 7 5].

12. Write a mat lab program to perform the convolution between step and ramp function and see how mat lab reacts to it.

13. Write a MATLAB program to perform convolution between sinusoidal and step signal and see how mat lab reacts to it.

14. Write a MATLAB program to perform convolution between impulse and ramp

signal and see how mat lab reacts to it.

15. Write a MATLAB program to perform the convolution between X (n) = [32 6 9] and y (n) = [-2 –4] and see how MATLAB reacts to it.

16. Write a MATLAB program to perform the convolution between X (n) = [2 -42 5] and y (n) = [4 2 3 4] and see how MATLAB reacts to it.

17. Write a MATLAB program to perform the convolution between X (n) = [2 1 0 1] and y (n) = [1 0 11] and see how MATLAB reacts to it.

18. Write a MATLAB program to perform the convolution between X (n) = [1 2 1 2 0 1 0 1] and y (n) = [2 0 1 10 0 2 0] and see how MATLAB reacts to it.

19.Write a MATLAB program to perform the convolution between X (n) = [22 0 2] and y (n) = [1 1 2 2] and see how MATLAB reacts to it.

20. Write a MATLAB program to perform the convolution between X (n) = [214 5 3] and y (n) = [21 6 21] and see how MATLAB reacts to it.

21.Write the MATLAB program to perform convolution between the following Sequences X(n)=[2 8 7 3], h(n) = [1 4 2 9].

22. Write a mat lab program to perform the convolution between sinusoidal and ramp function and see how mat lab reacts to it.

23. Write a MATLAB program to perform convolution between square and step signal and see how mat lab reacts to it.

24. Write a MATLAB program to perform convolution between sinusoidal and ramp signal and see how mat lab reacts to it.

25. Write a MATLAB program to perform the convolution between X (n) = [4 5 2 1] and y (n) = [-2 – 1] and see how MATLAB reacts to it.

VIVA QUESTIONS:-

1.Define Gibb's Phenomenon?

2. What is the importance of Gibb's Phenomenon?

3. What is Static and Dynamic System?

4. What is Causal Signal?

5. What is Causality Condition of the Signal?

6. Define Noise?

7. What is the importance of FS?

8. What is the importance of FT?

9. Define LTV system?

10.Define LTI system?

11.State the Commutative Properties of Convolution?

12..State the Associative Properties of Convolution?

13.Memorize Causal Lti Dt System?

14.What are the properties of continous Time fourier series.

15.State laplace transform.

16.Report the condition for convergance of L.T?

17. State region of convergance ?

18.State shifting property of L.T?

19.Memorize transfer function?

20.Memorize convolution property of L.T?

21.What Are The Desirable Characteristics Of The Window Function?

22..What Are The Advantages Of Kaiser Window?

24.For What Type Of Filters Frequency Sampling Method Is Suitable?

25.State Equations Used to Convert the Fir Filter Coefficients to Lattice Filter Coefficient.

26.How One Can Design Digital Filters From Analog Filters?

27.Give The Bilinear Transform Equation Between S-plane And Z-plane?

28.What Is Bilinear Transformation?

29.What Is The Advantage Of Cascade Realization?

30.What Is Meant By Sign Magnitude Representation?

31. Define Symetric and Anti-Symmetric Signals?

32.Define Continuous and Discrete Time Signals?

33.What are the Different types of representation of discrete time signals?

34.What are the Different types of Operation performed on signals?

35.State Parseval's Power theorem for a periodic signal?

36.What is Cross-correlation ?

37.Define ESD? Explain the relation between ESD and Auto-correlation ?

38.Define PSD? Explain the relation between PSD and Auto-correlation ?

39. State is Non-Recursive System?

40.What Is Natural Response?

41Locate Is Zero Input Response?

42.Define Is Forced Response?

43.Examine Complete Response?

44. Relation between ramp and parabolic signal?

45.Define orthogonality between signals?

46. State properties of convolution?

47.Give some examples of causal system?

48. State superposition theorem?

49.What is the importance of FT?

50. Define LTV system?

Real Time Applications:

- The Gibbs phenomenon, discovered by Henry Wilbraham and rediscovered by J. Willard Gibbs (1899), is the peculiar manner in which the Fourier series of a piecewise continuously differentiable periodic function behaves at a jump discontinuity.

EXPERMENT NO: 7

FINDING THE FOURIER TRANSFORM OF A GIVEN SIGNAL AND PLOTTING ITS MAGNITUDE AND PHASE SPECTRUM

AIM: -

To obtain Fourier Transform and Inverse Fourier Transform of a given signal / sequence and to plot its Magnitude and Phase Spectra.

SOFTWARE REQURIED:-

1.MATLAB R2010a.

2.Windows XP SP2.

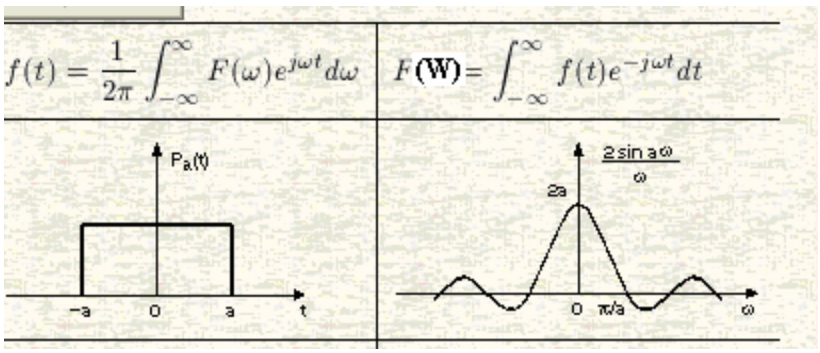
THEORY:-

Fourier Transform Theorems:

We may use Fourier series to motivate the Fourier transform as follows. Suppose that f is a function which is zero outside of some interval [−L/2, L/2]. Then for any T ≥L we may expand f in a Fourier series on the interval [−T/2,T/2], where the "amount" of the wave e2πinx/T in the Fourier series of f is given by

By definition

$$F(w) = \int_{-\infty}^{\infty} f(x)e^{-iwx}dx$$



The fast Fourier transform (FFT) is an efficient algorithm for computing the DFT of a sequence; it is not a separate transform. It is particularly useful in areas such as signal and image processing, where its uses range from filtering, convolution, and frequency analysis to

power spectrum estimation

For length N input vector x, the DFT is a length N vector X, with elements

N

X(k) = sum x(n)*exp(-j*2*pi*(k-1)*(n-1)/N), 1 <= k <= N.

n=1

The inverse DFT (computed by IFFT) is given by

N

x(n) = (1/N) sum X(k)*exp(j*2*pi*(k-1)*(n-1)/N), 1 <= n <= N.

k=1

PROCEDURE:-

- Open MATLAB
- Open new M-file
- Type the program
- Save in current directory
- Compile and Run the program
- For the output see command window\ Figure window

PROGRAM:-

```
%Fourier Transform%

clc

clear all;

close all;

syms t;

x=exp(-2*t)*heaviside(t);

y=fourier(x);

disp('Fourier Transform of input signal');

y

z=ifourier(y);

disp('Inverse Fourier Transform of input signal');

z
```

```
mg=abs(y);
subplot(2,1,1);
ezplot(mg);
xlabel('time');
ylabel('amplitude');
title('magnitude spectrum of a input signal');
grid;
pha=atan(imag(y)/real(y));
subplot(2,1,2);
ezplot(pha);
xlabel('time');
ylabel('amplitude');
title('phasespectrum of a input signal');
grid;
```

OUTPUT:-

Fourier Transform

Fourier Transform of input signal

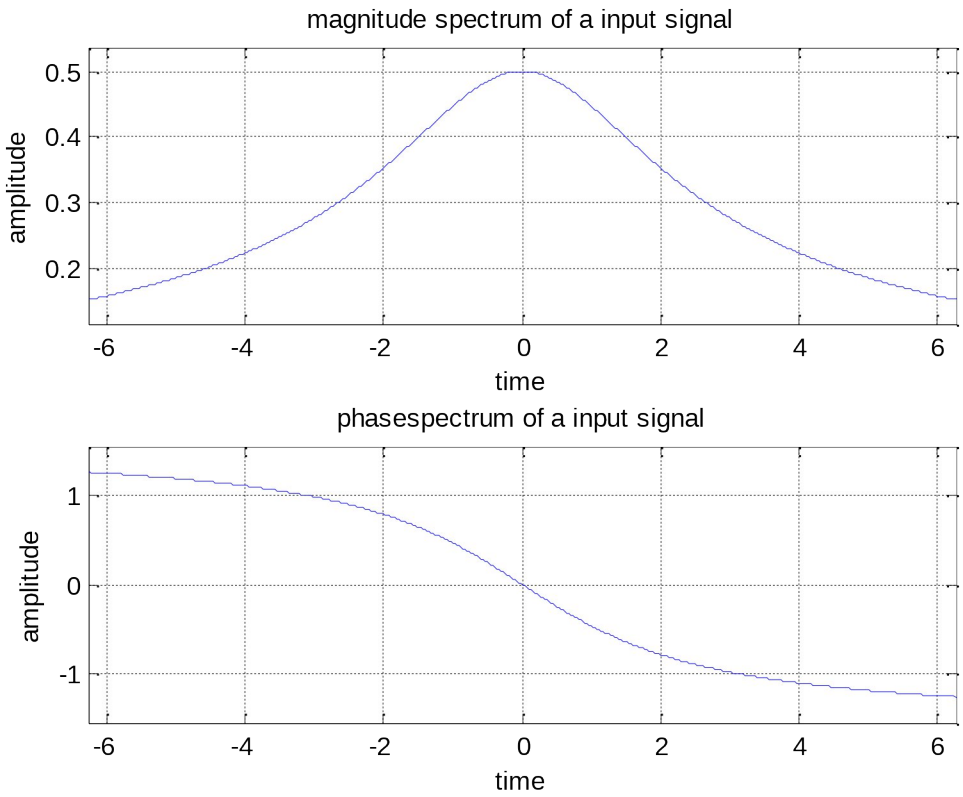
Y=

1/(2+w*i)

Inverse Fourier Transform of input signal

Z=

Heaviside(x)/exp(2*x)



RESULT:-

In this experiment the fourier transform of a given signal and plotting its magnitude and phase spectrum have been demonstrated using MATLAB .

VIVA QUESTIONS:-

1.Define Fourier Series?

2.What are the properties of Continuous-Time Fourier Series?

3. What is the Sufficient condition for the existence of F.T?

4. Define the F.T of a signal?

5. What is the difference b/w F.T&F.S?

6.Applications of Fourier transform?

7.what is plot?

8.what is stem?

9.what is difference between plot and stem?

10.what is fourier transform?

11.what is subplot?

12.what is formula of F.T?

13.what is sin signal?

14.what is cos signal?

15. Define the F.T of a signal?

16. What is the difference b/w F.T&F.S?

17.Applications of Fourier transform?

18.What is orthogonal signal?

19.what is system bandwidth?

20.what is signal bandwidth?

21.Define the F.T of a signal?

22. What is the difference b/w F.T&T.F?

23.what is fourier transform?

24.what is subplot?

25.what is formula of F.T?

26.what is sin signal?

27.what is cos signal?

28. Define the F.T of a signal?

29. What is the difference b/w F.T&F.S?

30.Applications of Fourier transform?

31.What is orthogonal signal?

32.Applications of Fourier transform?

33.Applications of Fourier series?

34.What is orthogonal signal?

35.what is system bandwidth?

36.what is signal bandwidth?

37.Define the F.T of a signal?

38. What is the difference b/w F.T&T.F?

39.what is fourier transform?

40.what is lineat system?

41.what is non linear system

42.what is even signal

43.what is odd signal

44.what is command for folding signal?

45.what is clc?

46.applications of BS LAB?

47.what is causal system

48.what is non causal system ?

49.what is LTI system?

50.what is system

EXERCISE PROGRAMS

1.Write a MATLAB program to find the cross correlation using FFT.

2. Write a MATLAB program to find F.T of the causal signal x(t)=t

3. Write a MATLAB program to find F.T of the causal signalx(t)=e^-at

4. Write a MATLAB program to find F.T of the causal signalx(t)=e^at

5. Write a MATLAB program to find F.T of the causal signalx(t)=te^at

6. Write a MATLAB program to find F.T of the causal signalx(t)=te^-at

7.Write a MATLAB program to find F.T of the causal signalx(t)=cost

8. Write a MATLAB program to find F.T of the causal signalx(t)=sint

9. Write a MATLAB program to find F.T of the causal signalx(t)=e^atcos(t)

10. Write a MATLAB program to find F.T of the causal signalx(t)=e^atsin(t)

11.Write a MATLAB program to find the cross correlation using DFT.

12. Write a MATLAB program to find F.T of the causal signal x(t)=at

13. Write a MATLAB program to find F.T of the causal signalx(t)=10e^-at

14. Write a MATLAB program to find F.T of the signalx(t)=1

15. Write a MATLAB program to find F.T of the causal signalx(t)=impulse function

16. Write a MATLAB program to find F.T of the causal signalx(t)=Delta function

17.Write a MATLAB program to find F.T of the causal signalx(t)=cos(at)

18. Write a MATLAB program to find F.T of the causal signalx(t)=sin(at)

19. Write a MATLAB program to find F.T of the causal signalx(t)=e^atcos(at)

20. Write a MATLAB program to find F.T of the causal signalx(t)=e^atsin(at)

Real Time Applications:

Fourier transforms having following applications

- Analysis of differential equations
- Fourier transform spectroscopy
- Quantum mechanics
- Signal processing applications etc

EXPERMENT NO: 8

LOCATING THE ZEROS AND POLES AND PLOTTING THE POLE ZERO MAPS IN S-PLANE AND Z-PLANE FOR THE GIVEN TRANSFER FUNCTION.

AIM: -

To locating the zeros and poles and plotting the pole zero maps in s-plane and z-plane for the given transfer function.

SOFTWARE REQURIED:-

1.MATLAB R2010a.

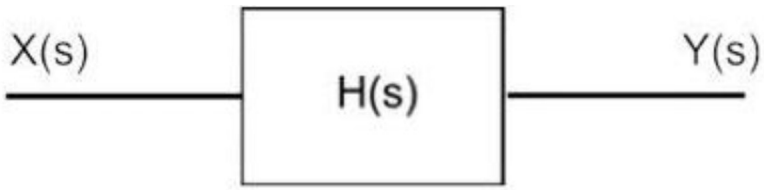
2.Windows XP SP2.

THEORY:-

A Transfer Function is the ratio of the output of a system to the input of a system, in the Laplace domain considering its initial conditions to be zero. If we have an input function of X(s), and an output function Y(s), we define the transfer function H(s) to be:

$$H(s) = \frac{Y(s)}{X(s)}$$

Transfer function is the Laplace transform of a system's impulse response.



Given a continuous-time transfer function in the Laplace domain, $H(s)$ or a discrete-time one in the Z-domain, $H(z)$, a zero is any value of s or z such that the transfer function is zero, and a pole is any value of s or z such that the transfer function is infinite.

***Zeros*:**1. The value(s) for z where the *numerator* of the transfer function equals zero

2. The complex frequencies that make the overall gain of the filter transfer function

zero.

Poles: 1. The value(s) for *z* where the *denominator* of the transfer function equals zero

2. The complex frequencies that make the overall gain of the filter transfer functioninfinite.

Z-transforms

the Z-transform converts a discrete time-domain signal, which is a sequence of real or complex numbers, into a complex frequency-domain representation.The Z-transform, like many other integral transforms, can be defined as either a one-sided or two-sided transform.

Bilateral Z-transform

The bilateral or two-sided Z-transform of a discrete-time signal x[n] is the function X(z) defined as

$$X(z) = \mathcal{Z}\{x[n]\} = \sum_{n=-\infty}^{\infty} x[n]z^{-n}$$

Unilateral Z-transform

Alternatively, in cases where x[n] is defined only for n ≥ 0, the single-sided or unilateral Z-transform is defined as

$$X(z) = \mathcal{Z}\{x[n]\} = \sum_{n=0}^{\infty} x[n]z^{-n}$$

In signal processing, this definition is used when the signal is causal.

$$\text{where } z = r.e^{j\omega}$$

$$X(z) = \frac{P(z)}{Q(z)}$$

The roots of the equation P(z) = 0 correspond to the 'zeros' of X(z)

The roots of the equation Q(z) = 0 correspond to the 'poles' of X(z)

PROCEDURE:-

- Open MATLAB
- Open new M-file
- Type the program
- Save in current directory
- Compile and Run the program
- For the output see command window\ Figure window

PROGRAM:-

```
%locating poles of zero on s-plane%

clc;

clear all;

close all;

num=input('enter numerator co-efficients');

den=input('enter denominator co-efficients');

h=tf(num,den);

poles=roots(den);

zeros=roots(num);

sgrid;

pzmap(h);

grid on;

title('locating poles of zeros on s-plane');


%locating poles &zeros on z-plane%

clc;

clear all;

close all;

num=input('enter numerator coefficient');

den=input('enter denominator coefficient');

p=roots(den);
```

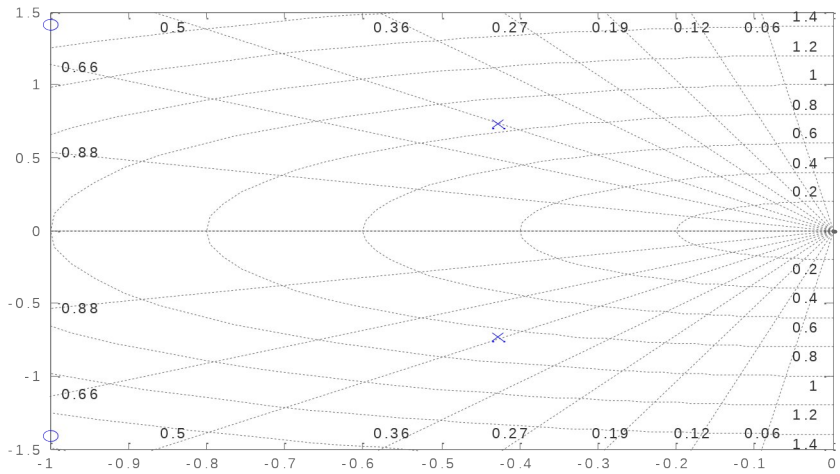
```
z=roots(num);

zplane(p,z);

grid;

title('locating poler and zeros on s-plane');
```

OUTPUT:-

locating poles of zero on s-plane

enter numerator coefficient[1 2 3]

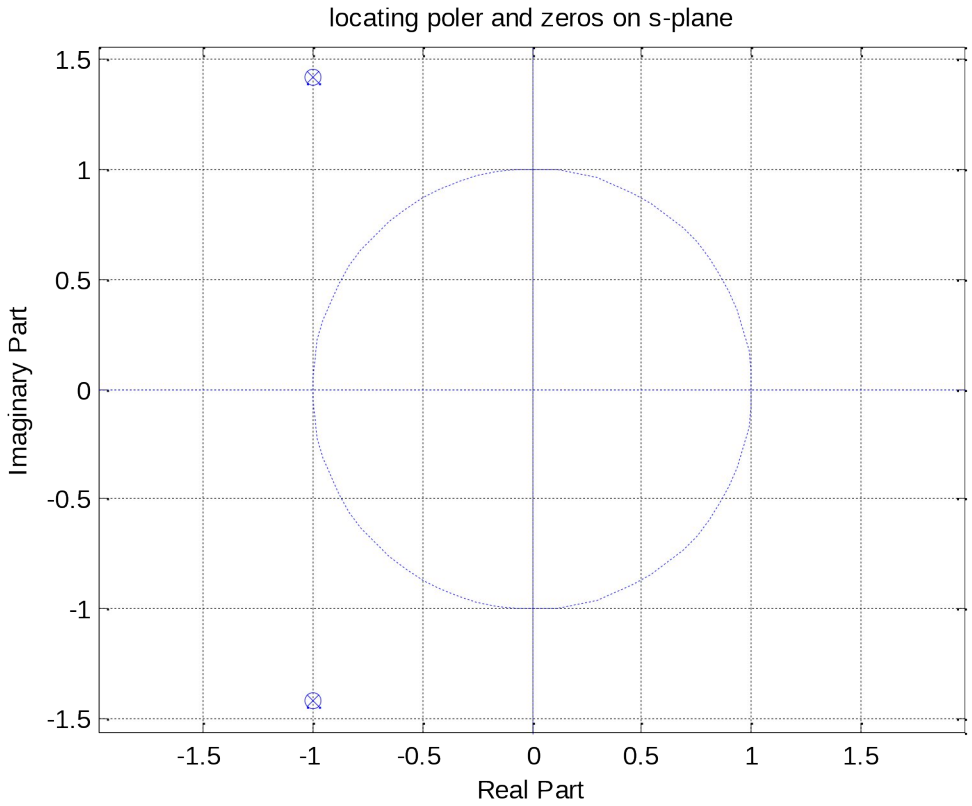
enter denominator coefficient[7 6 5]



locating poles &zeros on z-plane

enter numerator coefficient[1 2 3]

enter denominator coefficient[1 2 3]



RESULT:-

In this experiment the zeros and poles and plotting the pole zero maps in s-plane and z-plane for the given transfer function using MATLAB .

