Lab Manual

ECPC-208

MATLAB Programming

Bachelor of Technology

in

Electronics & Communication Engineering

Department of Electronics & Communication Engineering

National Institute of Technology

Kurukshetra-136119

Web page: http://www.nitkkr.ac.in/sub_courses.php?id=143&id3=62

Vision

To impart state-of-the-art Electronics and Communication Engineering Education and Research responsive to global challenges.

Mission

- **M1:** To prepare students with strong theoretical and practical knowledge by imparting quality education.
- **M2:** To produce comprehensively trained and innovative graduates in Electronics and Communication Engineering through hands on practice and research to encourage them for entrepreneurship.
- **M3:** To inculcate team work spirit and professional ethics in students.

Program Educational Objectives (PEOs)

PEO – 1: Have a lead and successful role in their professional career.

PEO – 2: Be able to analyze real life problems and design socially accepted and economically viable solutions in Electronics and Communication Engineering area.

PEO –3: Be capable of lifelong learning and professional development by pursuing higher education and participation in research and development activities.

PEO –4: Have appropriate human and technical communication skills to be a good team-member/leaders and responsible human being

Program Outcomes (POs)

A graduate of the Electronics and Communication Engineering Program will:

PO1: **Engineering knowledge**: Possess knowledge of mathematics, science, engineering fundamentals, and Electronics and Communication Engineering specialization to solve the problems in Electronics and Telecommunication Systems.

PO2: **Problem analysis**: Be able to analyze complex problems in Communication systems, Analog &Digital Electronic Systems, & DSP based systems using first principles of mathematics, science, and engineering sciences to reach substantiated conclusions.

PO3: **Design/development of solutions**: Be able to design solutions for complex Electronics and communication 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.

PO4: **Conduct investigations of complex problems**: Be able to 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.

PO5: **Modern tool usage**: Be able to 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.

PO6: **The engineer and society**: Be able to apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional Electronics and Communication Engineering practice.

PO7: **Environment and sustainability**: Be able to understand the impact of Electronics and communication engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8: **Ethics**: Be able to apply ethical principles, commit to professional ethics in context to Electronics and communication engineering practice.

PO9: **Individual and team work**: Be able to function effectively as an individual, as a member or leader in diverse teams, and in multidisciplinary settings.

PO10: **Communication**: Be able to communicate effectively on complex Electronics and communication engineering activities with the engineering community and with society at large.

PO11: **Life-long learning**: Be able to 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.

PO12: **Project management and finance:** Have knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member/ leader in a team, to manage projects in multidisciplinary environments.

Program Specific Outcomes (PSOs)

At the end of the program, the student will:

PSO1: Clearly understand the fundamental concepts of Electronics and Communication Engineering.

PSO2: Formulate the real life problems and develop solutions in the area of semiconductor technology, signal processing and communication systems.

PSO3: Posses the skills to communicate effectively in both oral and written forms, demonstrating the practice of professional ethics, and responsive to societal and environmental needs.

ECPC-208 MATLAB Programming					
	L	**T**	**P**	**Credits**	**Total contact hours**
	0	**0**	**2**	**1**	**20**
Course Objectives	This lab aims to get familiarize the students about the numerical computing in various fields. MATLAB allows matrix manipulations, plotting the function by using polar & contour3 commands, implementation of algorithms & creation of user interfaces. It calculates their design, waveforms, graphs, circles, circular helix and solves various integral and differential equations. Using MATLAB symbolic math toolbox, determine the Laplace transform. Further in this lab students will attain the knowledge about convolution and cross correlation between two sequences.				
Course Outcomes	At the end of the course, the students will be able to: 1. Learn various aspects of MATLAB such as interface, syntax, debugging and execution. 2. Understand how various MATLAB scripts are created, saved and executed. 3. Apply above knowledge in writing simple programs. 4. Learn basic concepts of simulation using SIMULINK and write complex programs.				

List of Experiments

1 To study Basic MATLAB arithmetic Commands.

2 For an electrical circuit with an inductance L=0.01 mH and resistance R=100Ω,the damped natural frequency of oscillation f=$\sqrt{\frac{1}{LC} - \frac{R^2}{4C^2}}$ write a progoram to calculate the frequency for different values of c varying from 0.1 to 1 in step of 0.01.

3 Write a Matlab program to define the vectors:

$$\bar{u} =< 1,2,3,4 > and\ \bar{v} =< 2,3,4,5 >$$

Now determine the following using Matlab

a) Multiply the vector v with a scalar quantity i. e. $5\bar{v}$

b) Take the power of 5 of a vector i. e. $\bar{u}^5$

c) Take the power of 5 of a vector i. e. $\bar{v}^5$

d) Multiply the vectors element by element i. e. $\overline{u.*\bar{v}}$

e) First take the transpose of a vector and then multiply the vectors

element by element $\bar{u}.*\bar{v}^t$

4 Write a Matlab program to calculate:

(i) Summation of a number k from 0 to 100 i.e. $\sum_{k=0}^{100} k$

(ii) Summation of a number k^2 from 0 to 100 i.e. $\sum_{k=0}^{100} k^2$

(iii) Summation of a number 1/k from 0 to 100 i.e. $\sum_{k=1}^{100} 1/k$

(iv) Summation of a number $1/k^2$ from 0 to 100 i.e. $\sum_{k=1}^{100} 1/k^2$

5. Write a Matlab program to break a function, f(x) into odd and even parts, one can compute the two function

$$f_{odd}(x) = \frac{f(x) - f(-x)}{2}$$

$$f_{even}(x) = \frac{f(x) + f(-x)}{2}$$

6. Calculate using Matlab

(i) Define the symbolic variable x.

(ii) Define the symbolic function $y = e^x$

(iii) Define the symbolic function $y = e^{-x}$

(iv) Using the result of previous two sections, calculate $f_{odd}(x)$ and $f_{even}(x)$ for the function $y = e^x$

7. Write a Matlab program to generate different waveforms –

(i) Square wave
(ii) Sine wave
(iii) Triangle wave
(iv) Exponential wave
(v) unit step function
(vi) unit impulse function
(vii) A rectangular pulse of width 2
(viii) Unit ramp function

8. Draw graphs of the functions using Matlab

$(i)\frac{\sin x}{x}$ $(ii)\frac{1}{(x-1)^2} + x$ $(iii)\frac{x^2+1}{x^2-4}$ $(iv)\frac{(10-x)^{\frac{1}{3}}-2}{(4-x^2)^{\frac{1}{2}}}$

9. Draw the circle of radius r=5 using Matlab.

10. Write a function in Matlab for factorial to compute the factorial n! . for n= 50.

11. Write a Matlab program to compute sum of all powers of 2 below 50 using while command.

12. Write a Matlab program to solve the equations:

$$-6x - 2y + 2z = 15$$
$$-3x + 4y - 3z = 13$$
$$2x + 4y - 7z = -9$$

13. The Fibonacci sequence starts off with the numbers 0 and 1, then succeeding terms are the sum of its two immediate predecessors. Write a Matlab program for Fibonacci series.
14. Write a Matlab program for the calculation of the following:
    1-1/2+ 1/3- 1/4 + 1/5 ……
15. Write a Matlab program to generalize for the following:

$$s(20) = 1 + \frac{1}{2^2} + \frac{1}{3^2} + \frac{1}{4^2} + \cdots + \frac{1}{20^2}$$
$$s(21) = 1 + \frac{1}{2^2} + \frac{1}{3^2} + \frac{1}{4^2} + \cdots + \frac{1}{21^2}$$
$$\vdots$$
$$s(100) = 1 + \frac{1}{2^2} + \frac{1}{3^2} + \frac{1}{4^2} + \cdots + \frac{1}{100^2}$$

16. The area, A, of a triangle with sides of length a, b and c is given by $A = \sqrt{(s-a)(s-b)(s-c)}$ where s=(a+b+c)/2. Write a Matlab function that will accept the values a, b and c as inputs and return the value of A as output.
17. Write a Matlab program for a positive number to compute and display the even powers of 2 less than or equal to positive number.
18. Use the command plot3(x,y,z) to plot the circular helix $x(t) = \sin t\,, y(t) = \cos t\ , z(t) = t, 0 \le t \le 20$
19. Plot the surface defined by the function using Matlab:
    $f(x,y) = (x-3)^2 + (y-2)^2$ for $2 \le x \le 4, 1 \le y \le 3$
20. Find the solution of first order ODE:
$$\dot{x} = 2x + 5\sin t\,, x(0) = 1$$
21. Plot $r^2 = 2\sin 5t,\ for\ 0 \le x \le 2\pi$ using polar command in Matlab.
22. Plot $z = -\frac{5}{1+x^2+y^2}, for\ |x| \le 3, |y| \le 3$ using contour3 command in Matlab.
23. Compute the following integral:
$$I = \int_{-1}^{1}\int_{0}^{2} (1 - 6x^2 y)\, dxdy$$

24. Compute the first order differential equation

$$\frac{dy}{dx} = x + t$$

With initial condition x(0)=0

25. Compute the following transcendental equation using Matlab:

$\sin x = e^x - 5$ here initial value x0=1.