VIVA QUESTIONS:-

1.study the details of ztrans() and iztrans() functions?

2.what are poles and zeros?

3.how you specify the stability based on poles and zeros?

4.define s-plane and z-plane?

5.what is the difference b/w s-plane and z-plane?

6.bilateral z-transform

7.z-transforms

8.unilateral z-transforms

9.what is pole?

10.what is zero?

11.what is splane?

12.what is zplane?

13.what is difference between ploe and zero?

14.what is subplot?

15.what is subplot(4,5,6)?

16.define s plane?

17.define z plane?

18.define transform function?

19.what is plot?

20.what is stem?

21.what is difference between plot and stem?

22.what is subplot(2 2 2)?

23.what is system bandwidth?

24what is signal bandwidth

25.what os signal?

26.what is orthogonality function?

27.what are the classifications of sgnals?

22.what are poles and zeros?

29.how you specify the stability based on poles and zeros?

30.Define s-plane and z-plane?

31.what is the difference b/w s-plane and z-plane?

32. what is subplot?

33.define transform function?

34.what is plot?

35.what is stem?

36.what is difference between plot and stem?

37.what is fourier transorm?

38.what is system?

39.what is signal?

40.what is trignometric series?

41.application of convolution?

42.applications of lti system?

43.what is stable system?

44.define laplace-transform?

45. what is the condition for convergence of the l.t?

46. what is the region of convergence(roc)?

47. state the shifting property of l.t?

48. state convolution property of l.t?

49.Define i.l.t?

50.applications of lti system

EXERCISE PROGRAMS

1.Write a MATLAB program to find the impulse response of the following difference equation3y(n)-5y(n-1)+4y(n-2)=x(n)-2x(n-1).

2. Write a MATLAB program to find the impulse response of the following difference equation 6y(n)-9y(n-1)-4y(n-2)=x(n)-5x(n-1).

3. Write a MATLAB program to find the impulse response of the following difference equation8y(n)-6y(n-1)+4y(n-2)=x(n)+2x(n-1).

4. Write a MATLAB program to find the impulse response of the following difference equation 3y(n)+5y(n-1)+9y(n-2)=x(n)-9x(n-1).

5. Write a MATLAB program to find the impulse response of the following difference equation6y(n)-5y(n-1)+4y(n-2)=x(n)-2x(n-1).

6. Write a MATLAB program to find the impulse response of the following difference equation7y(n)-5y(n-1)+4y(n-2)=x(n)-9x(n-1).

7.Write a MATLAB program to find the impulse response of the following difference equation3y(n)-5y(n-1)+4y(n-2)=x(n)-6x(n-1).

8.Write a MATLAB program to find the impulse response of the following difference equation 5y(n)-5y(n-1)+5y(n-2)=x(n)-2x(n-1).

9.Write a MATLAB program to find the impulse response of the following difference equation3y(n)-6 y(n-1)+4y(n-2)=x(n)-7x(n-1).

10.Write a MATLAB program to find the impulse response of the following difference equation2y(n)-5y(n-1)+4y(n-2)=x(n)-2x(n-1).

11.Write a MATLAB program to find the impulse response of the following difference equation 3y(n)-5y(n-1)+4y(n-2)=5x(n)-6x(n-1).

12. Write a MATLAB program to find the impulse response of the following difference equation6y(n)-8y(n-1)-4y(n-2)=7x(n)-5x(n-1).

13. Write a MATLAB program to find the impulse response of the following difference equation8y(n)-8y(n-1)+9y(n-2)=x(n)+5x(n-1).

14. Write a MATLAB program to find the impulse response of the following difference equation 3y(n)+9y(n-1)+9y(n-2)=9x(n)-5x(n-1).

15. Write a MATLAB program to find the impulse response of the following difference equation6y(n)-5y(n-1)+4y(n-2)=7x(n)-2x(n-1).

16. Write a MATLAB program to find the impulse response of the following difference

equation 7y(n)-5y(n-1)+4y(n-2)=x(n)-7x(n-1).

17. Write a MATLAB program to find the impulse response of the following difference equation 3y(n)-5y(n-1)+4y(n-2)=x(n)-6x(n-1).

18. Write a MATLAB program to find the impulse response of the following difference equation 5y(n)-5y(n-1)+5y(n-2)=7x(n)-2x(n-1).

19. Write a MATLAB program to find the impulse response of the following difference equation3y(n)-6 y(n-1)+4y(n-2)=4x(n)-x(n-1).

20. Write a MATLAB program to find the impulse response of the following difference equation2y(n)-5y(n-1)+4y(n-2)=x(n)-2x(n-1).

Real Time Applications:

Z-Transforms having following applications

- Analysis of differential equations
- Z- transform spectroscopy
- Quantum mechanics
- Signal processing applications etc
- Conversion of analog signals to digital signals

EXPERMENT NO: 9

VERIFICATION OF SAMPLING THEORM

AIM: -

To Demonstrate Sampling Theorem and aliasing affect using MATLAB.

SOFTWARE REQURIED:-

1. MATLAB R2010a.

2.Windows XP SP2.

THEORY:-

Sampling Theorem:

The theorem shows that a band limited analog signal that has been sampled can be perfectly reconstructed from an infinite sequence of samples if the sampling rate exceeds 2B samples per second, where B is the highest frequency in the original signal.

If a signal contains a component at exactly B hertz, then samples spaced at exactly 1/(2B) seconds do not completely determine the signal, Shannon's statement notwithstanding.

Proof: Let g(t) be a bandlimited signal whose bandwidth is fm

(wm = 2πfm).

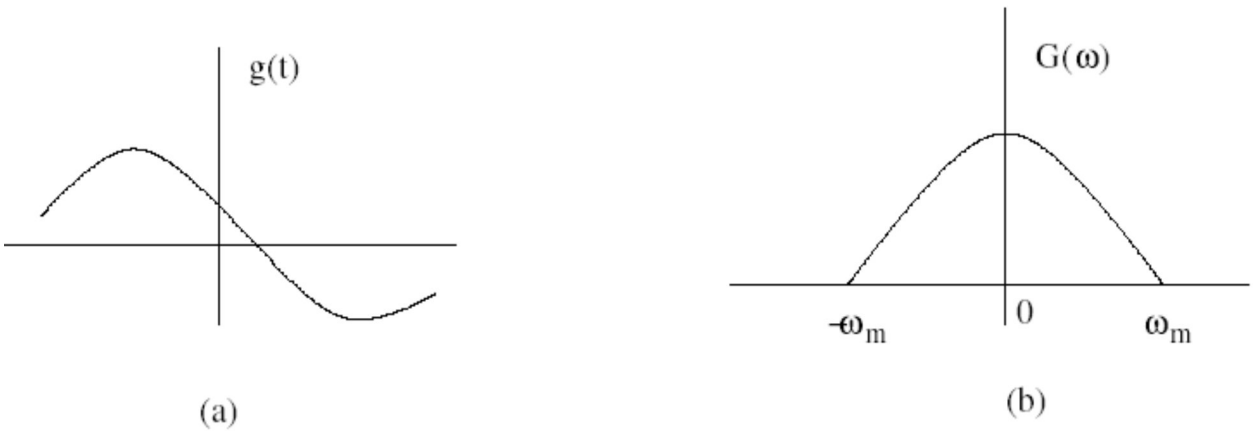


Figure 2: (a) Original signal g(t) (b) Spectrum G(w)

δ(t) is the sampling signal with fs = 1/T > 2fm.

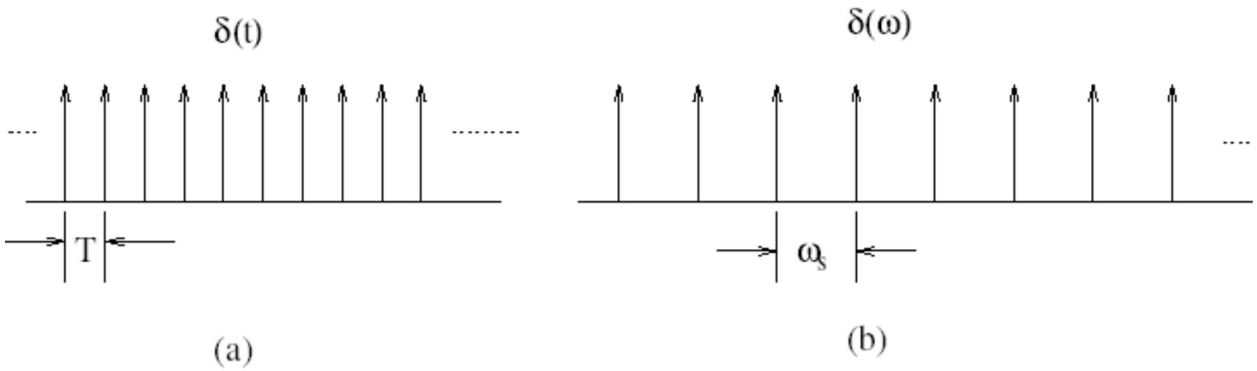


Figure 3: (a) sampling signal δ(t)) (b) Spectrum δ(w)

Let gs(t) be the sampled signal. Its Fourier Transform Gs(w) isgiven by

$$\begin{aligned}
\mathcal{F}(g_s(t)) &= \mathcal{F}\left[g(t)\delta_T(t)\right] \\
&= \mathcal{F}\left[g(t)\sum_{n=-\infty}^{+\infty}\delta(t-nT)\right] \\
&= \frac{1}{2\pi}\left[G(\omega) * \omega_0 \sum_{n=-\infty}^{+\infty}\delta(\omega-n\omega_0)\right] \\
G_s(\omega) &= \frac{1}{T}\sum_{n=-\infty}^{+\infty} G(\omega) * \delta(\omega-n\omega_0) \\
G_s(\omega) &= \mathcal{F}\left[g(t)+2g(t)\cos(\omega_0 t)+2g(t)\cos(2\omega_0 t)+\cdots\right] \\
G_s(\omega) &= \frac{1}{T}\sum_{n=-\infty}^{+\infty} G(\omega-n\omega_0)
\end{aligned}$$

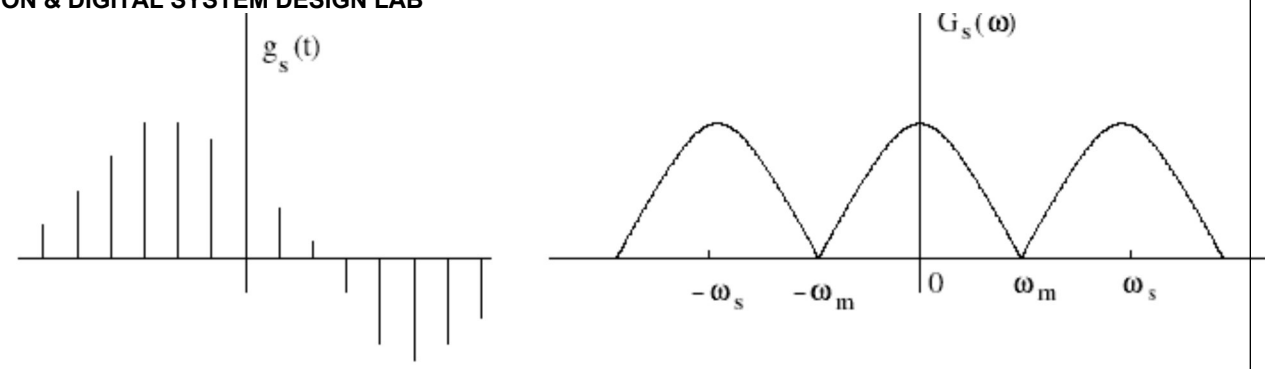


Figure 4: (a) sampled signal gs(t) (b) Spectrum Gs(w)

If $\omega_s = 2\omega_m$, i.e., $T = 1/2f_m$. Therefore, $G_s(\omega)$ is given by

$$G_s(\omega) = \frac{1}{T} \sum_{n=-\infty}^{+\infty} G(\omega - n\omega_m)$$

To recover the original signal G(w):

1. Filter with a Gate function, H2wm(w) of width 2wm

Scale it by T.

$$G(\omega) = TG_s(\omega)H_{2\omega_m}(\omega).$$

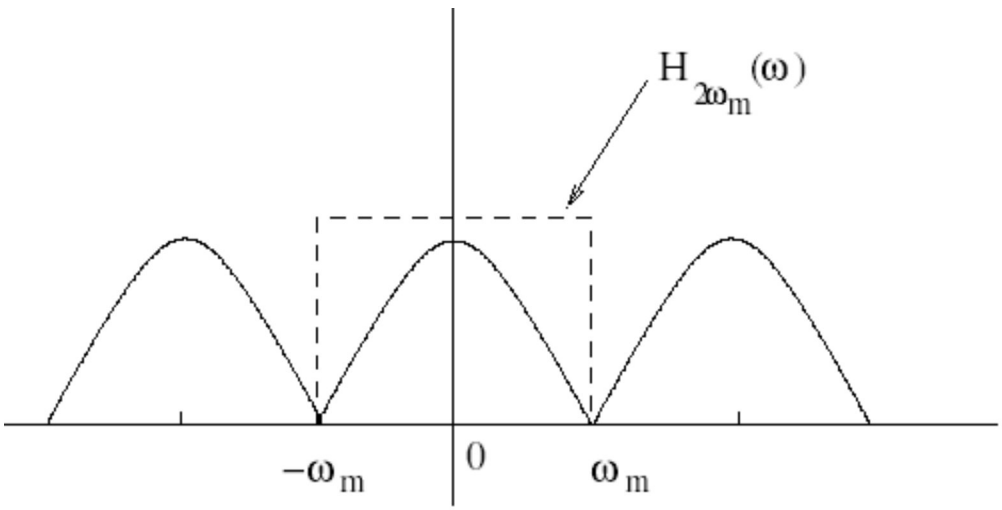


Figure 5: Recovery of signal by filtering with a fiter of width 2wm

Aliasing

{ Aliasing is a phenomenon where the high frequency components of the sampled signalinterfere with each other because of inadequate sampling ws < 2wm.

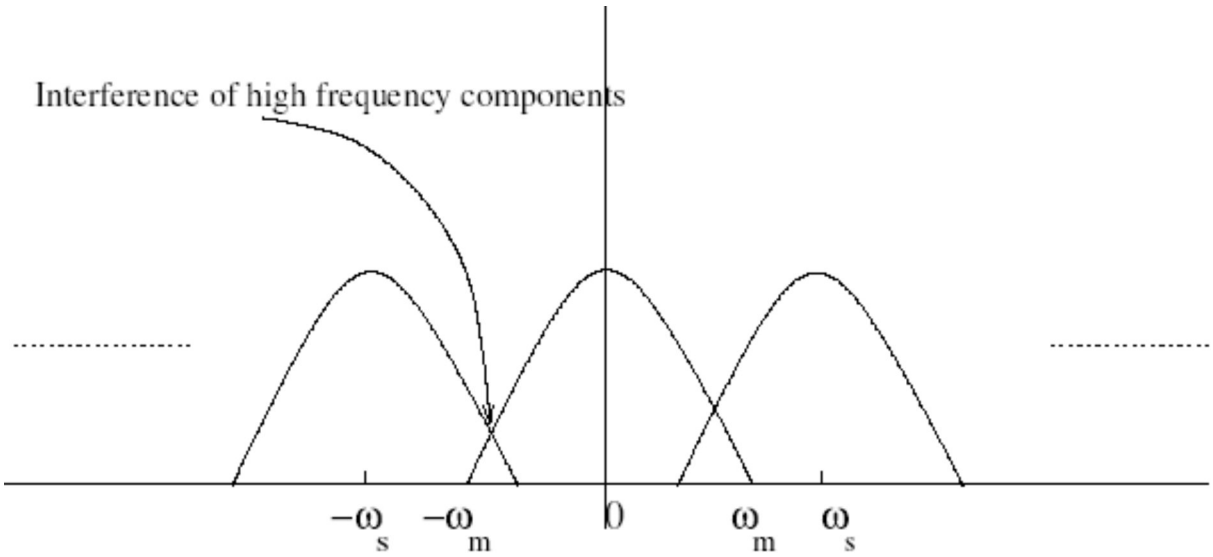


Figure 6: Aliasing due to inadequate sampling

Aliasing leads to distortion in recovered signal. This is the reason why sampling frequency should be at least twice the bandwidth of the signal.