26. Determine the convolution of x (t) =$\frac{1}{1+t^2}$with itself.

27. Compute the cross correlation between the following two sequences.

X(n)= {1,2, -1,3}, h(n)= {3, -2,1,4}

28. Let x (n)=u(n)-u(n-10). Decompose x(n) into even and odd components.

29. Let x (t)=$e^{-1000}|t|$

a) Sample x(t) at fs=5000 samples/sec to obtain x(n)

b) From the samples x(n), reconstruct x(t).

30. Using MATLAB symbolic math toolbox, determine the Laplace Transform of the following

a) x(t)=t$e^{-at}u(t)$

b) x(t) = [$\sin(at) + \cos(bt)(u(t))$

EXPERIMENT 1

Objective: To study the Basic MATLAB arithmetic commands

Apparatus Required:

A PC installed with MATLAB software.

Theory:

INTRODUCTION TO MATLAB:

MATLAB is a powerful language for technical computing. The name MATLAB stands for MATRIX Laboratory, because its basic data element is a matrix (array). MATLAB can be used for math computations, modeling and simulations, data analysis and processing, visualization and graphics, and algorithm development.

Table 1.1 MATLAB Windows

Window	Purpose
Command Window	Main window, enters variables, runs programs.
Figure Window	Contains output from graphic Commands.
Editor Window	Creates and debugs script and function files.
Help Window	Provides help information.
Command History window	Logs commands entered in the Command Window.
Workspace Window	Provides information about the variables that are used.
Current Folder Window	Shows the files in the current folder.

WORKING IN THE COMMAND WINDOW:

The Command Window is MATLAB's main window and can be used for executing commands, opening other windows, running programs written by the user, and managing the software. An example is shown in Figure 1-1.

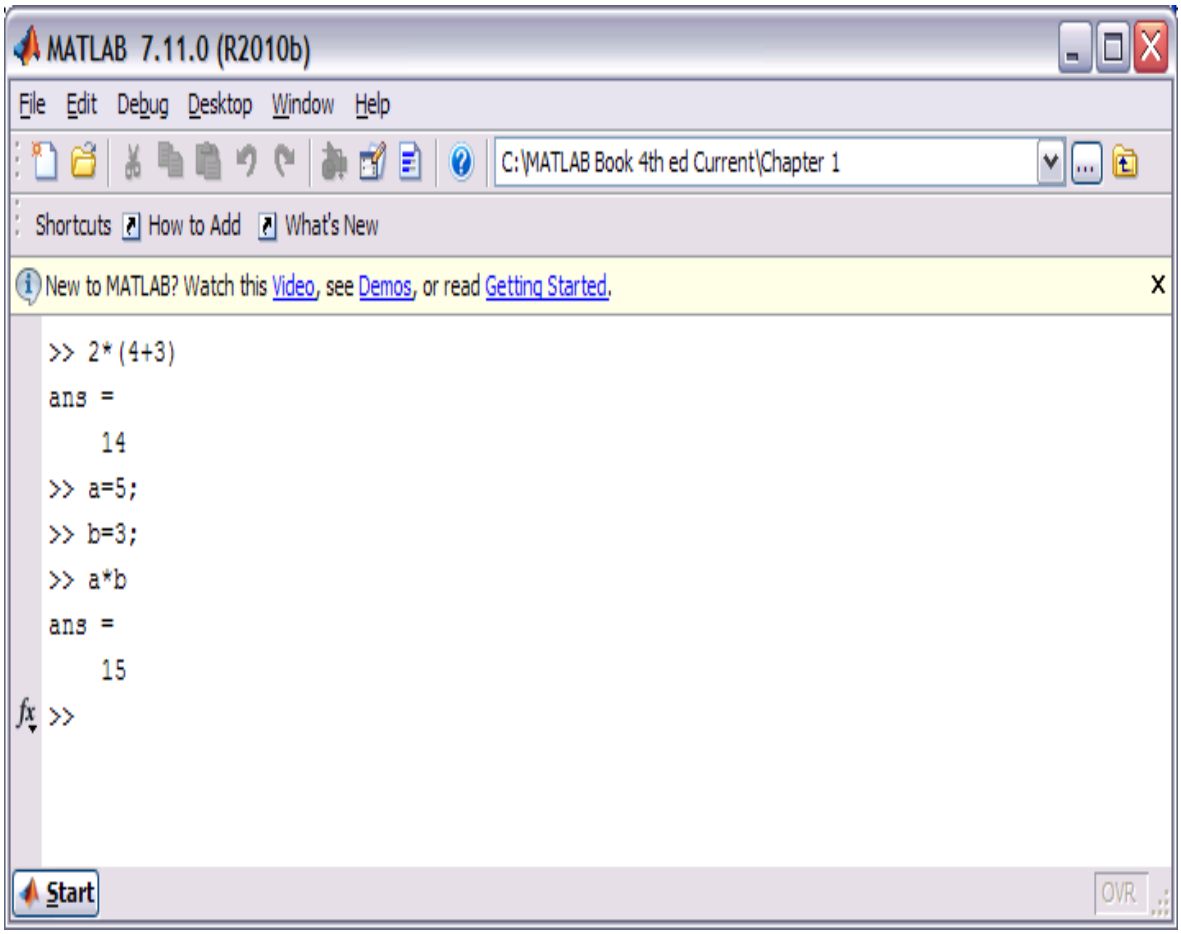


Fig.1.1: Command Window

NOTES FOR WORKING IN THE COMMAND WINDOW:

- To type a command the cursor must be placed next to the command prompt (>>).
- Once a command is typed and the **Enter** key is pressed, the command is executed. However, only the last command is executed. Everything executed previously (that might be still displayed) is unchanged.
- Several commands can be typed in the same line. This is done by typing a comma between the commands. When the **Enter** key is pressed the commands are executed In order from left to right.
- It is not possible to go back to a previous line that is displayed in the Command Window, make a correction, and then re-execute the command.
- A previously typed command can be recalled to the command prompt with the up arrow key. When the command is displayed at the command prompt, it can be modified if needed and then executed. The down-arrow key can be used to move down the list of previously typed commands.

- If a command is too long to fit in one line, it can be continued to the next line by typing three periods … (called an ellipsis) and pressing the **Enter** key. The continuation of the command is then typed in the new line. The command can continue line after line up to a total of 4,096 characters.

ARITHMETIC OPERATIONS WITH SCALARS:

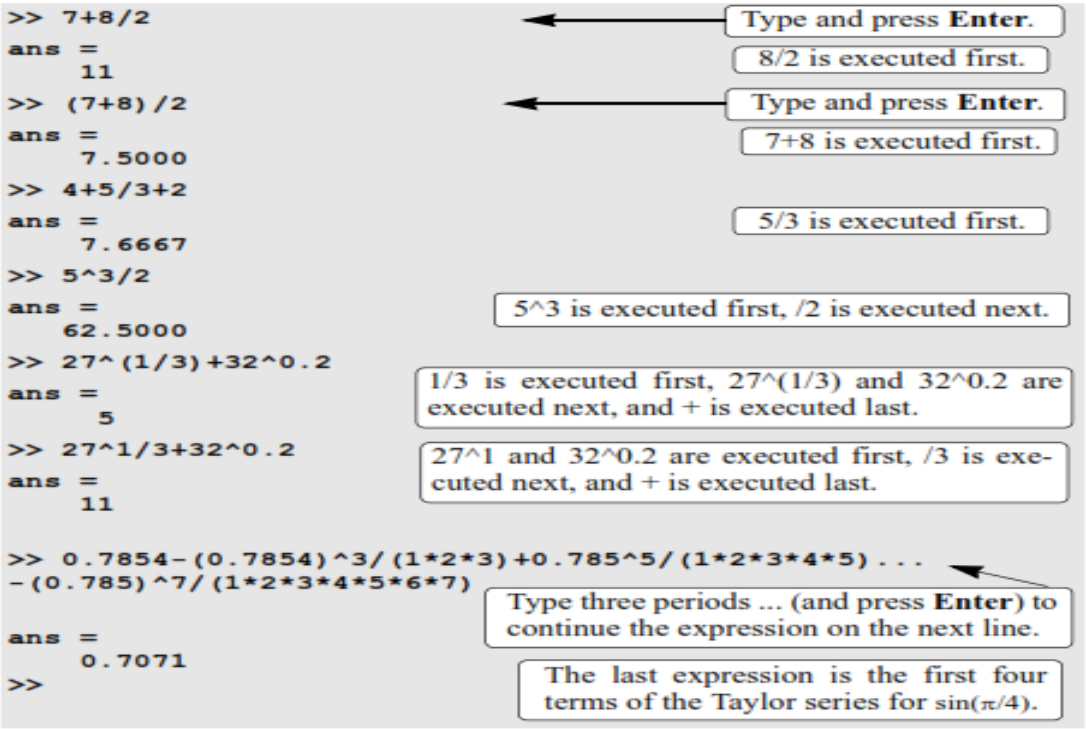
The symbols of arithmetic operations are:

Operation	Symbol	Example
Addition	**+**	**5+3**
Subtraction	**-**	**5-3**
Multiplication	*****	**5*3**
Right division	**/**	**5/3**
Left division	****	**3\5**
Exponentiation	**^**	**5^3**

USING MATLAB AS A CALCULATOR:

The simplest way to use MATLAB is as a calculator. This is done in the Command Window by typing a mathematical expression and pressing the **Enter** key. MATLAB calculates the expression and responds by displaying ans= and the numerical result of the expression in the next line. This is demonstrated in Tutorial 1-1.