PROCEDURE:-

- Open MATLAB
- Open new M-file
- Type the program
- Save in current directory
- Compile and Run the program
- For the output see command window\ Figure window

PROGRAM:-

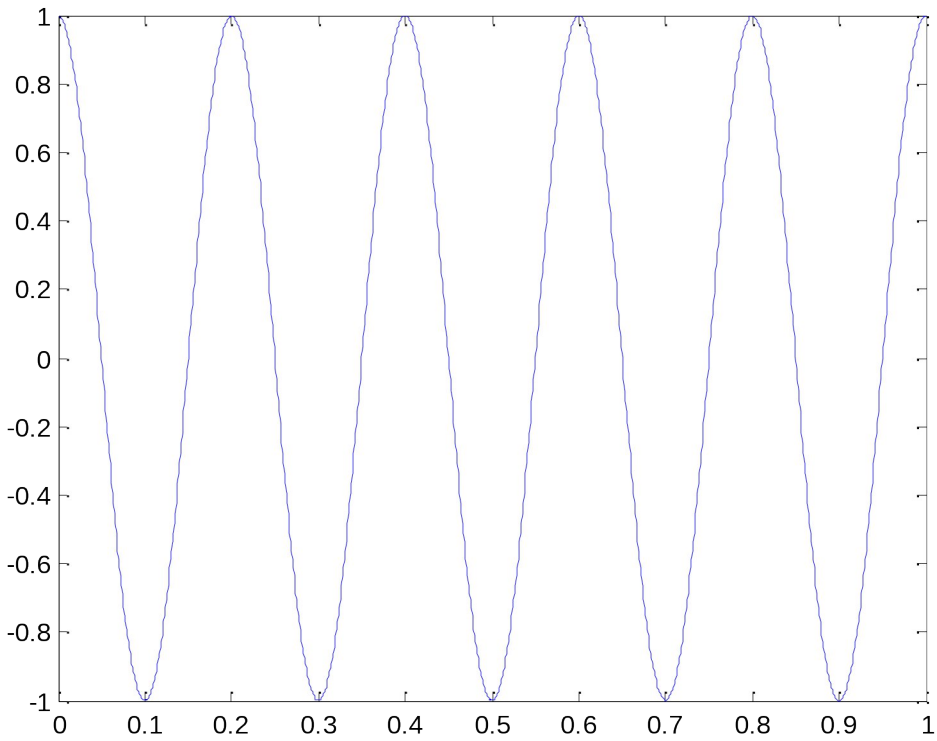
```
%sampling theorem%

clc;

clear all;

close all;

t=0:0.001:1;
```

```
f=5;
x=cos(2*pi*f*t);
plot(t,x);
%when fs>2fm%
fs1=3*f;
ts1=1/fs1;
n1=0:ts1:1;
xs1=cos(2*pi*f*n1);
figure;
plot(n1,xs1,'r');
hold on;
plot(t,x);
hold off;
%when fs=2fm%
fs2=2*f;
ts2=1/fs2;
n2=0:ts2:1;
xs2=cos(2*pi*f*n2);
figure;
plot(n2,xs2,'r');
hold on;
plot(t,x);
hold off;
%when fs<2fm%
fs3=1.5*f;
ts3=1/fs3;
n3=0:ts3:1;
xs3=cos(2*pi*f*n3);
```

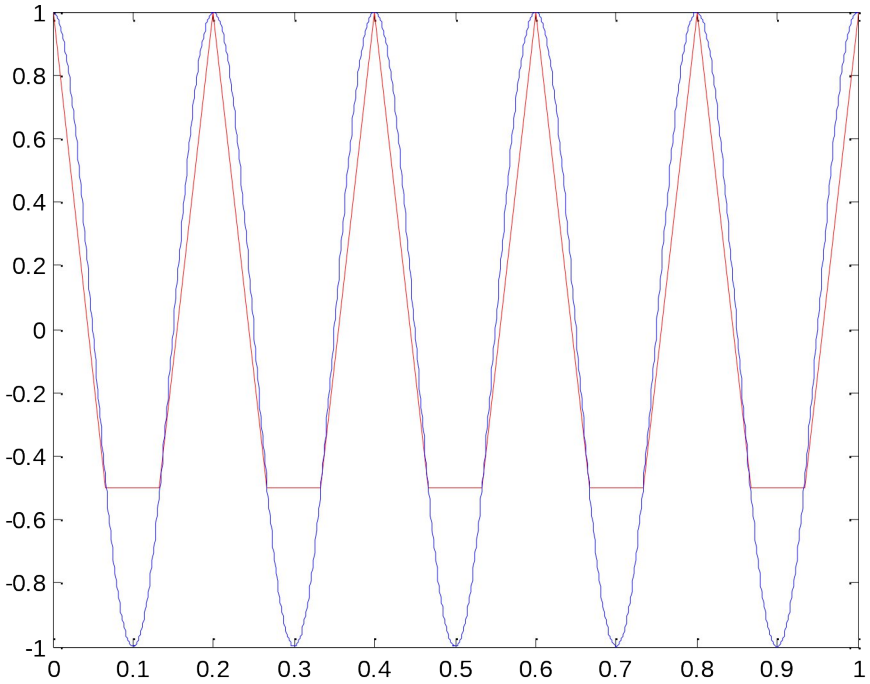
```
figure;

plot(n3,xs3,'r');

hold on;

plot(t,x);

hold off;
```

OUTPUT:-

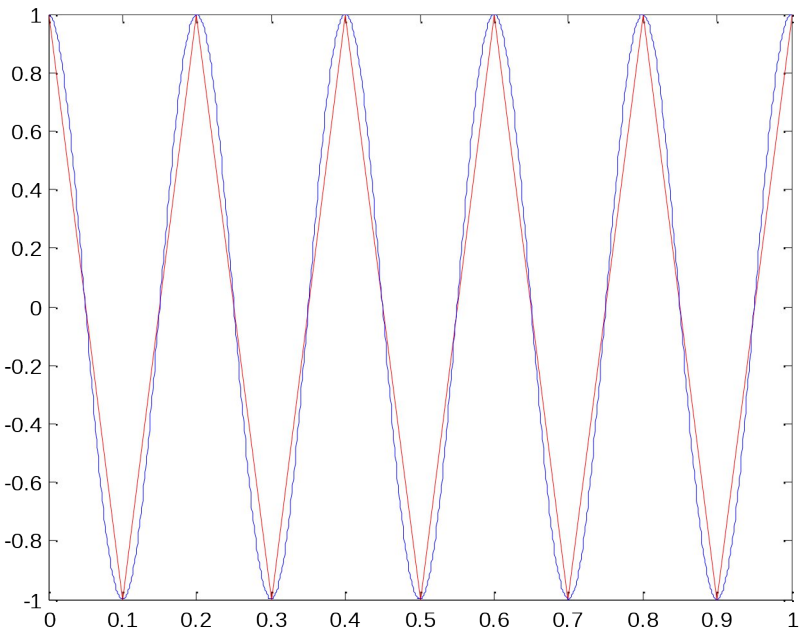
Sampling theorem



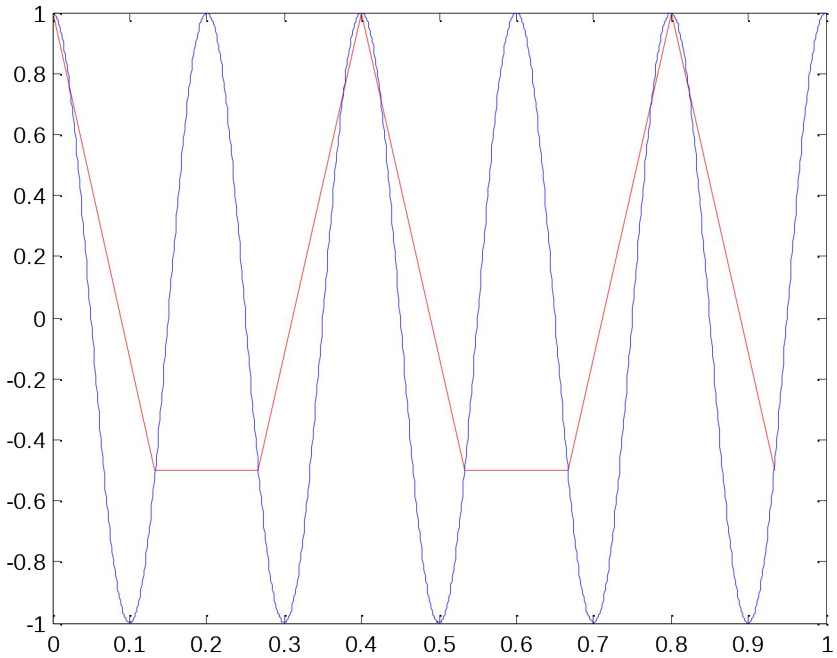
when fs>2fm



when fs=2fm



when fs<2fm



RESULT:-

In this experiment the sampling theorem have been verified using MATLAB .

VIVA QUESTIONS:-

Sampling Theorem

1. If Sampled frequency less than nyquist rate then it is called as.
2. If Sampled frequency greater than nyquist rate then it is called as.
3. If Sampled frequency is nyquist rate then it is called as.
4. What is the cause of Aliasing effect.
5. Explain the function of Anti aliasing filter.
6. What are types of sampling techniques are there.
7. The spectrum of the sampled signal may be obtained without overlapping only if
8. The desired signal of maximum frequency w_m centered at frequency w=0 may be recovered if
9. A distorted signal of frequency f_m is recovered from a sampled signal if the sampling frequency f_s is
10. Calculate the minimum sampling rate to avoid aliasing when a continuous time signal is given by $x(t) = 5 \cos 400\pi t$
11. Calculate the minimum sampling rate to avoid aliasing when a continuous time signal is given by $x(t) = 5 \sin 400\pi t$
12. Calculate the minimum sampling rate to avoid aliasing when a continuous time signal is given by $x(t) = 5 \cos 400\pi t + 5\sin 400\pi t$

13. Calculate the Nyquist rate for sampling when a continuous time signal is given by $x(t) = 5 \cos 100\pi t + 10 \cos 200\pi t - 15 \cos 300\pi t$.
14. What is low pass filter.
15. Define high pass filter.
16. Explain Band pass filter.
17. What is Band stop pass filter.
18. What is band reject filter.
19. The instantaneous sampling means?
20. The sampling technique that has the minimum noise interference is.
21. Explain clc command.
22. Narrate the term clear in MATLAB .
23. Draw the Frequency response of high pass filter.
24. Draw the Frequency response of Band pass filter.
25. Draw the Frequency response of Band pass filter.
26. Define aliasing effect.
27. suggest the method to eliminate aliasing effect.
28. compare sampling techniques.
29. Distinguish between sampling rate and sampling frequency.
30. Define sampling Interval
31. Explain cross correlation.
32. how to do the sampling process.
33. write the differences between continuous and discrete signals.
34. Write the equation of sampled signal.
35. write the formula for natural sampling.
36. calculate Nyquist rate for Band limited signals.
37. Define cut off frequency.
38. Explain roll off rate.
39. Define the term SNR.
40. Draw the Flat to sampled signal.
41. Distingush between Natural and Ideal sampling.
42. what is meant by Ideal sampling.
43. Narrate the term Instantaneous sampling.
44. Explain the commands plot and subplot.
45. Write The properties of psd.
46. Write the applications of sampling.
47. What are the advantages of sampling
48. Explain Draw backs in Analog signal processing.
49. mention the method to avoid Interference.
50. Elaborate the term white noise.

EXERCISE PROGRAM:-

1.Write a MATLAB program to find the effect of up sampling in frequency domain.

2. Write a MATLAB program to get the above output where t0 = 2

3. Write a MATLAB program to find the effect of up sampling in frequency domain for 20khz.

4.Write a program to get the following output t = -1: -5

5. Write mat lab program to get the above output

X(t) = 1; (0<t<2)

= 10;(2<t<15) Note: Add ramp and unit

6.Write a MATLAB program to generate a sine wave with amplitude = 3, frequency 20Hz.

7.Write a MATLAB program to generate a cos wave with amplitude = 3, frequency 20Hz.

8.Write a MATLAB program to generate a triangular wave with amplitude = 8, frequency 10Hz.

9.Write a MATLAB program to generate a square wave with amplitude = 2, frequency 10kHz.

10.Write a MATLAB program to generate the signum function.

11.Write a MATLAB program to generate exponential growing signal.

12.Write a MATLAB program to generate exponential decaying signal.

13.Write a MATLAB program to generate a triangular wave with amplitude = 6,frequency 1Hz.

14.Write a MATLAB program to generate a square wave with amplitude = 5, frequency 5kHz.

15.Write a MATLAB program to generate a SAWTOOTH wave with amplitude = 8, frequency5Khz.

16.Write a MATLAB program to generate a sine wave with amplitude = 5, frequency 5Hz.

17.Write a MATLAB program to generate a cos wave with amplitude = 4, frequency 10Hz.

18.Write a MATLAB program to generate a triangular wave with amplitude = 5, frequency 4Hz.

19.Write a MATLAB program to generate a square wave with amplitude = 1, frequency

20kHz.

20.Write a MATLAB program to generate the signum function.

21.Write a MATLAB program to generate a square wave with amplitude = 4, frequency 5kHz.

22.Write a MATLAB program to generate a triangular wave with amplitude = 6, frequency 6Hz.

23.Write a MATLAB program to generate a triangular wave with amplitude = 8,frequency 2Hz.

24.Write a MATLAB program to generate a square wave with amplitude = 7, frequency 5kHz.

25.Write a MATLAB program to generate a SAWTOOTH wave with amplitude =10, frequency 10Khz.

REAL TIME APPLICATIONS:

- Industrial control and automation (Control the velocity or position of an object)
- Examples: Controlling the position of a valve or shaft of a motor
- Examples: Digital processing applications
- TV reception
- RADAR
- SONAR

EXPERMENT NO: 10

CHECKING A RANDOM PROCESS FOR STATIONARITY IN WIDE SENSE.

AIM: -

Checking a random process for stationarity in wide sense.

SOFTWARE REQURIED:-

1.MATLAB R2010a.

2.Windows XP SP2.

THEORY:-

A stationary process (or strict(ly) stationary process or strong(ly) stationary process) is a stochastic process whose joint probability distribution does not change when shifted in time or space. As aresult, parameters such as the mean and variance, if they exist, also do not change over time or position..Weak or wide-sense stationaryA weaker form of stationary commonly employed in signal processing is known as weak-sensestationary, wide-sense stationarity (WSS) or covariance stationarity. WSS random processes onlyrequire that 1st and 2nd moments do not vary with respect to time.

$$\mathbb{E}\{x(t)\} = m_x(t) = m_x(t+\tau)\ \forall \tau \in \mathbb{R}$$

and autocorrelation function

$$\mathbb{E}\{x(t_1)x(t_2)\} = R_x(t_1,t_2) = R_x(t_1+\tau, t_2+\tau) = R_x(t_1-t_2,0)\ \forall \tau \in \mathbb{R}.$$

The first property implies that the mean function mx(t) must be constant. The second property implies that thecorrelation function depends only on the difference between t1 and t2 and only needs to be indexed by onevariable rather than two variables. Thus, instead of writing,

Rx(t1-t2,0)we usually abbreviate the notation and write

$$R_x(\tau) \text{ where } \tau = t_1 - t_2.$$

This also implies that the auto covariance depends only on _ = t1 − t2, since

$$C_x(t_1,t_2) = C_x(t_1-t_2,0) = C_x(\tau).$$

Stationary and Non Stationary Random Process:

A random X(t) is stationary if its statistical properties are unchanged by a time shift in the time origin.Whenthe auto-Correlation function Rx(t,t+T) of the random X(t) varies with time difference T and the mean valueof the random variable X(t1) is independent of the choicet1,then X(t) is said to be stationary in the widesenseor wide-sense stationary . So a continuous- Time random process X(t) which is WSS has the following properties

1) $E[X(t)]=\mu X(t)= \mu X(t+T)$

2) The Autocorrelation function is written as a function of T that is

$RX(t, t+T)=Rx(T)$

If the statistical properties like mean value or moments depends on time then the random process is saidto be non-stationary.

When dealing with two random process X(t) and Y(t), we say that they are jointly wide-sense stationary if each process is stationary in the wide-sense.

$Rxy(t,t+T)=E[X(t)Y(t+T)]=Rxy(T)$.

PROCEDURE:-

- Open MATLAB
- Open new M-file
- Type the program
- Save in current directory
- Compile and Run the program
- For the output see command window\ Figure window

PROGRAM:-

```
Clc;

Close all;

clear all

y = randn([1 40])

my=round(mean(y));

z=randn([1 40])

mz=round(mean(z));

vy=round(var(y));

vz=round(var(z));

t = sym('t','real');

h0=3;

x=y.*sin(h0*t)+z.*cos(h0*t);

mx=round(mean(x));

k=2;
```

```
xk=y.*sin(h0*(t+k))+z.*cos(h0*(t+k));

x1=sin(h0*t)*sin(h0*(t+k));

x2=cos(h0*t)*cos(h0*(t+k));

c=vy*x1+vz*x1;
```

OUTPUT:-

```
%if we solve "c=2*sin(3*t)*sin(3*t+6)" we get c=2cos(6)

%which is a costant does not depent on variable 't'

% so it is wide sence stationary.
```

RESULT:-

Checking a random process for stationarity in wide sense by using MATLAB.

VIVA QUESTIONS:-

1. What is the value of an area under the conditional PDF ?
2. When do the conditional density functions get converted into the marginally density functions ?
3. Which among the below mentioned standard PDFs is/are applicable to discrete random variables ?
4. What would happen if the value of term [(m-x) / ($\sigma\sqrt{2}$)] increases in the expression of Guassian CDF?
5. Which type of standard PDFs has/ have an ability to describe an integer valued random variable concerning to the repeated trials carried /conducted in an experiment?
6. Which theorem states that the total average power of a periodic signal is equal to the sum of average powers of the individual fourier coefficients?
7. How to Represent any function using Fourier series.
8. calculate the value of autocorrelation value at origin.
9. Write about properties of correlation.
10. Describe the properties of Auto correlation.
11. Write about properties cross correlation.
12. What is meant by continuous Random process.
13. Explain Discrete Random process.
14. Narrate the First order random process.
15. Elaborate second order random process.
16. What is meant by third order random process.
17. Explain nth order random process.
18. What is meant by random process.
19. Classify the random process
20. .What is meant by continuous Random process.
21. Write Briefly about Discrete Random process.
22. What is meant by Discrete Random sequence

23. What is meant by continuous Random sequence.
24. What is meant Ergodicity.
25. Explain Time average.
26. Explain cross correlation.
27. how to do the sampling process.
28. write the differences between continuous and discrete signals.
29. Write the equation of sampled signal.
30. Explain clc command.
31. Narrate the term clear in MATLAB .
32. Draw the Frequency response of high pass filter.
33. What is Band stop pass filter.
34. What is band reject filter.
35. The instantaneous sampling means?
36. The sampling technique that hasthe minimum noise interference is.
37. What Types of analog pulse modulation systems.
38. Write about correlation.
39. Write about Auto correlation.
40. Explain Draw backs in Analog signal processing
41. Write the properties of Expectation.
42. How to find Mean value using MATLAB .
43. What is the Relation between Mean and Mean square value.
44. Relate PDF and CDF.
45. Write the properties of CDF.
46. Write the properties of PDF.
47. measure the mean value of Gaussian Density function.
48. Differentiate Binomial and Gaussian Distribution.
49. Calculate mean value of any distribution function at origin.
50. Find Inverse Fourier Transform of impulse function.