Tutorial 1-1: Using MATLAB as a calculator.



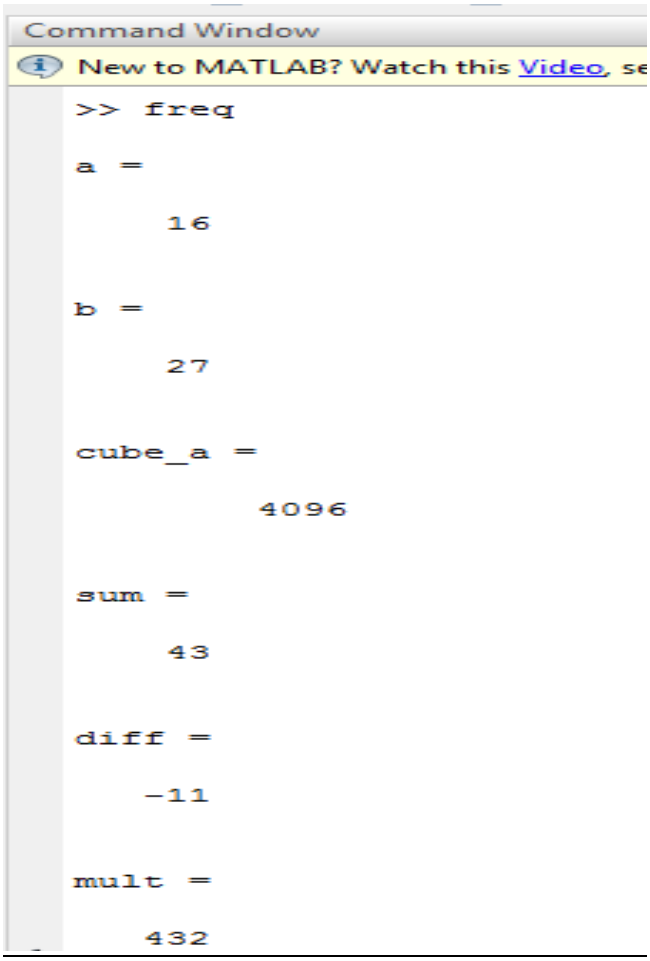
Procedure:

Open MATLAB in your PC.
Open a new script.
Write the code as mentioned in the next heading in the script.
Save the script.
Run the script.
Desired result will be displayed on the command window.

Code:

```
clc
clear all
close all
a=16
b=27
cube_a=a^3
sum=a+b
diff=a-b
mult=a*b
div=a/b
c=[1 4;35 49]
sqrt(c)
```

Expected Outcome:



Assignments:

Calculate following:

1. $\frac{(14.8^2+6.5^2)}{3.8^2}+\frac{55}{(\sqrt{2}+14)}$
2. $(\pm 3.5^3)+\frac{e^6}{ln524}+206^{1/3}$
3. $\frac{16.5^2(8.4\pm\sqrt{70})}{4.3^2\pm 17.3}$
4. $\frac{5.2^3\pm 6.4^2+3}{1.6^8\pm 2}+\left(\frac{13.3}{5}\right)^{1.5}$

Conclusion:

In this experiment, the motive was to introduce MATLAB as calculator.

At the end students should try to learn as much as they can from this experiment and should try different Algebraic calculation problems in MATLAB.

EXPERIMENT 2

Objective: For an electrical circuit with inductance L=0.00001 and resistance R=100 the damped natural frequency of oscillation is F=sqrt(1/L*C-R^2/4*C^2). Write a program to calculate frequency for different value of C varying from 0.1 to 1 in steps of 0.1

Apparatus Required:

A PC installed with MATLAB software.

Theory:

MATLAB is used as a calculator

Description of command used:

'+': This is used for Addition.

'-' : This is used for Subtraction.

'*' : This is used for Multiplication.

'/' : This is used for Division.

'.*' : This is used for element by element Multiplication.

'./' : This is used for element by element Division.

SQRT **:**It is used to do square roots of the value given to it.

Procedure:

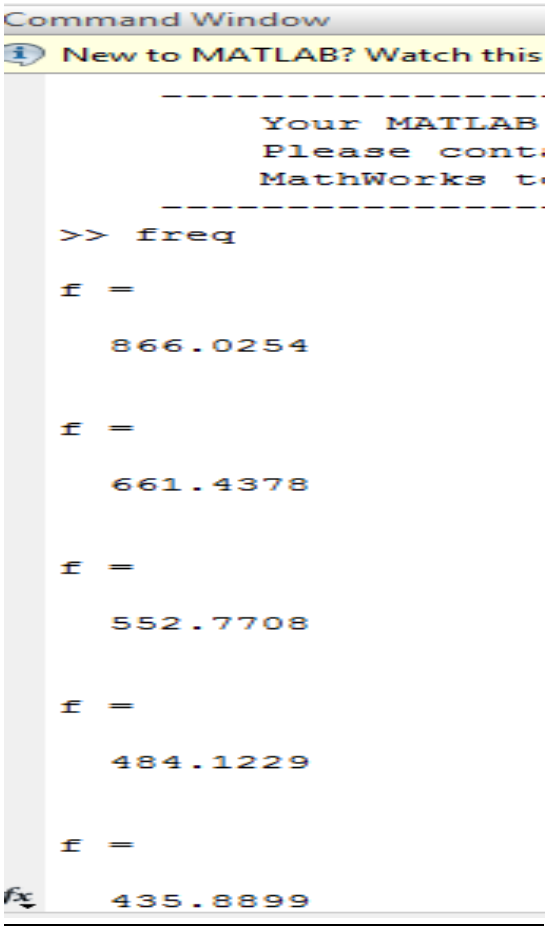
Open MATLAB in your PC.
Open a new script.
Write the code as mentioned in the next heading in the script.
Save the script.
Run the script.
Desired result will be displayed on the command window.

Code:

```
clc
L=0.00001;
R=100;
for C=0.1:0.1:1
```

```
   f=sqrt((1/(L*C))-((R^2)/(4*C*C)))
end
```

Expected Outcome:



Assignments:

1. A cube has a side of 18 cm. a) Determine the radius of a sphere that has the same surface area as the cube. b) Determine the radius of a sphere that has the same volume as the cube.

Conclusion:

In this experiment, the motive was to introduce MATLAB as calculator.

At the end students should try to learn as much as they can from this experiment and should try different Algebraic calculation problems in MATLAB.

EXPERIMENT 3

Objective: Write a MATLAB program to define the vectors.

U=<1,2,3,4> and V=<2,3,4,5>

Now determine the following using MATLAB

a) Multiply the vector v with a scalar quantity.
b) Take the power of 5 of a vector u.
c) Take the power of 5 of a vector v.
d) Multiply the vectors element by element
e) First take the transpose of a vector and then multiply the vectors element by element

Apparatus Required:

A PC installed with MATLAB software.

Theory:

Row vector-Vector that only contains a single row eg.,vector A.
Column vector - Vector that contains only a single column, eg. Vector B.
Square vector- Vector that contains equal number of row and column, eg. Vector C and Vector D.
Vector operations like addition and subtraction can only be done on vectors that contain equal number of rows and column.
Vector operation like multiplication can only be done if:
number of column of first vector=number of rows of second vector.

Procedure:

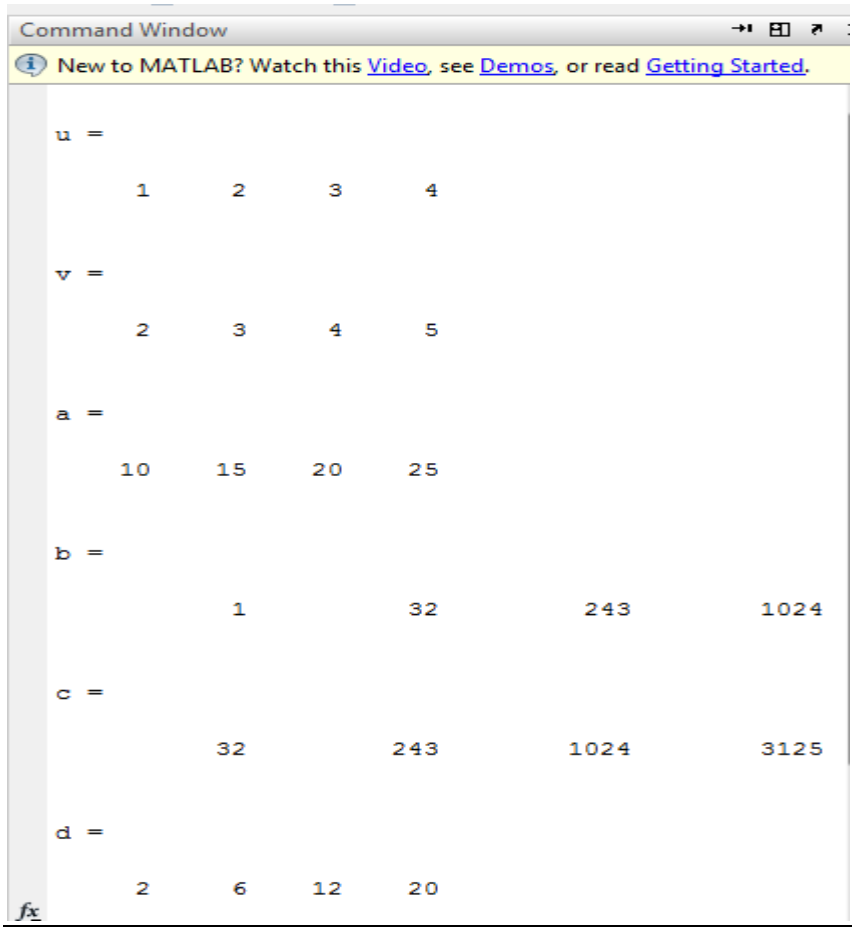
Open MATLAB in your PC.
Open a new script.
Write the code as mentioned in the next heading in the script.
Save the script.
Run the script.
Desired result will be displayed on the command window.