EXERCISE PROGRAMS

1.Write a program to simulate parseval's relation

2. Write a mat lab program to perform the cross correlation between sinusoidal and ramp function and see how mat lab reacts to it.

3. Write a MATLAB program to perform cross correlation between square and step signal and see how mat lab reacts to it.

4. Write a MATLAB program to perform cross correlation between sinusoidal and ramp signal and see how mat lab reacts to it.

5. Write a MATLAB program to perform the cross correlation between X (n) = [1 2 3 5] and y (n) = [- 1 – 2] and see how MATLAB reacts to it.

6. Write a MATLAB program to perform the cross correlation between X (n) = [1 -3 5] and y (n) = [1 2 3 4] and see how MATLAB reacts to it.

7. Write a MATLAB program to perform the cross correlation between X (n) = [1 0 1 1] and y (n) = [1 0 0 0 0] and see how MATLAB reacts to it.

8.Write a MATLAB program to perform the cross correlation between X (n) = [1 1 1 1 0 0 0 0] and y (n) = [1 0 1 0 1 0 1 0] and see how MATLAB reacts to it.

9.Write a MATLAB program to perform the cross correlation between X (n) = [1 1 0 0] and y (n) = [1 1 1 1] and see how MATLAB reacts to it.

10.Write a MATLAB program to perform the cross correlation between X (n) = [6 7 8 9 10] and y (n) = [5 4 3 2 1] and see how MATLAB reacts to it.

11.Write the MATLAB program to perform cross correlation between the following sequences

X(n)=[2 -2 3 2, h(n) = [-2 4 -5 2].

12. Write a mat lab program to perform the convolution between step and ramp function and see how mat lab reacts to it.

13. Write a MATLAB program to perform convolution between square and step signal and see how mat lab reacts to it.

14. Write a MATLAB program to perform convolution between sinusoidal and square signal and see how mat lab reacts to it.

15. Write a MATLAB program to perform the convolution between X (n) = [2 3 4 5] and y (n) = [-2 –4] and see how MATLAB reacts to it.

16. Write a MATLAB program to perform the convolution between X (n) = [3 -4 6] and y (n) = [2 6 8 6] and see how MATLAB reacts to it.

17. Write a MATLAB program to perform the convolution between X (n) = [3 1 2 0] and y (n) = [2 4 3 4 5] and see how MATLAB reacts to it.

18.Write a MATLAB program to perform the convolution between X (n) = [2 2 1 0 2 1 1 0] and y (n) = [1 1 1 2 1 0 1 0] and see how MATLAB reacts to it.

19.Write a MATLAB program to perform the convolution between X (n) = [2 1 2 1] and y (n) = [1 2 1 2] and see how MATLAB reacts to it.

20.Write a MATLAB program to perform the convolution between X (n) = [5 6 9 8 7] and y (n) = [1 2 3 2 1] and see how MATLAB reacts to it.

21.Write the MATLAB program to perform cross correlation between the following sequences

X(n)=[4 -6 5 1], h(n) = [-1 3 -4 3].

22. Write a mat lab program to perform the cross correlation between ramp and step function and see how mat lab reacts to it.

23. Write a MATLAB program to perform cross correlation between square and step signal and see how mat lab reacts to it.

24. Write a MATLAB program to perform cross correlation between sinusoidal and step signal and see how mat lab reacts to it.

25. Write a MATLAB program to perform the convolution between X (n) = [1 5 6 5] and y (n) = [-3 –6] and see how MATLAB reacts to it.

REAL TIME APPLICATIONS:

- Parseval's theorem for energy signals
- Parseval's theorem for power signals
- Digital signal processing applications etc…

DIGITAL SYSTEM DESIGN LAB

EXPERIMENT 1

REALIZATION OF BOOLEAN EXPRESSIONS USING GATES

AIM: Realization of Boolean Expressions using Gates

APPARATUS REQUIRED: IC 7404,IC 7408, IC 7432**,** Trainer kit, patch cards.

LOGIC DIAGRAM 1:

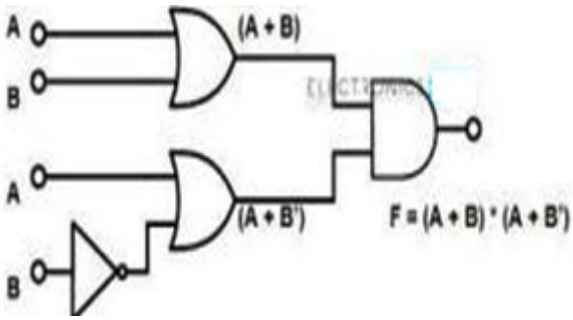


Fig1. Logic diagram 1

LOGIC DIAGRAM 2

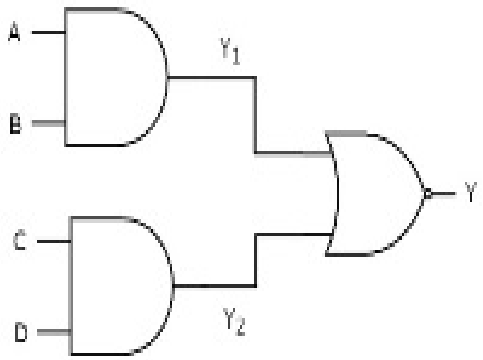
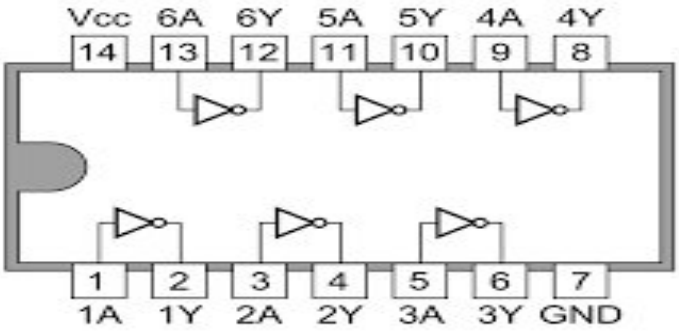


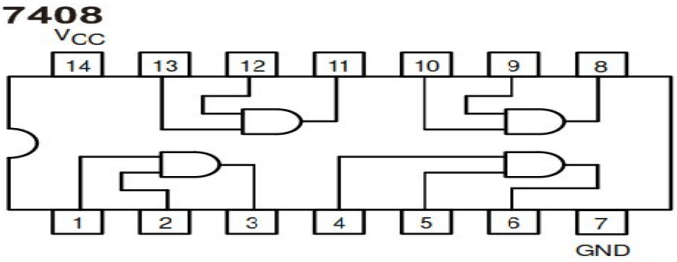
Fig2: logic diagram 2

IC PIN DIAGRAMS:

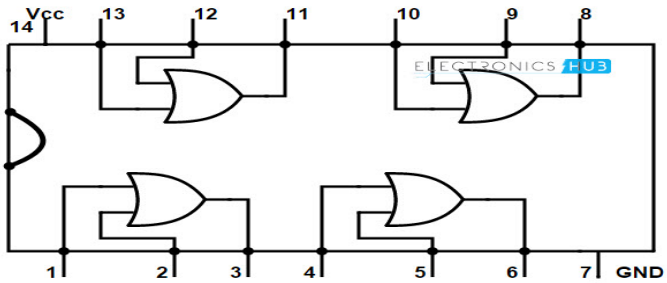
7404 Hex Inverters



7408



7432



THEORY:

Logic gates

Digital systems are said to be constructed by using logic gates. These gates are the AND, OR, NOT, NAND, NOR, EXOR and EXNOR gates. The basic operations are described below with the aid of truth tables.

AND gate

2 Input AND gate		
A	B	A.B
0	0	0
0	1	0
1	0	0
1	1	1

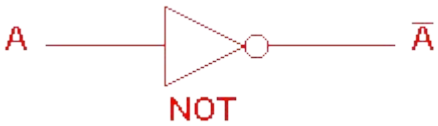
The AND gate is an electronic circuit that gives a **high** output (1) only if **all** its inputs are high. A dot (.) is used to show the AND operation i.e. A.B. Bear in mind that this dot is sometimes omitted i.e. AB

OR gate

2 Input OR gate		
A	B	A+B
0	0	0
0	1	1
1	0	1
1	1	1

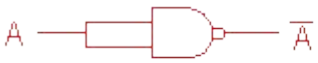
The OR gate is an electronic circuit that gives a high output (1) if **one or more** of its inputs are high. A plus (+) is used to show the OR operation.

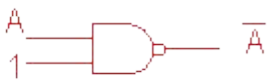
NOT gate



NOT gate	
A	$\overline{A}$
0	1
1	0

The NOT gate is an electronic circuit that produces an inverted version of the input at its output. It is also known as an *inverter*. If the input variable is A, the inverted output is known as NOT A. This is also shown as A', or A with a bar over the top, as shown at the outputs. The diagrams below show two ways that the NAND logic gate can be configured to produce a NOT gate. It can also be done using NOR logic gates in the same way.



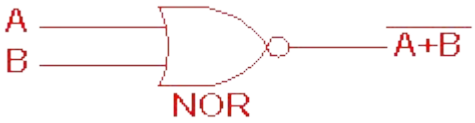


NAND gate

2 Input NAND gate		
A	B	$\overline{A.B}$
0	0	1
0	1	1
1	0	1
1	1	0

This is a NOT-AND gate which is equal to an AND gate followed by a NOT gate. The outputs of all NAND gates are high if **any** of the inputs are low. The symbol is an AND gate with a small circle on the output. The small circle represents inversion.

NOR gate



2 Input NOR gate		
A	B	$\overline{A+B}$
0	0	1
0	1	0
1	0	0
1	1	0

This is a NOT-OR gate which is equal to an OR gate followed by a NOT gate. The outputs of all NOR gates are low if **any** of the inputs are high.

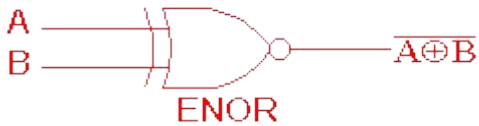
The symbol is an OR gate with a small circle on the output. The small circle represents inversion.

EXOR gate

2 Input EXOR gate		
A	B	A⊕B
0	0	0
0	1	1
1	0	1
1	1	0

The '**Exclusive-OR**' gate is a circuit which will give a high output if **either, but not both**, of its two inputs are high. An encircled plus sign (⊕) is used to show the EOR operation.

EXNOR gate



2 Input EXNOR gate		
A	B	$\overline{A⊕B}$
0	0	1
0	1	0
1	0	0
1	1	1

The '**Exclusive-NOR**' gate circuit does the opposite to the EOR gate. It will give a low output if **either, but not both**, of its two inputs are high. The symbol is an EXOR gate with a small circle on the output. The small circle represents inversion.

The NAND and NOR gates are called *universal functions* since with either one the AND and OR functions and NOT can be generated.

Note:

A function in *sum of products* form can be implemented using NAND gates by replacing all AND and OR gates by NAND gates.

A function in *product of sums* form can be implemented using NOR gates by replacing all AND and OR gates by NOR gates

Table 1: Logic gate symbols

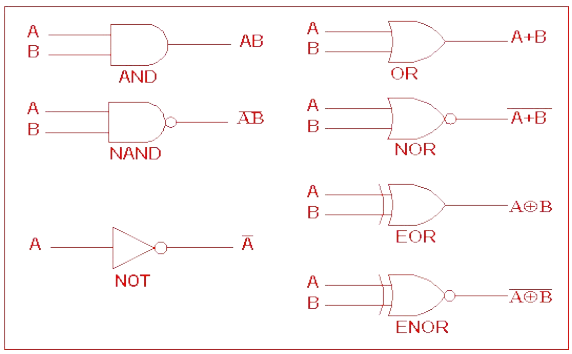


Table 2 is a summary truth table of the input/output combinations for the NOT gate together with all possible input/output combinations for the other gate functions. Also note that a truth table with 'n' inputs has 2^n rows. You can compare the outputs of different gates.

Table 2: Logic gates representation using the Truth table

NOT gate	
A	$\overline{A}$
0	1
1	0

INPUTS		OUTPUTS					
A	B	AND	NAND	OR	NOR	EXOR	EXNOR
0	0	0	1	0	1	0	1
0	1	0	1	1	0	1	0
1	0	0	1	1	0	1	0
1	1	1	0	1	0	0	1

TRUTH TABLE:

Logic diagram 1:

A	B	A+B	B’	A+B’	F= (A+B)*(A+B’)

Logic diagram 2:

A	B	Y1=A*B	C	D	Y2=C*D	(A*B)+(C*D)	Y= ((A*B)+(C*D))'

PROCEDURE:

1. Make the connections as per the circuit diagram
2. Switch on the power supply
3. Verify the truth table

PRECAUTIONS:

1. The power supply pins must be checked whether power is available at those pins using test probes.
2. No loose connections should be there and care must be taken to avoid shorting of pins.

RESULT:_ Realization of Boolean Expressions using Gates AND ,OR and NOT gates NOR gates have been verified.

VIVA QUESTIONS

1. The boolean expression of an OR gate is _____?
2. A _____ gate gives the output as 1 only if all the inputs signals are?
3. Which of the gate will give a 0 when both of its inputs are 1?
4. The gate which is called an inverter is called _____?
5. The expression of an EXOR gate is _____?
6. When logic gates are connected to form a gating/logic network it is called as a _____ logic circuit.

7. The universal gate that can be used to implement any Boolean expression is _____?
8. Electronic circuits that operate on one or more input signals to produce standard output _____?
9. What are the universal gates?
10. A _____ is a circuit with only one output but can have multiple inputs?
11. The Output is LOW if any one of the inputs is HIGH in case of a _____ gate?
12. How many AND gates are required to realize the following expression Y=AB+BC?
13. Number of outputs in a half adder _____
14. The expression of a NAND gate is_____?
15. The _____ gate is an OR gate followed by a NOT gate?
16. Brain of computer is _____?
17. What does MBR stand for?
18. In the instruction ADD A, B, the answer gets stored in _____?
19. What does PC stand for?
20. Which of the following holds the last instruction fetched?
21. The portion of the processor which contains the hardware required to fetch the operations is _____?
22. Causing the CPU to step through a series of micro operations is called _____?
23. The functions of execution and sequencing are performed by using _____?
24. What does D in the D-flip flop stand for?
25. The length of a register is called _____?
26. Opcode indicates the operations to be performed?
27. CPU has built-in ability to execute a particular set of machine instructions, called as _____?
28. Write two characterstics of combinational circuits?
29. Explain what is excitation table?
30. Explain what is Boolean Algebra?
31. Explain what are the basic logic elements?

32. Define positive logic and negative logic?
33. Explain what is an inverter?
34. Explain what is the specialty of NAND and NOR gates?
35. Explain why NAND-NAND realization is preferred over AND-OR realization?
36. Explain why is a two-input NAND gate called universal gate?
37. Explain what is associate law?
38. Explain what is a latch?
39. Explain what is pulse logic system?
40. Implement all logic gate by using universal gate?
41. Which logic gate is a basic comparator?
42. When are two numbers are equal?
43. What are the different types of comparator?
44. What are the advantages of comparator?
45. If two numbers are not equal then binary variable will be
46. A procedure that specifies finite set of steps is called ?
47. . How many select lines would be required for an 8-line-to-1-line multiplexer?
48. How many NOT gates are required for the construction of a 4-to-1 multiplexer?
49. What are the applications of multiplexer and de-multiplexer?
50. In 2n to 1 multiplexer how many selection lines are there?

EXPERIMENT 2

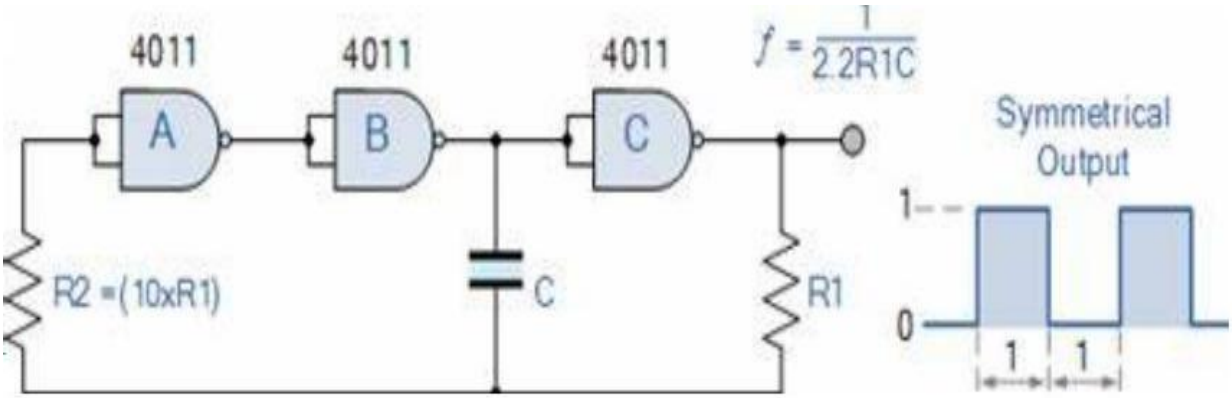
GENERATION OF CLOCK USING NAND / NOR GATES

AIM: Generation of clock using NAND / NOR gates

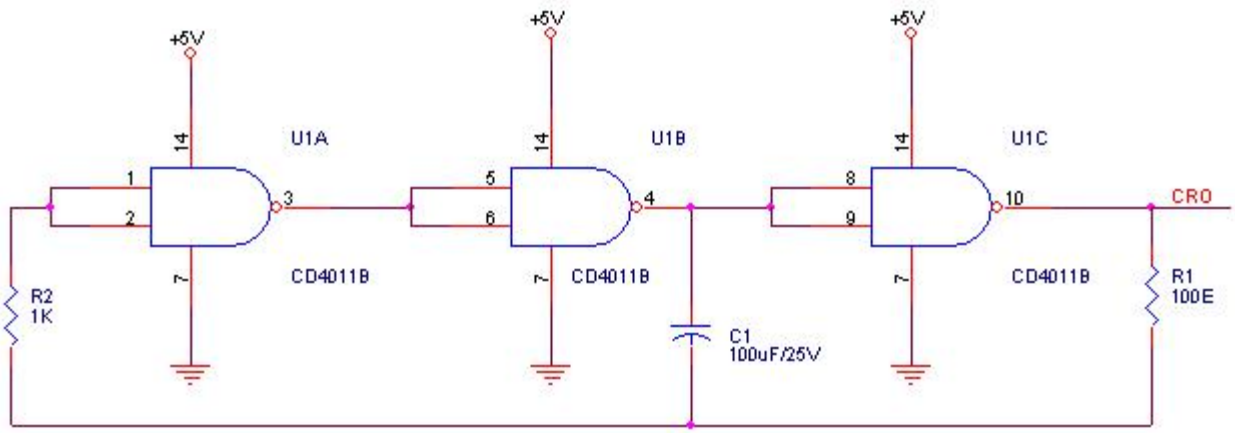
Equipments Needed:

1) Patch Cords
2) IC CD 4011, 1k Resistance , 100E Resistance , 100uF/25V Electrolytic capacitor, Bread Board

Block Diagram:

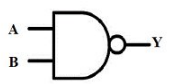


Circuit Diagram:



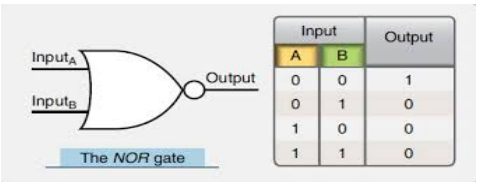
THEORY:

NAND Gate: The NAND gate represents the complement of the AND operation. Its name is an abbreviation of NOT AND. The graphic symbol for the NAND gate consists of an AND symbol with a bubble on the output, denoting that a complement operation is performed on the output of the AND gate. The truth table and the graphic symbol of NAND gate is shown in the figure. The truth table clearly shows that the NAND operation is the complement of the AND.