Code:

```
clc
```

```
u = [1,2,3,4]
v = [2,3,4,5]
a = 5*v
b = u.^5
c = v.^5
d = u.*v
e = u*transpose(v)
```

Expected Outcome:



Assignments:

1. Using the ones and zeros commands, create a matrix in which the first two rows are 0s and the next two rows are 1s.
2. Create a matrix in which the middle two rows and the middle two columns are 1s, and the rest of the entries are 0s.
3. Define the variables x= 0.85,y=12.5 and then use them to create a column vector that has the following elements: y, y^x, ln(y/x), y.x and x+y

Conclusion:

In this experiment, the motive was to create arrays using MATLAB.
At the end, student should try to learn as much as they can from this experiment and should try different Matrix calculation problems in MATLAB.

EXPERIMENT 4

Objective: Write a MATLAB program to calculate:

a) Summation of a number k from 0 to 100.
b) Summation of a number k^2 from 0 to 100.
c) Summation of a number 1/ k from 1 to 100.
d) Summation of a number 1/k^2 from 1 to 100.

Apparatus Required:

A PC installed with MATLAB software.

Theory:

Element wise Operation: If we apply "." before any operation then that operation is operated on every element of array separately.

sum(A): If A is a vector, returns the sum of the elements of the vector.

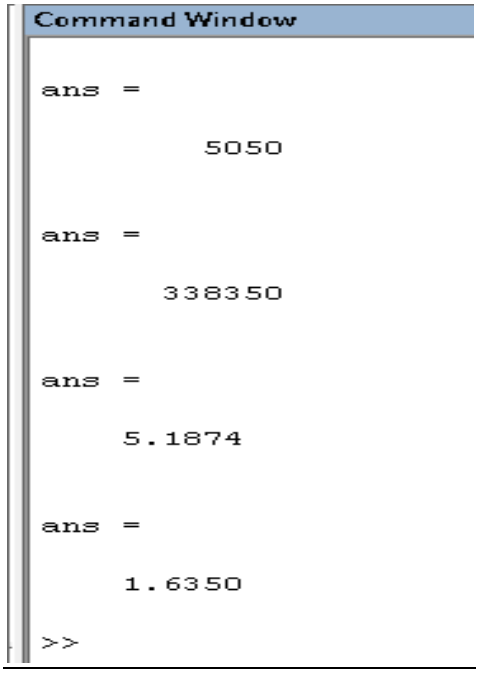
Procedure:

Open MATLAB in your PC.
Open a new script.
Write the code as mentioned in the next heading in the script.
Save the script.
Run the script.
Desired result will be displayed on the command window.

Code:

```
clc
clear all
close all
N = 0:100;
sum(N)
sum(N.^2)
N= 1:100;
sum(1./N)
sum(1./N.^2)
```

Expected Outcome:



Assignments:

1. For the function $y = x^3 \pm 2x^2 + x$, calculate the value of y for the following values of x using element by element operations: $\pm 2, \pm 1, 0, 1, 2, 3, 4$.
2. For the function $y = \frac{x^2 \pm 2}{x+4}$ calculate the value of y for the following values of x using element by element operations: $\pm 3, \pm 2, \pm 1, 0, 1, 2, 3$.

Conclusion:

In this experiment, the motive was to introduce the element wise operations on array using MATLAB.
At the end, student should try to learn as much as they can from this experiment and should try different element wise operation problems in MATLAB.

EXPERIMENT 5

Objective: Write a MATLAB program to break a function into odd and even parts.

Apparatus Required:

A PC installed with MATLAB software.

Theory:.

Even and odd signals bear some important symmetry properties. Under reversal of independent variable, these signals either remain the same (evensignal) or get reflected or flipped (odd signal) about the horizontal axis. Equations or definitions (1) and (2) mathematically express these propertiesfor both continuous and discrete time cases.