Inputs		output
A	B	Y
0	0	1
0	1	1
1	0	1
1	1	0

NOR Gate: The NOR gate represents the complement of the OR operation. Its name is an abbreviation of NOT OR. The graphic symbol for the NOR gate consists of an OR symbol with a bubble on the output, denoting that a complement operation is performed on the output of the OR gate. The truth table and the graphic symbol of NOR gate is shown in the figure. The truth table clearly shows that the NOR operation is the complement of the OR.



Input		Output
A	B	
0	0	1
0	1	0
1	0	0
1	1	0

Universal Gates: A universal gate is a gate which can implement any Boolean function without need to use any other gate type. The NAND and NOR gates are universal gates. In practice, this is advantageous since NAND and NOR gates are economical and easier to fabricate and are the basic gates used in all IC digital logic families. In fact, an AND gate is typically implemented as a NAND gate followed by an inverter not the other way around!! Likewise, an OR gate is typically implemented as a NOR gate followed by an inverter

PROCEDURE:

1. Make the connection as per the above connection diagram.
2. Switch On the power supply.
3. Observed the output on the CRO.
4. BY changing the value of R1, R2 and C1 to change the Clock Output.

RESULT: Clock signal is generated successfully by using nand/nor gate.

VIVA QUESTIONS:

1. What are the universal gates? Why they are called so?

2. Realize the EX – OR gates using minimum number of NAND gates.

3. Give the truth table for EX-NOR and realize using NAND gates?

4. What are the logic low and High levels of TTL IC's and CMOS IC's?

5. Compare TTL logic family with CMOS family?

6 .Which logic family is fastest and which has low power dissipation?

7. What are the different methods to obtain minimal expression?

8.What is a Min term and Max term

9. State the difference between SOP and POS.

10. What is K-map? Why is it used?

11.What do you mean by Logic Gates?

12.What are the applications of Logic Gates?

13.What is Truth Table?

14. Why we use basic logic gates?

15.Write down the truth table of all logic gates?

16.What do you mean by universal gate?

17.Write truth table for 2 input NOR,NAND gate?

18. Implement all logic gate by using universal gate?

19.Why is they called universal Gates?

20. Give the name of universal gate?

21. Draw the circuit diagram of Half adder circuit?

22.Draw the circuit diagram of full adder circuit?

23 Draw the full adder circuit by using Half Adder circuit and minimum no. of logicgate?

24.Write Boolean function for half adder?

25. Write Boolean function for Full adder?261.Design the half Adder and Full adder using NAND-NAND Logic.

26.Pseudo Random Sequence Generator also known as what?

27.Ring counter belong to which type of counter?

28.What are the types of ring counter?

29. What is the difference between Johnson Ring Counter and synchronous ring counter?

30.What is meant by pseudorandom number generator?

31. List out the applications of PRNG.

32. TRNG stands for

33. Define Uniformity in PRNG

34. Define scalability.

35. Write the syntax for component declaration.

36. Write the behavioral code for IC 74x189 without declaring the function

37. Explain about different types of RAMs?

38. How to specify the memory size?

39. Explain read and write operations?

40. What are the differences between RAM and RAM?

41. Explain the steps of a compilation process of a VHDL program?

42. Explain the types of design units?

43. Why configurations are needed?

44. What is binding? What is subprogram in vhdl

45.Write the behavioral code for the IC 74x74.

46. Write the dataflow code for the IC 74x74.

47. What is the difference between sequential and combinational circuit?

48. What is a flip-flop? Explain the functions of preset and clear inputs in flip-flop?

49. What is meant by a clocked flip-flop?

50. What is meant by excitation table?

EXPERIMENT 3

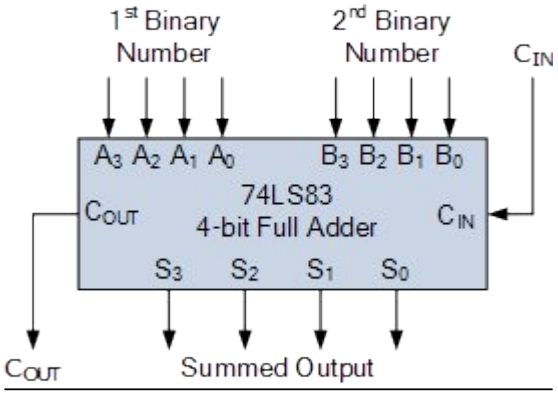
DESIGN A 4 – BIT ADDER / SUBTRACTOR

AIM: Design a 4 – bit Adder / Subtractor

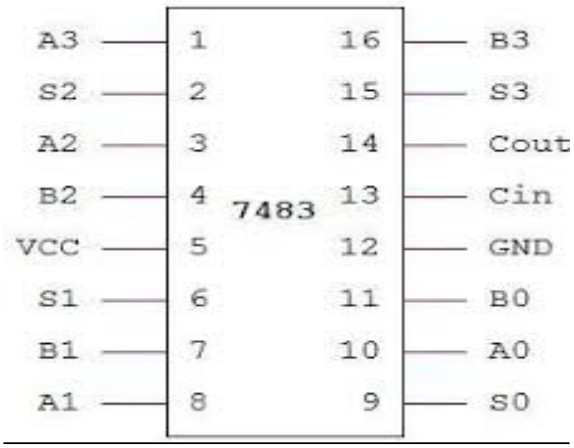
APPARATUS REQUIRED:_IC 7408, 7432, 7486, Bread Board, Connecting wires.

BLOCK DIAGRAM:

4-BIT ADDER USING 74LS83



IC 74LS83 PIN DIAGRAM



TRUTH TABLE

C_{in}	INPUT A				INPUT B				C_{out}	OUTPUT S			
	A_3	A_2	A_1	A_0	B_3	B_2	B_1	B_0		S_3	S_2	S_1	S_0

THEORY:

FOUR-BIT BINARY PARALLEL ADDER:

In the preceding section, we discussed how two binary bits can be added and the addition of two binary bits with a carry. In practical situations it is required to add two data each containing more than one bit. Two binary numbers each of *n* bits can be added by means of a full adder circuit. Consider the example that two 4-bit binary numbers $B_4B_3B_2B_1$ and $A_4A_3A_2A_1$ are to be added with a carry input C_1. This can be done by cascading four full adder circuits as shown in Figure 5.48. The least significant bits A_1, B_1, and C_1 are added to the produce sum output S_1 and carry output C_2. Carry output C_2 is then added to the next significant bits A_2 and B_2 producing sum output S_2 and carry output C_3. C_3 is then added to A_3 and B_3 and so on. Thus finally producing the four-bit sum output $S_4S_3S_2S_1$ and final carry output Cout. Such type of four-bit binary adder is commercially available in an IC package. For the addition of two *n* bits of data, *n* numbers of full adders can be cascaded as

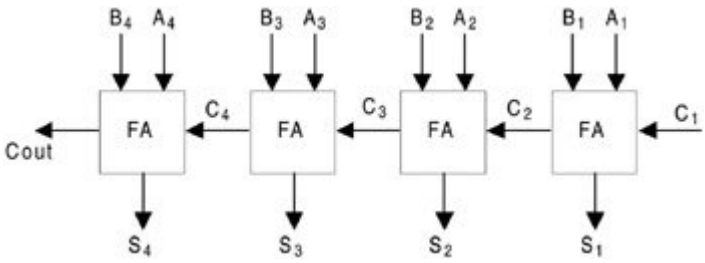


Figure : 4-bit full adder

PROCEDURE:

1. Connections are made as per the circuit diagram
2. Switch on the supply
3. Apply the input values

4. Verify the truth table for different input values

PRECAUTIONS: -

1. Connection should be tight.
2. O/P should be finding sequentially.
3. IC's should be handled carefully.

RESULT:- The operation of 4 Bit Adder has been verified.

VIVA QUESTIONS:

1. How many basic binary subtraction operations are possible?
2. What are the two types of basic adder circuits?

3. A binary parallel adder produces arithmetic sum in what?
4. Total number of inputs in a half adder is
5. Controlled inverter is also known as
6. A logic circuit that provides a HIGH output for both inputs HIGH or both inputs LOW is
7. What is the major difference between half-adders and full-adders?
8. How many basic binary subtraction operations are possible?
9. What are the two types of basic adder circuits?
10. When performing subtraction by addition in the 2's-complement system:
11. What is a 4 bit adder?
12. What is a subtractor?
13. Describe the function of a full adder?
14. Design a full adder using two half adders?
15. What is the difference between half adder and a full adder?
16. Write the applications of adders and subtractors?
17. Draw the logic diagram of adder?
18. Draw the logic diagram of a subtractor?
19. What is the use of adder in digital circuits?
20. Is it possible to construct a circuit to perform both addition and subtraction at the same time?
21. How are adders used in processors? Explain.
22. Carry is obtained in which operation?
23. What are the limitations of half adders?
24. How many logic gates are required for designing a full adder and what are they?
25. How many number of inputs does a half adder and a full adder have?
26. For upto how many bits can a half subtractor perform subtraction?
27. What are the bits which undergo subtraction operation in half subtractors?
28. How many outputs are required for a adder and a subtractor?
29. Describe minuend?
30. Describe subtrahend?
31. Design a full subtractor?
32. Design a full adder?
33. Which circuit provides high output for both low inputs and both high inputs?
34. Explain ex-or gate briefly?

35. What are the different types of adder circuits?
36. Write the boolean expression for half subtractor?
37. write the boolean expression for full subtractor?
38. write the boolean expression for half adder?
39. write the boolean expression for full adder?
40. draw the circuit of a half adder?
41. Draw the circuit of a half subtractor?
42. Draw the circuit of a full subtractor?
43. Design a half adder and a full adder using nand-nand logic?
44. Construct a full subtractor using half subtractors with minimum no of logic gates?
45. List out the logic gates used for the construction of adders and subtractors?
46. What is the ic used in this experiment?
47. Draw the pin configuration of ic7483?
48. Using half adder or full adder perform addition of 2 3 bit binary numbers?
49. What is binary adder?
50. Are adder/subtractor combinational circuits? Explain?

EXPERIMENT: 4

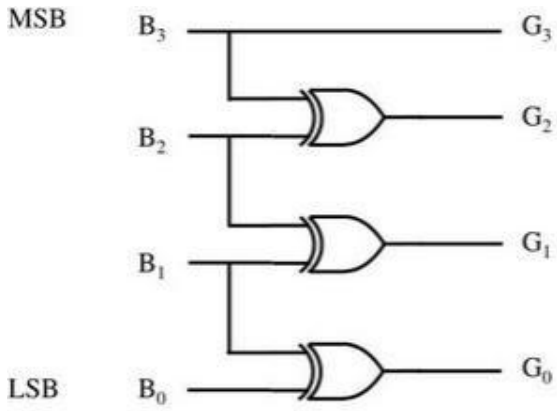
DESIGN AND REALIZATION OF A 4 – BIT GRAY TO BINARY AND BINARY TO GRAY CONVERTER

AIM: Design and realization of a 4 – bit `gray to Binary` and `Binary to Gray` Converter

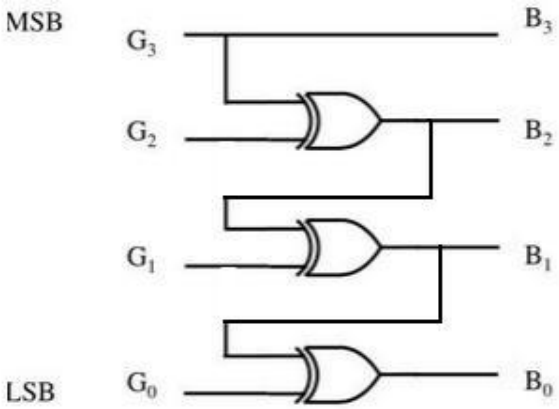
EQUIPMENTS NEEDED:

1) Patch Cords
2) IC 74LS136- 2 Nos.

BLOCK DIAGRAM:

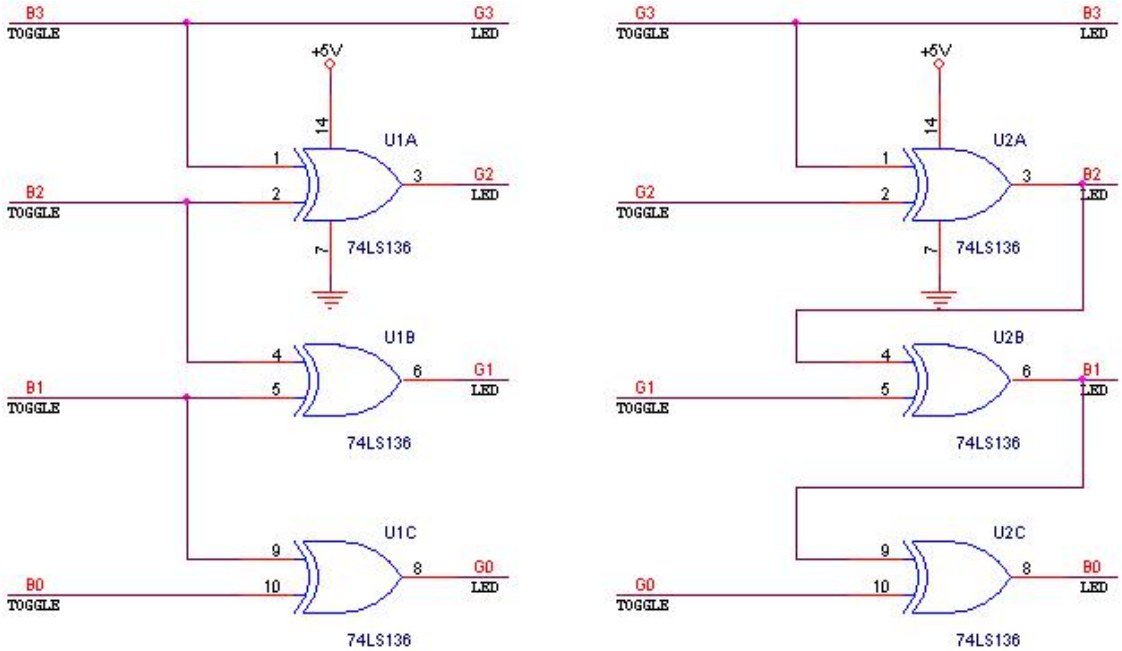


Binary To Gray Code Conversion

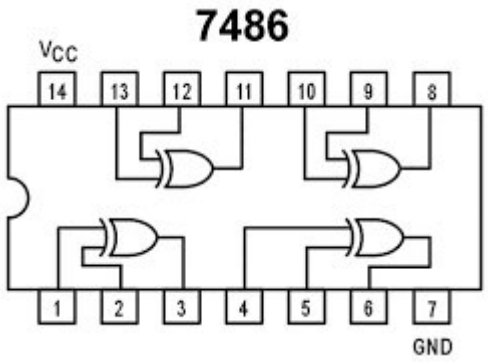


Gray To Binary Code Conversion

CIRCUIT DIAGRAM:



PIN DIAGRAM OF IC7486:



TRUTH TABLE

Decimal	B3	B2	B1	B0	Decimal	G3	G2	G1	G0

PROCEDURE:

1) Make the connection as per the above connection diagram.
2) Switch On the power supply.
3) Set the 4- bit data by the toggle switch for binary to gray and gray to Binary Converter.
4) Observed the output on the LEDs
5) Make the selection inputs as per the given below table and get the Outputs as per below table

PRECAUTIONS:

1. Connection should be tight.
2. O/P should be finding sequentially.
3. IC's should be handled carefully.

RESULT: Convertion f binary to gray and gary to binary codes are sucessfully verified with the help of truth table

VIVA QUESTIONS

1. What is gray code?
2. A code converter is a logic circuit that?

3. Reflected binary code is also known as?
4. Why do we use gray codes?
5. Convert binary number into gray code: 100101
6. The primary use for gray code is
7. Code is a symbolic representation of?
8. Why is the gray code more practical to use when coding the position of a rotating shaft?
9. If two numbers are not equal then binary variable will be?
10. 74ls85 is a?
11. What is a code converter?
12. What is the use of gray code?
13. What is the code?
14. What is the other name for gray code?
15. Why is the gray code more practical to use when coding the position of a rotating shaft?
16. Why do we use gray codes?
17. One way to convert bcd to binary using the hardware approach is?
18. Earlier, reflected binary codes were applied to?
19. Convert binary number into gray code: 100101
20. The binary representation of bcd number 00101001
21. Gray code representation of 14 is
22. 01001101 represents the letter m in
23. How many bits are in a byte?
24. Convert hexadecimal value 16 to decimal.
25. Are the voltages in digital electronics are continuously variable.
26. Which is typically the longest: bit, byte, nibble, word?
27. Convert the binary number 1100 to gray code.
28. Convert the gray code 1011 to binary.
29. What is the difference between binary coding and binary-coded decimal?
30. Digital electronics is based on the which numbering system.
31. The 1's complement of 10011101 is
32. An informational signal that makes use of binary digits is considered to be:

33. The binary-coded decimal (bcd) system can be used to represent each of the 10 decimal digits as which code?
34. The decimal number 18 is equal to which binary number?
35. A code converter is a logic circuit that?
36. Reflected binary code is also known as?
37. The primary use of gray code is?
38. Code is a symbolic representation of?
39. If two numbers are not equal then their binary variable will be?
40. Ttl74ls85 is a?
41. What is the function of an enable input on a multiplexer chip?
42. How many outputs are on a bcd decoder?
43. What is an encoder?
44. What is a decoder?
45. In a gray code, each number is 3 greater than the binary representation of that number is it true or false justify?.
46. Use the weighting factors to convert the following bcd numbers to binary.
47. 0101 0011 0010 0110 1000
48. Which digital system translates coded characters into a more useful form?
49. How many inputs will a decimal-to-bcd encoder have?
50. A principle regarding most ic decoders is that when the correct input is present, the related output will switch:

EXPERIMENT: 5

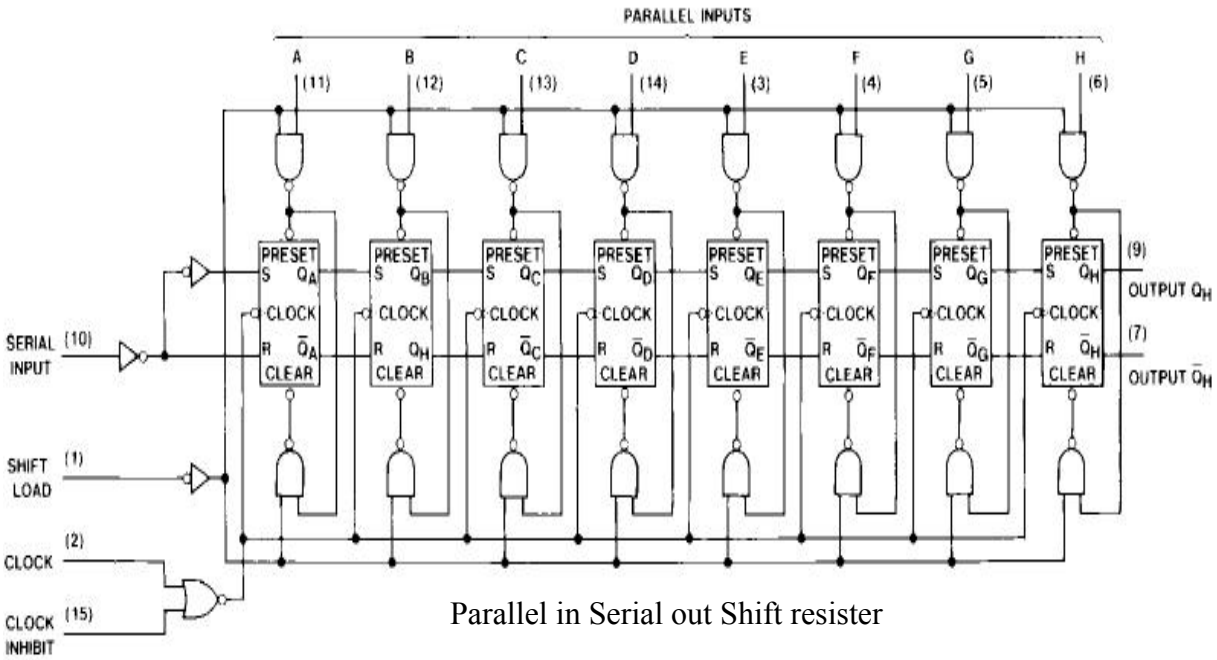
DESIGN AND REALIZATION OF AN 8 BIT PARALLEL LOAD AND SERIAL OUT SHIFT REGISTER USING FLIP-FLOPS.

AIM: Design and realization of an 8 bit parallel load and serial out shift register using flip-flops.

EQUIPMENTS NEEDED:

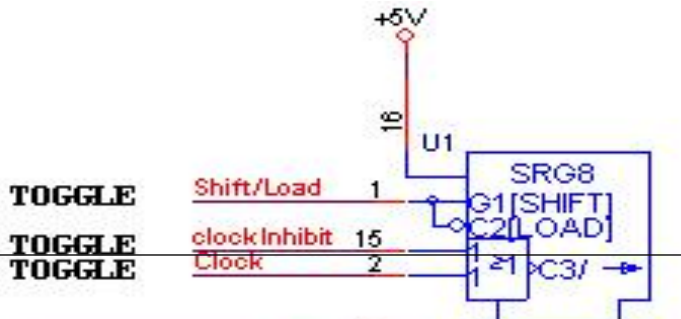
1. Patch Cords
2. IC 74LS165
3. Trainer kit

BLOCK DIAGRAM:

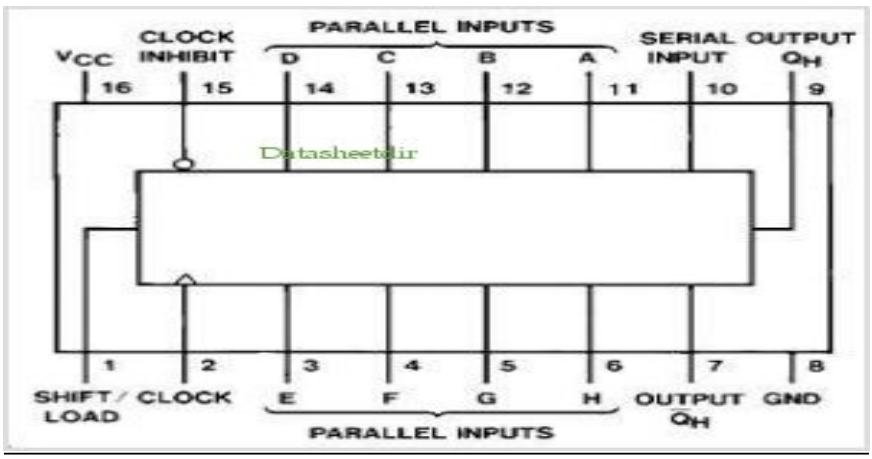


Parallel in Serial out Shift resister

CIRCUIT DIAGRAM:



PIN DIAGRAM OF IC 74LS165:



TRUTH TABLE:

Clock	Shift/	CLK	CLK	D0	D1	D2	D3	D4	D5	D6	D7	D_{out}

Pulse No	Load	INH										

THEORY:

The Shift Register is another type of sequential logic circuit that can be used for the storage or the transfer of binary data

This sequential device loads the data present on its inputs and then moves or "shifts" it to its output once every clock cycle, hence the name **Shift Register**.

A *shift register* basically consists of several single bit "D-Type Data Latches", one for each data bit, either a logic "0" or a "1", connected together in a serial type daisy-chain arrangement so that the output from one data latch becomes the input of the next latch and so on.

Data bits may be fed in or out of a shift register serially, that is one after the other from either the left or the right direction, or all together at the same time in a parallel configuration.

The number of individual data latches required to make up a single **Shift Register** device is usually determined by the number of bits to be stored with the most common being 8-bits (one byte) wide constructed from eight individual data latches.

Shift Registers are used for data storage or for the movement of data and are therefore commonly used inside calculators or computers to store data such as two binary numbers before they are added together, or to convert the data from either a serial to parallel or parallel to serial format. The individual data latches that make up a single shift register are all driven by a common clock (Clk) signal making them synchronous devices.

Shift register IC's are generally provided with a *clear* or *reset* connection so that they can be "SET" or "RESET" as required. Generally, shift registers operate in one of four different modes with the basic movement of data through a shift register being:

- Serial-in to Parallel-out (SIPO) - the register is loaded with serial data, one bit at a time, with the stored data being available at the output in parallel form.
- Serial-in to Serial-out (SISO) - the data is shifted serially "IN" and "OUT" of the register, one bit at a time in either a left or right direction under clock control.
- Parallel-in to Serial-out (PISO) - the parallel data is loaded into the register simultaneously and is shifted out of the register serially one bit at a time under clock control.
- Parallel-in to Parallel-out (PIPO) - the parallel data is loaded simultaneously into the register, and transferred together to their respective outputs by the same clock pulse.

Parallel-in to Serial-out (PISO) Shift Register

The Parallel-in to Serial-out shift register acts in the opposite way to the serial-in to parallel-out one above. The data is loaded into the register in a parallel format in which all the data bits enter their inputs simultaneously, to the parallel input pins P_A to P_D of the register. The data is then read out sequentially in the normal shift-right mode from the register at Qrepresenting the data present at P_A to P_D.

This data is outputted one bit at a time on each clock cycle in a serial format. It is important to note that with this type of data register a clock pulse is not required to parallel load the register as it is already present, but four clock pulses are required to unload the data.

PROCEDURE:

1.Make the connection as per the above connection diagram.

2.Switch On the power supply.

3.Set the data by the toggle switch.

4.Set the Clock by the toggle switch.

5.Set the Preset by the toggle switch.

6.Set the Clear by the toggle switch.
7.Observed the output on the LEDs

PRECAUTIONS:

1. Connection should be tight.

2. O/P should be finding sequentially.
3. IC's should be handled carefully.

RESULT: Parallel load and serial out shift register operation is verified by using truth table

VIVA QUESTIONS

1. Define shift registers?
2. List the different types of shift registers?

3. The full form of SIPO is
4. A shift register that will accept a parallel input or a bidirectional serial load and internal shift features is called as?
5. What is meant by parallel load of a shift register?
6. With a 200 khz clock frequency, eight bits can be serially entered into a shift register in
7. Based on how binary information is entered or shifted out, shift registers are classified into categories.
8. A serial in/parallel out, 4-bit shift register initially contains all 1s. The data nibble 0111 is waiting to enter. After four clock pulses, the register contains
9. A sequence of equally spaced timing pulses may be easily generated by which type of counter circuit
10. To operate correctly, starting a ring shift counter requires
11. Define shift registers
12. List out different types of shift registers.
13. The full form of SIPO is
14. A shift register that will accept a parallel input or a bidirectional serial load and internal shift features is called as?
15. What is meant by parallel load shift registesr?
16. With a 200khz clock frequency eight bits can be entered into a shift register in.
17. Based on how binary information is entered or shifted out,shift registers are classified into categories.
18. A serial in/parallel out 4 bit shift register initially contains all 1's the data nibble 0111 is waiting to enter.after four clock pulses,the register contains?
19. .a sequence of equally spaced timing pulses may be easily generated by which type of counter circuit?
20. To operate correctly,starting a ring shift counter requires.
21. Explain the difference between *serial* digital data and *parallel* digital data
22. What is the definition of a *register* in the context of digital circuitry? Also, define and compare/contrast what a *shift register* is.
23. Draw the schematic diagram for a five-bit serial-in/serial-out shift register circuit, and be prepared to give a brief explanation of how it functions.

24. Explain how a shift register circuit could be built from D-type flip-flops with the ability to shift data either to the right or to the left, on command.
25. Explain what a *universal* shift register is
26. Describe how we can get parallel data entered into a shift register circuit.
27. A shift register that will accept a parallel input or a bidirectional serial load and internal shift features is called as?
28. How can parallel data be taken out of a shift register simultaneously?
29. What is meant by parallel load of a shift register?
30. The group of bits 11001 is serially shifted (right-most bit first) into a 5-bit parallel output shift register with an initial state 01110. After three clock pulses, the register contains?
31. Assume that a 4-bit serial in/serial out shift register is initially clear. We wish to store the nibble 1100. What will be the 4-bit pattern after the second clock pulse?
32. An 8-bit serial in/serial out shift register is used with a clock frequency of 2 mhz to achieve a time delay (td) of
33. On the fifth clock pulse, a 4-bit Johnson sequence is $Q_0 = 0$, $Q_1 = 1$, $Q_2 = 1$, and $Q_3 = 1$. On the sixth clock pulse, the sequence is _____.
34. The bit sequence 0010 is serially entered (right-most bit first) into a 4-bit parallel out shift register that is initially clear. What are the Q outputs after two clock pulses?
35. On the third clock pulse, a 4-bit Johnson sequence is $Q_0 = 1$, $Q_1 = 1$, $Q_2 = 1$, and $Q_3 = 0$. On the fourth clock pulse, the sequence is _____.
36. A bidirectional 4-bit shift register is storing the nibble 1101. Its $\text{RIGHT}/\overline{\text{LEFT}}$ input is HIGH. The nibble 1011 is waiting to be entered on the serial data-input line. After three clock pulses, the shift register is storing _____.
37. What does the output enable do on the 74395A chip?
38. In a 6-bit Johnson counter sequence there are a total of how many states, or bit patterns?
39. A modulus-12 ring counter requires a minimum of how many flipflops?
40. Stepper motors have become popular in digital automation systems because they are driven by ---------- signals and have repetitive_____ moment.

41. A sequence of equally spaced timing pulses may be easily generated by which type of counter circuit?
42. The bit sequence 10011100 is serially entered (right-most bit first) into an 8-bit parallel out shift register that is initially clear. What are the Q outputs after four clock pulses?

43. If an 8-bit ring counter has an initial state 10111110, what is the state after the fourth clock pulse?
44. How would a latch circuit be used in a microprocessor system?
45. A 4-bit shift register that receives 4 bits of parallel data will shift to the _____ by _____ position(s) for each clock pulse.
46. How many clock pulses will be required to completely load serially a 5-bit shift register?
47. An 8-bit serial in/serial out shift register is used with a clock frequency of 150 khz. What is the time delay between the serial input and the Q_3 output?
48. What are the three output conditions of a three-state buffer?
49. The primary purpose of a three-state buffer is?
50. What is the difference between a ring shift counter and a Johnson shift counter?

EXPERIMENT NO: 6

DESIGN AND REALIZATION OF A SYNCHRONOUS AND ASYNCHRONOUS COUNTER USING FLIP-FLOPS

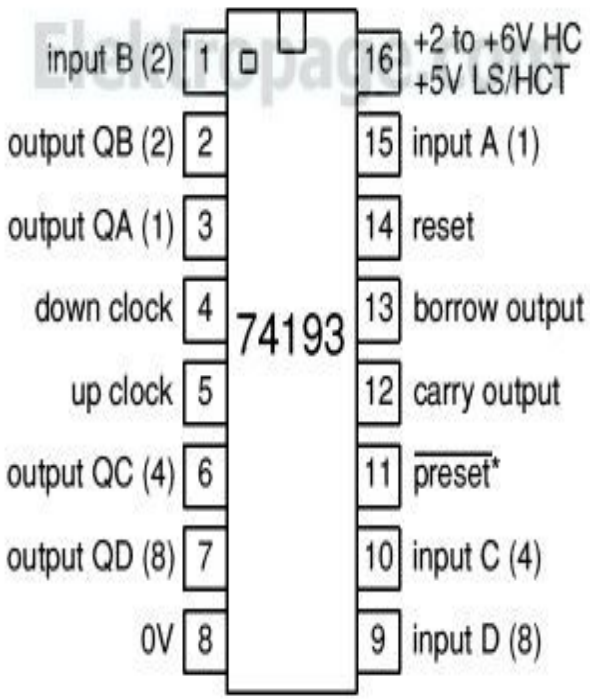
AIM: Design and realization of a Synchronous and Asynchronous counter using flip-flops

EQUIPMENTS NEEDED:

1. Patch Cords
2. IC 74LS90, IC 74193
3. TRAINER KIT

BLOCK DIAGRAM:

SYNCHRONOUS UPDOWN COUNTER(IC74193):



TRUTH TABLE:

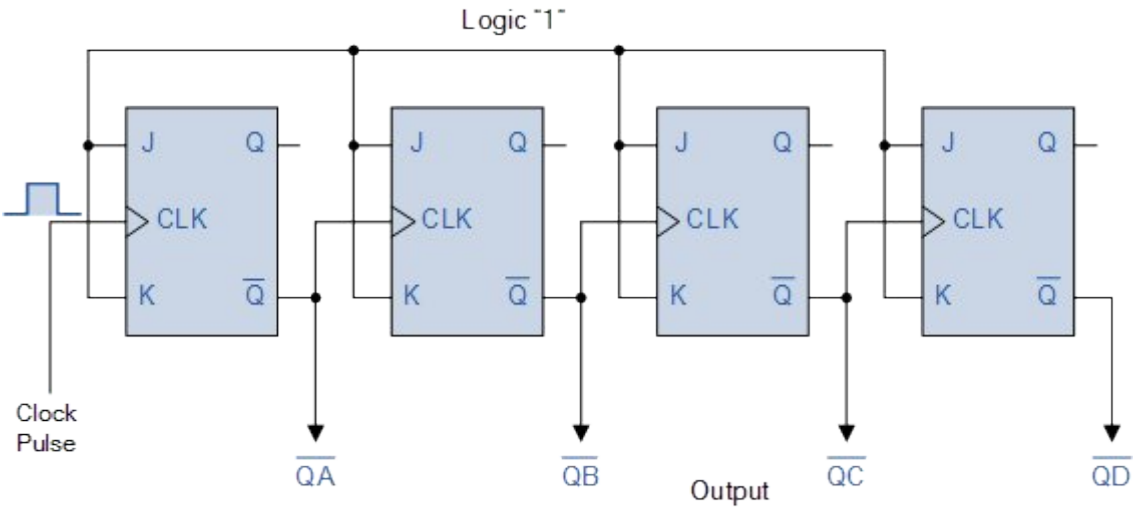
COUNT –UP MODE					COUNT DOWN MODE				
States	Q_D	Q_C	Q_B	Q_A	States	Q_D	Q_C	Q_B	Q_A

THEORY:

As well as counting "up" from zero and increasing or incrementing to some preset value, it is sometimes necessary to count "down" from a predetermined value to zero allowing us to produce an output that activates when the zero count or some other pre-set value is reached.

This type of counter is normally referred to as a **Down Counter**, (**CTD**). In a binary or BCD down counter, the count decreases by one for each external clock pulse from some preset value. Special dual purpose IC's such as the TTL 74LS193 or CMOS CD4510 are 4-bit binary Up or Down counters which have an additional input pin to select either the up or down count mode.

4-bit Count Down Counter



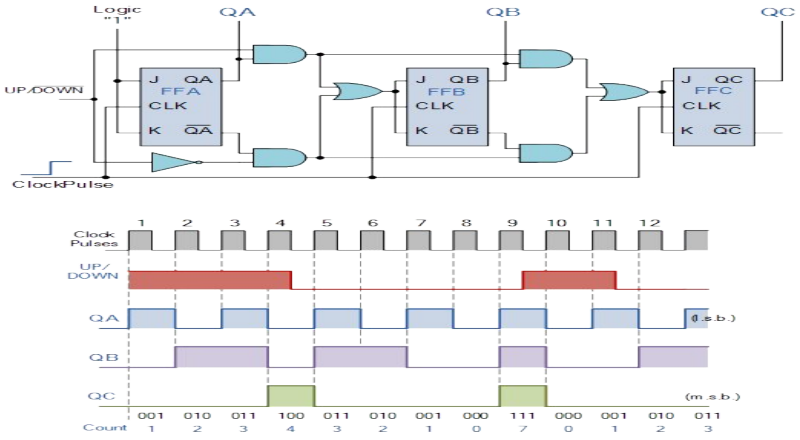
In the 4-bit counter above the output of each flip-flop changes state on the falling edge (1-to-0 transition) of the CLK input which is triggered by the Q output of the previous flip-flop, rather than by the Q output as in the up counter configuration. As a result, each flip-flop will change state when the previous one changes from 0 to 1 at its output, instead of changing from 1 to 0.

Bidirectional Counter

Both Synchronous and Asynchronous counters are capable of counting "Up" or counting "Down", but their is another more "Universal" type of counter that can count in both directions either Up or Down depending on the state of their input control pin and these are known as **Bidirectional Counters**.

Bidirectional counters, also known as Up/Down counters, are capable of counting in either direction through any given count sequence and they can be reversed at any point within their count sequence by using an additional control input as shown below.

Synchronous 3-bit Up/Down Counter



The circuit above is of a simple 3-bit Up/Down synchronous counter using JK flip-flops configured to operate as toggle or T-type flip-flops giving a maximum count of zero (000) to seven (111) and back to zero again. Then the 3-Bit counter advances upward in sequence (0,1,2,3,4,5,6,7) or downwards in reverse sequence (7,6,5,4,3,2,1,0).

Generally most bidirectional counter chips can be made to change their count direction either up or down at any point within their counting sequence. This is achieved by using an additional input pin which determines the direction of the count, either Up or Down and the timing diagram gives an example of the counters operation as this Up/Down input changes state.

Nowadays, both up and down counters are incorporated into single IC that is fully programmable to count in both an "Up" and a "Down" direction from any preset value producing a complete **Bidirectional Counter** chip. Common chips available are the 74HC190 4-bit BCD decade Up/Down counter, the 74F569 is a fully synchronous Up/Down binary counter and the CMOS 4029 4-bit Synchronous Up/Down counter.

PROCEDURE:

1. Make the connection as per the above connection diagram.
2. Switch On the power supply.
3. Set the data by the toggle switch.
4. Set the Clock by the toggle switch.
5. Set the Preset by the toggle switch
6. Set the Clear by the toggle switch.
7. Observed the output on the LEDs
8. Make the selection inputs as per the given below table and get the Outputs as per below table

RESULT: Synchronous and asynchronous counter operation is verified by using truth table.

VIVA QUESTIONS:

1. State various applications of counters.
2. Difference between Asynchronous clock and Synchronous Clock
3. Draw the truth table of SR and JK
4. Draw the Excitation Table of SR and JK
5. Give the Excitation Table of D and T Flip Flop
6. What is meant of Edge Triggering
7. Types Of Shift Registers.
8. Specify the operations done on Shift Registers
9. Explain the decade counter
10. Draw the Logic diagram for Conversion
11. A MOD-12 and a MOD-10 counter are cascaded. Determine the output frequency if the input clock frequency is 60 MHz
12. Which segments of a seven-segment display would be required to be active to display the decimal digit 2?
13. How many AND gates would be required to completely decode ALL the states of a MOD-64 counter, and how many inputs must each AND gate have?
14. A BCD counter is a _____.
15. How many flip-flops are required to construct a decade counter?
16. The terminal count of a typical modulus-10 binary counter is _____
17. A seven-segment, common-anode LED display is designed for:……
18. How many flip-flops are required to make a MOD-32 binary counter?
19. Using four cascaded counters with a total of 16 bits, how many states must be deleted to achieve a modulus of 50,000?
20. A MOD-16 ripple counter is holding the count 1001_2. What will the count be after 31 clock pulses?
21. The terminal count of a modulus-11 binary counter is _____.
22. List which pins need to be connected together on a 7493 to make a MOD-12 counter.
23. How can a digital one-shot be implemented using HDL?
24. Integrated-circuit counter chips are used in numerous applications including:……
25. Synchronous construction reduces the delay time of a counter to the delay of:
26. Synchronous counters eliminate the delay problems encountered with

asynchronous counters because the:

27. What is the difference between combinational logic and sequential logic?
28. What is the difference between a 7490 and a 7492?
29. When two counters are cascaded, the overall MOD number is equal to the _____ of their individual MOD numbers.
30. A MOD-12 and a MOD-10 counter are cascaded. Determine the output frequency if the input clock frequency is 60 MHz
31. Which segments of a seven-segment display would be required to be active to display the decimal digit 2?
32. How many AND gates would be required to completely decode ALL the states of a MOD-64 counter, and how many inputs must each AND gate have?
33. A BCD counter is a _____.
34. How many flip-flops are required to construct a decade counter?
35. The terminal count of a typical modulus-10 binary counter is _____.
36. A seven-segment, common-anode LED display is designed for:……
37. Which of the following is an invalid output state for an 8421 BCD counter?
38. How many different states does a 3-bit asynchronous counter have?
39. A 5-bit asynchronous binary counter is made up of five flip-flops, each with a 12 ns propagation delay. The total propagation delay ($t_{p(tot)}$) is _____.
40. One of the major drawbacks to the use of asynchronous counters is:----------
--
41. Once an up-/down-counter begins its count sequence, it cannot be reversed.(True/False)……..
42. Three cascaded modulus-5 counters have an overall modulus of _____.
43. An asynchronous 4-bit binary down counter changes from count 2 to count 3. How many transitional states are required?
44. How many different states does a 3-bit asynchronous counter have?
45. A 5-bit asynchronous binary counter is made up of five flip-flops, each with a 12 ns propagation delay. The total propagation delay ($t_{p(tot)}$) is _____.
46. One of the major drawbacks to the use of asynchronous counters is:----------
--
47. Once an up-/down-counter begins its count sequence, it cannot be reversed.(True/False)……..
48. Three cascaded modulus-5 counters have an overall modulus of _____.

49. An asynchronous 4-bit binary down
50. The final output of a modulus-8 counter occurs one time for every _____.

EXPERIMENT NO-7

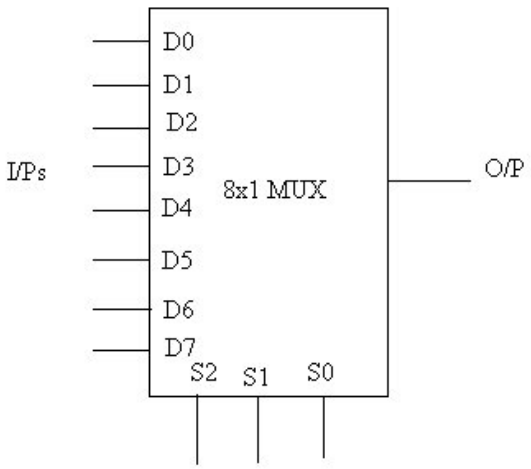
DESIGN AND REALIZATION OF 8X1 MUX USING 2X1 MUX

AIM: Design and realization of 8x1 MUX using 2x1 MUX

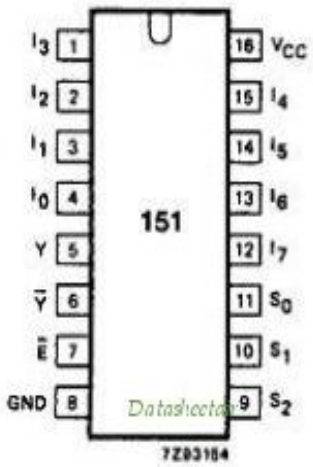
APPARATUS: Trainer kit, Connecting wires, patch cards.

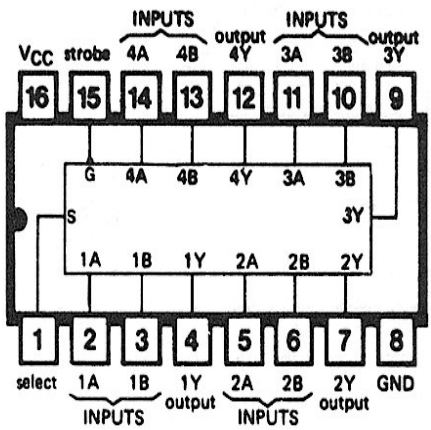
S.NO.	Component	Type	Quantity
1	8 to1 multiplexer	IC 74151	1
	2 to 1 multiplexer	IC 74157	
2.	inverter	IC 7404	1
3.	Digital IC trainer	-	1

BLOCK DIAGRAM:



IC Pin description of 74HC151





Function table for 8x1 MUX:

Chip Enable(E)	Selection lines S2 S1 S0			Output

THEORY:

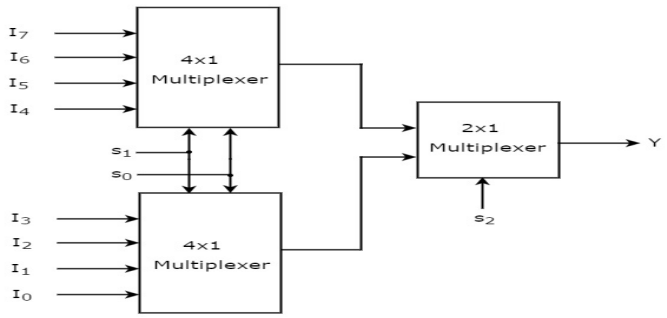
8x1 Multiplexer :

In this section, let us implement 8x1 Multiplexer using 4x1 Multiplexers and 2x1 Multiplexer. We know that 4x1 Multiplexer has 4 data inputs, 2 selection lines and one output. Whereas, 8x1 Multiplexer has 8 data inputs, 3 selection lines and one output.

So, we require two **4x1 Multiplexers** in first stage in order to get the 8 data inputs. Since, each 4x1 Multiplexer produces one output, we require a **2x1 Multiplexer** in second stage by considering the outputs of first stage as inputs and to produce the final output.

Let the 8x1 Multiplexer has eight data inputs I_7 to I_0, three selection lines s_2, s_1 & s0 and one output Y. The **Truth table** of 8x1 Multiplexer is shown below.

We can implement 8x1 Multiplexer using lower order Multiplexers easily by considering the above Truth table. The **block diagram** of 8x1 Multiplexer is shown in the following figure.



The same **selection lines, s_1 & s_0** are applied to both 4x1 Multiplexers. The data inputs of upper 4x1 Multiplexer are I_7 to I_4 and the data inputs of lower 4x1 Multiplexer are I_3 to I_0. Therefore, each 4x1 Multiplexer produces an output based on the values of selection lines, s_1 & s_0.

The outputs of first stage 4x1 Multiplexers are applied as inputs of 2x1 Multiplexer that is present in second stage. The other **selection line, s_2** is applied to 2x1 Multiplexer.

- If s_2 is zero, then the output of 2x1 Multiplexer will be one of the 4 inputs I_3 to I_0 based on the values of selection lines s_1 & s_0.
- If s_2 is one, then the output of 2x1 Multiplexer will be one of the 4 inputs I_7 to I_4 based on the values of selection lines s_1 & s_0.

Therefore, the overall combination of two 4x1 Multiplexers and one 2x1 Multiplexer performs as on 8x1 Multiplexer.

PROCEDURE:

1. Make the connections as per the circuit diagram
2. Switch on the power supply
3. Verify truth table

PRECAUTIONS:

1. Suitable signals must be given to enable pins of IC in order to enable the chip.
2. The order in which we are connecting the input variables to selection pins must be proper.

RESULT: 8X1 Mux by using 2X1 Mux is verified along with truth table

VIVA QUESTIONS

1. What is a multiplexer?
2. Which combinational circuit is renowned for selecting a single input from multiple inputs & directing the binary information to output line?
3. Which is the major functioning responsibility of the multiplexing combinational circuit?
4. How many select lines would be required for an 8-line-to-1-line multiplexer?
5. How many NOT gates are required for the construction of a 4-to-1 multiplexer?
6. What are the applications of multiplexer and de-multiplexer?
7. In 2n to 1 multiplexer how many selection lines are there?
8. How to get higher order multiplexers?
9. Implement an 8:1 mux using 4:1 muxes
10. What is the difference between multiplexer & demultiplexer?
11. Explain the operation of a digital multiplexer?

12. What makes the circuit of a multiplexer more complex?
13. What Is data selector?
14. What is a multiplexer?
15. Which mux without any additional circuitry can be used to obtain all the functions of 3 variable but not all of 4 variables?
16. How many 2*1 mux are required to realize 4*1 mux and explain how?
17. Design a 4*1 mux using 2*1 mux?
18. What are the minimum number of 21 mux required to generate 2 input nandgate and a 2 input Ex-OR gate?
19. How a multiplexer can act as a universal combinational circuit explain?
20. Construct a NOT gate using 2*1 mux
21. . Construct a AND gate using 2*1 mux
22. Construct OR gate using 2*1 mux with n-1 selection lines
23. Construct a NAND gate using 2*1 mux
24. Construct a NOR gate using 2*1 mux
25. Construct a Ex-OR gate using 2*1 mux
26. Construct a Ex-NOR gate using 2*1 mux
27. How many 2*1 mux are required for 8*1 mux construction?
28. How many 2*1 mux are required for 16*1 mux construction?
29. How many 2*1 mux are required for 64*1 mux construction?
30. Obtain the logic for the construction of different multiplexers using 2*1 mux?
31. How can you classify different digital multiplexers?
32. What is synchronous multiplexer?
33. What is asynchronous multiplexer?
34. What is quasi-synchronous multiplexer?
35. What are advantages of digital multiplexing?
36. Will multiplexing create additional harmonics in the system?
37. What are the two basic multiplexing techniques?
38. Why are generally multiplexers are used?
39. What is demultiplexer?
40. What are the differences between multiplexer and demultiplexer?
41. How to get higher order multiplexers?
42. What are the different logic gates that are used in multiplexers.draw their symbols?
43. What is data distributor?
44. How many data inputs does a mux have?

45. What are the components of a mux?
46. What is a combinational circuit?
47. Hat is the ic used in the design of 16*1 mux using two 8*1 mux?
48. What is an integrated circuit?
49. Draw the pin configuration of IC74151
50. How many selectionlines are required for 8*1 mux?

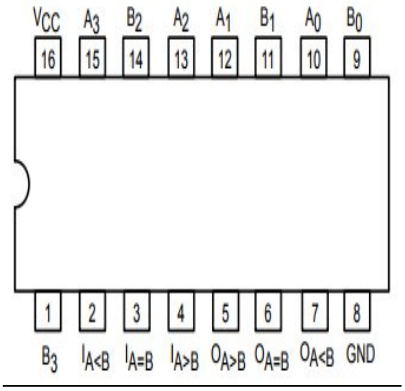
EXPERIMENT 8

DESIGN AND REALIZATION OF 4 BIT COMPARATOR

AIM: Design and realization of 4 bit comparator

APPARATUS REQUIRED: IC 7485, 4-BIT Digital Comparator Trainer Kit, Patch Chords

IC PIN DESCRIPTION:

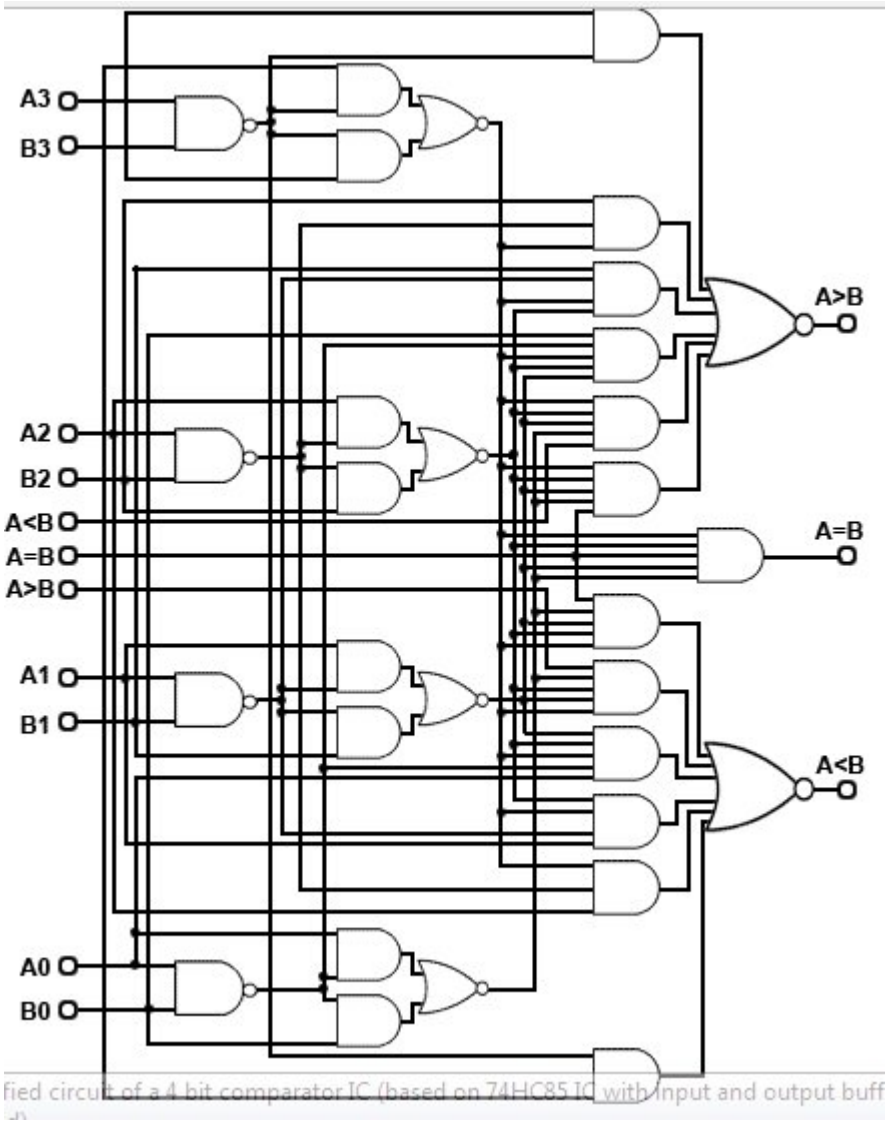


TRUTH TABLE

COMPARING INPUTS				CASCADING INPUTS			OUTPUTS		
A_3,B_3	A_2,B_2	A_1,B_1	A_0,B_0	$I_{A>B}$	$I_{A<B}$	$I_{A=B}$	$O_{A>B}$	$O_{A<B}$	$O_{A=B}$
$A_3>B_3$	X	X	X	X	X	X	H	L	L
$A_3<B_3$	X	X	X	X	X	X	L	H	L
$A_3=B_3$	$A_2>B_2$	X	X	X	X	X	H	L	L
$A_3=B_3$	$A_2<B_2$	X	X	X	X	X	L	H	L
$A_3=B_3$	$A_2=B_2$	$A_1>B_1$	X	X	X	X	H	L	L
$A_3=B_3$	$A_2=B_2$	$A_1<B_1$	X	X	X	X	L	H	L
$A_3=B_3$	$A_2=B_2$	$A_1=B1$	$A_0>B_0$	X	X	X	H	L	L
$A_3=B_3$	$A_2=B_2$	$A_1=B_1$	$A_0<B_0$	X	X	X	L	H	L
$A_3=B_3$	$A_2=B_2$	$A_1=B_1$	$A_0=B_0$	H	L	L	H	L	L
$A_3=B_3$	$A_2=B_2$	$A_1=B_1$	$A_0=B_0$	L	H	L	L	H	L
$A_3=B_3$	$A_2=B_2$	$A_1=B_1$	$A_0=B_0$	X	X	H	L	L	H
$A_3=B_3$	$A_2=B_2$	$A_1=B_1$	$A_0=B_0$	H	H	L	L	L	L
$A_3=B_3$	$A_2=B_2$	$A_1=B_1$	$A_0=B_0$	L	L	L	H	H	L

H = HIGH Level
L = LOW Level
X = IMMATERIAL

LOGIC DIAGRAM: 4 BIT MAGNITUDE COMPARATOR



THEORY:4-bit Magnitude Comparator

Some commercially available digital comparators such as the TTL 74LS85 or CMOS 4063 4-bit magnitude comparator have additional input terminals that allow more individual comparators to be "cascaded" together to compare words larger than 4-bits with magnitude comparators of "n"-bits being produced. These cascading inputs are connected directly to the corresponding outputs of the previous comparator as shown to compare 8, 16 or even 32-bit words.

PROCEDURE:

1) Connections are given as per circuit diagram
2) Logical inputs are given as per circuit diagram
3) Observe the output and verify the truth table

RESULT:

Thus the design and implementation of magnitude comparator were done

VIVA QUESTIONS:

1. What is Magnitude Comparator?
2. List out the applications of comparators?
3. What is digital comparator?
4. Realize a single bit comparator?
5. Which logic gate is a basic comparator?
6. When are two numbers are equal?
7. What are the different types of comparator?
8. What are the advantages of comparator?
9. If two numbers are not equal then binary variable will be
10. A procedure that specifies finite set of steps is called ?
11. How many 4-bit comparators are needed to construct 12-bit comparator?
12. What does a digital comparator mean?
13. Design a 2-bit comparator using gates?
14. Explain the phases of a simulation?
15. Explain briefly about wait statement?
16. What do you mean by Logic Gates?
17. What are the applications of Logic Gates?
18. What is Truth Table?
19. Why we use basic logic gates?
20. Write down the truth table of all logic gates?
21. What do you mean by universal gate?
22. Write truth table for 2 input NOR,NAND gate?
23. Implement all logic gate by using universal gate?
24. Why is they called universal Gates?
25. Give the name of universal gate?
26. Draw the circuit diagram of Half adder circuit?

27.Draw the circuit diagram of full adder circuit?

28 Draw the full adder circuit by using Half Adder circuit and minimum no. of logicgate?

29.Write Boolean function for half adder?

30. Write Boolean function for Full adder?

31.Design the half Adder and Full adder using NAND-NAND Logic.

32. Draw the circuit diagram of Half Subtractor circuit?

33.Draw the circuit diagram of full subtractor circuit?

34.Draw the full subtractor circuit by using half subtractor circuit and minimum no. of logic gate?

35. Write Boolean function for half 7ubtractor?

36.Write Boolean function for Full Subtractor?

37. What is Excess-3 code? Why it is called Excess-3 code?

38.What is the application of Excess-3 code?

39. What is ASCII code?

40. Excess-3 code is Weighted or Unweighted?

41.Out of the possible 16 code combination? How many numbers used in Excess-3 code?

42.Which logic gate is a basic comparator?

43.When are two numbers are equal?

44.What are the different types of comparator?

45.What are the advantages of comparator?

46.If two numbers are not equal then binary variable will be

47.A procedure that specifies finite set of steps is called

48.How many 4-bit comparators are needed to construct 12-bit comparator?

49. What does a digital comparator mean?

50. Design a 4-bit comparator using gates?

EXPERIMENT NO-9

DESIGN A RING COUNTER & TWISTED RING COUNTER USING 4 BIT SHIFT REGISTER

AIM:

To Construct a Ring Counter and Twisted Ring Counter using 4 Bit Shift Register.

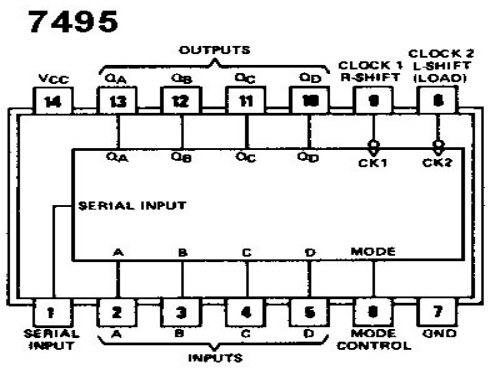
APPARATUS:

1. Ring Counter and Twisted Ring Counter using $\varkappa$Bit Shift Register Trainer kit.
2. Patch Cords.

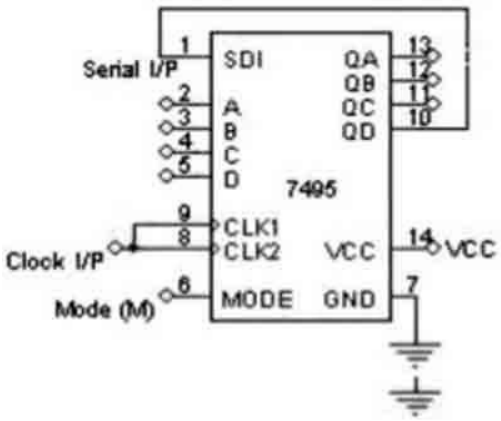
THEORY:

Ring counter is a basic register with direct feedback such that the contents of the register simply circulate around the register when the clock is running. Here the last output that is QD in a shift register is connected back to the serial input. A basic ring counter can be slightly modified to produce another type of shift register counter called Johnson counter. Here complement of last output is connected back to the not gate input and not gate output is connected back to serial input. A four bit Johnson counter gives 8 state output.

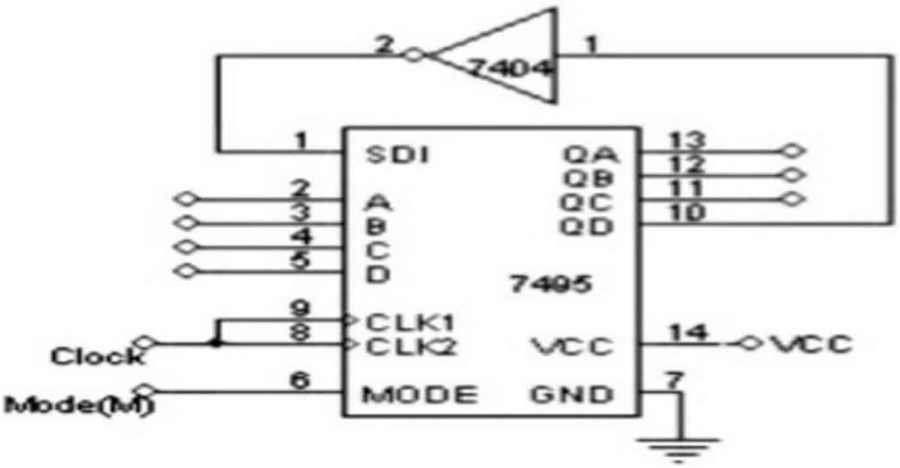
PIN CONFIGURATION:



CIRCUIT DIAGRAM: Ring Counter



Twisted Ring Counter:



PROCEDURE:

Ring Counter:

1. Make the Connection as show in the Ring Counter Circuit Diagram.
2. Connect Inputs A, B, C, D to input switch present on trainer kit.
3. Connect the Outputs QA, QB, QC, QD
4. Connect the Serial I/P to Pin 10 of the 7495 IC i.e., QD
5. Connect 8th and 9th Pin's of the IC 7ϰ9Ǫ to Clock, which is present on the trainer.
6. Connect Mode(M) 6th Pin of IC 7495 to Input Switch
7. Verify the truth table of Ring counter.

Twisted Ring Counter:

1. Make the Connection as show in the Twisted Ring Counter Circuit Diagram.
2. Connect Inputs A, B, C, D to input switch present on trainer kit.
3. Connect the Outputs QA, QB, QC, QD
4. Connect the Serial I/P to NOT Gate, which is present on trainer kit
5. Connect other terminal of the NOT Gate to Pin 10 of the 7495 IC i.e., QD
6. Connect 8th and 9th Pin's of the IC 7ϰ9Ǫ to Clock, which is present on the trainer.
7. Connect Mode(M) 6th Pin of IC 7495 to Input Switch
8. Verify the truth table of Twisted Ring counter

TRUTH TABLE:

Ring Counter:

Set the Mode to High and Low condition for reset.

Clock	QA	QB	QC	QD
0	1	0	0	0
1	0	1	0	0
2	0	0	1	0
3	0	0	0	1
4	1	0	0	0
5	0	1	0	0
6	0	0	1	0
7	0	0	0	1
8	1	0	0	0

Twisted Ring Counter:

Clock	QA	QB	QC	QD
0	0	0	0	0
1	1	0	0	0
2	1	1	0	0
3	1	1	1	0
4	1	1	1	1
5	0	1	1	1
	0	0	1	1
7	0	0	0	1
8	0	0	0	0

RESULTS:

A Ring Counter and Twisted Ring Counter using 4 Bit Shift Register was constructed and implemented.

VIVA QUESTIONS

1. Define Ring counter?
2. By adding recirculation lines to a 4-bit parallel-in serial-out shift register, it becomes a _____, _____, and _____out register.
3. What type of register would have a complete binary number shifted in one bit at a time and have all the stored bits shifted out one at a time?
4. When is it important to use a three-state buffer?
5. A bidirectional 4-bit shift register is storing the nibble 1110. Its input is LOW. The nibble 0111 is waiting to be entered on the serial data-input line. After two clock pulses, the shift register is storing _____
6. In a parallel in/parallel out shift register, D0 = 1, D1 = 1, D2 = 1, and D3 = 0. After three clock pulses, the data outputs are _____
7. The group of bits 10110111 is serially shifted (right-most bit first) into an 8-bit parallel output shift register with an initial state 11110000. After two clock pulses, the register contains
8. What type of register would have a complete binary number shifted in one bit at a time and have all the stored bits shifted out one at a time?
9. In a 4-bit Johnson counter sequence there are a total of how many states, or bit patterns?
10. If a 10-bit ring counter has an initial state 1101000000, what is the state after the second clock pulse?
11. How much storage capacity does each stage in a shift register represent?
12. Ring shift and Johnson counters are----------
13. What is the difference between a shift-right register and a shift-left register?
14. What is a transceiver circuit?
15. A 74HC195 4-bit parallel access shift register can be used for…….operation
16. Which type of device may be used to interface a parallel data format with external equipment's serial format?
17. What is the function of a buffer circuit?
18. What is the preset condition for a ring shift counter?
19. Which is not characteristic of a shift register?
20. To keep output data accurate, 4-bit series-in, parallel-out shift registers employ a----------
21. Another way to connect devices to a shared data bus is to use a……
22. A down counter using n-flip-flops count…….

23. UP Counter is……
24. DOWN counter is……
25. How many different states does a 3-bit asynchronous down counter have?.....
26. In a down counter, which flip-flop doesn't toggle when the inverted output of the preceeding flip-flop goes from HIGH to LOW.
27. In a 3-bit asynchronous down counter, the initial content is
28. In a 3-bit asynchronous down counter, at the first negative transition of the clock, the counter content becomes
29. In a 3-bit asynchronous down counter, at the first negative transition of the clock, the counter content becomes
30. The hexadecimal equivalent of 15,536 is _____
31. Define static RAM
32. Define dynamic RAM
33. Classify types of ROMs
34. Applications of ROMS
35. What is the difference between latch& Flip-Flop, Explain with logic diagram.
36. Explain any one application of SR latch.
37. What is race around condition? how it is avoided?
38. How synchronous counters differ from asynchronous counters?
39. List counter applications.
40. State various applications of counters.
41. Difference between Asynchronous clock and Synchronous Clock
42. Draw the truth table of SR and JK
43. Draw the Excitation Table of SR and JK
44. Give the Excitation Table of D and T Flip Flop
45. What is meant of Edge Triggering
46. Types Of Shift Registers.
47. Specify the operations done on Shift Registers
48. Explain the decade counter
49. Draw the Logic diagram for Conversion of D-SR
50. List the Counter Types

EXPERIMENT 10

DESIGN AND REALIZATION OF A SEQUENCE DETECTOR-A FINITE STATE MACHINE

AIM: Design and Realization of a sequence detector-a finite state machine

APPARATUS REQUIRED: IC 7474, Bread board trainer kit , Patch Chords

THEORY:

Digital logic Design 101 sequence detector (Mealy machine)

A sequence detector is a sequential state machine which takes an input string of bits and generates an output 1 whenever the target sequence has been detected.In a Mealy machine, output depends on the present state and the external input (x). Hence in the diagram, the output is written outside the states, along with inputs. Sequence detector is of two types:

1. Overlapping
2. Non-Overlapping

In an overlapping sequence detector the last bit of one sequence becomes the first bit of next sequence. However, in non-overlapping sequence detector the last bit of one sequence does not become the first bit of next sequence. In this post, we'll discuss the design overlapping 101 Mealysequence detector.

Examples:

For non overlapping case

Input :0110101011001

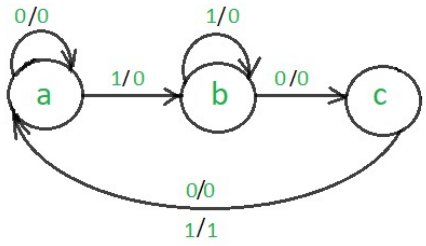
Output:0000100010000

For overlapping case

Input :0110101011001

Output:0000101010000

The steps to design non-overlapping 101 Mealy sequence detector are: **Step1:Developthestatediagram** – The state diagram of a Mealy machine for a 101 sequence detector is:



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Step 2:CodeAssignment –

Rule 1 : States having the same next states for a given input condition should have adjacent assignments.

Rule 2:States that are the next states to a single state must be given adjacent assignments. Rule 1 given preference over Rule 2.

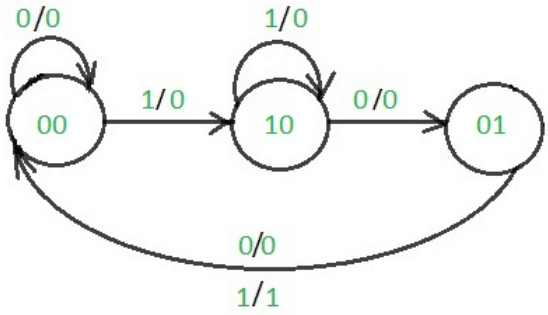
¶

Previous States	States	Next States
a,c	a	a,b
b,a	b	b,c
b	c	a

x / y	0	1
0	a	b
1	c	

¶

The state diagram after the code assignment is:



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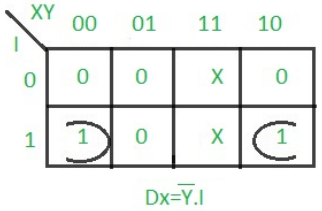
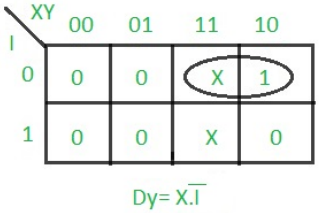
Step 3: Make Present State/Next State table – We'll use D-FlipFlops for design purpose.

Present States		i/p	Next States		Flip Flop Excitations		O/P
X	Y		X'	Y'	Dx	Dy	
0	0	0	0	0	0	0	0
0	0	1	1	0	1	0	0
0	1	0	0	0	0	0	0
0	1	1	0	0	0	0	1
1	0	0	0	1	0	1	0
1	0	1	1	0	1	0	0
1	1	0	X	X	X	X	X
1	1	1	X	X	X	X	X

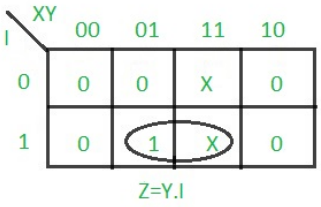
Step 4: Draw K-maps for Dx, Dy and output (Z) –



Dx=$\overline{Y}$.I

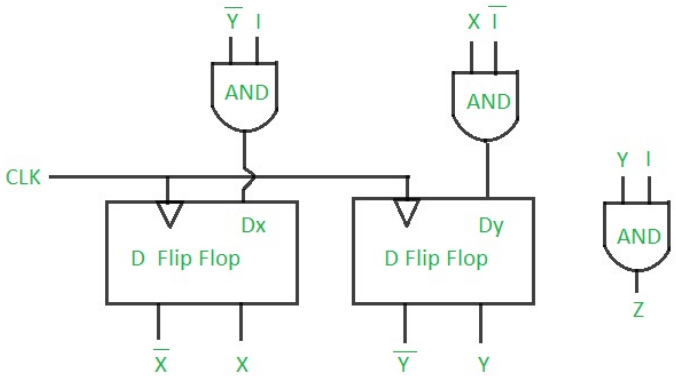


Dy= X.$\overline{I}$



Z=Y.I

Step 5: Finally implement the circuit –

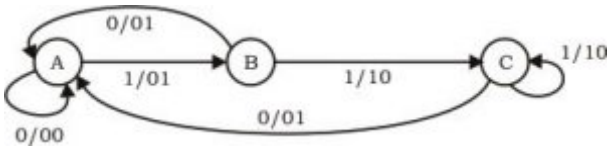


This is the final circuit for a Mealy 101 non overlapping sequence detector.

RESULT: sequence detector-a finite state machine is verified by using truth table

VIVA QUESTIONS:

1. The Finite state machine described by the following state diagram with A as starting state, where an arc label is x / y and x stands for 1-bit input and y stands for 2- bit output



2. Difference between Moore's and Mealy models?
3. Define Moore's model?
4. Define Melay model?
5. What are the applications of FSM?
6. What are the examples of Moore's and Melay?
7. Draw the state diagram of FSM?
8. Derive the transistion table for FSM?
9. Define the types of FSM?
10. In mealy machine, the O/P depends upon?
11. For a give Moore Machine, Given Input='101010', thus the output would be of length?
12. Define finite state machine?
13. Design a circuit that detects three consecutive '1's using Mealy and Moore FSM?
14. Fault coverage is _____ in finite state machines?
15. _____ is used to control the read and write operations?
16. Finite state machines are used for?
17. How many test patterns are required to test the circuit using counters?
18. What is slack?
19. Explain about setup time and hold time, what will happen if there is setup time and hold tine violation, how to overcome this?
20. What are different ways to synchronize between two clock domains?

21. What is skew, what are problems associated with it and how to minimize it?
22. What is glitch? What causes it (explain with waveform)? How to overcome it?
23. What is difference between latch and flipflop?
24. Given only two xor gates one must function as buffer and another as inverter?
25. Difference between heap and stack?
26. Difference between onehot and binary encoding?
27. Tell some of applications of buffer?
28. How to achieve 180 degree exact phase shift?
29. How to calculate maximum operating frequency?
30. Draw the state diagram to output a "1" for one cycle if the sequence "0110" shows up (the leading 0s cannot be used in more than one sequence)?
31. Design a FSM (Finite State Machine) to detect a sequence 10110?
32. What is an LFSR .List a few of its industry applications.?
33. what is false path?how it determine in ckt? what the effect of false path in ckt?
34. What are multi-cycle paths?
35. what is difference between RAM and FIFO?
36. The circle can rotate clockwise and back. Use minimum hardware to build a circuit to indicate the direction of rotating.?
37. Is it possible to reduce clock skew to zero?
38. what is Difference between writeback and write through cache?
39. What are different ways Multiply & Divide?
40. Design a circuit that calculates the square of a number?
41. In Moore's machine the output dependence on ?
42. In Melay machine the output dependence on?
43. What are the advantages of Moore's and Melay models?
44. What are the disadvantages of Moore's and Melay models?

45. What are the state encoding techniques in FSM?
46. Define One-hot encoding technique?
47. Define Gray encoding technique?
48. Define Binary encoding technique?
49. What are the differences between Binary, Gray and One-hot encoding?
50. What are the types of representations in FSM?