Even Signals: $x(t) = x(-t)$, $x[n] = x[-n]$ (1)

Odd Signals: $x(t) = -x(-t)$, $x[n] = -x[-n]$ (2)

A signal x(t) can be decomposed into even and odd parts as expressed by the equations (3) and (4)

$$x_e(t) = \frac{1}{2}\{x(t) + x(-t)\} \quad (3)$$

$$x_o(t) = \frac{1}{2}\{x(t) - x(-t)\} \quad (4)$$

Where x(t)= $x_e(t) + x_o(t)$

Procedure:

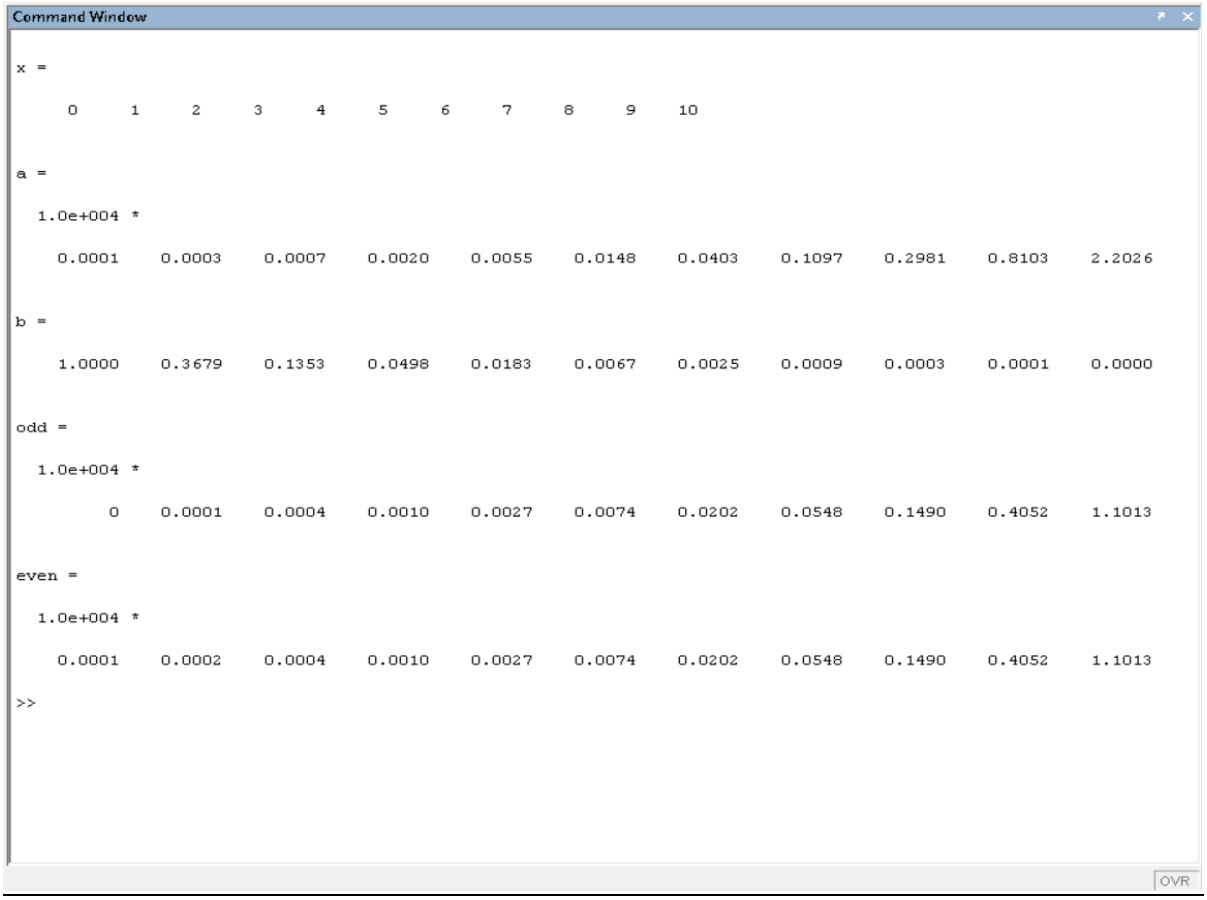
Open MATLAB in your PC.
Open a new script.
Write the code as mentioned in the next heading in the script.
Save the script.
Run the script.
Desired result will be displayed on the command window.

Code:

```
clc
clear all
close all
x=0:1:10
a= exp(x)
b= exp(-x)
odd=(a-b)/2
```

even=(a+b)/2

Expected Outcome:



Assignments:

1. Break a signal Sin(x) into even and odd parts.

Conclusion:

In this experiment, the motive was to understand MATLAB tool is used to break a signal or function in even and odd parts.

At the end students should try to learn as much as they can from this experiment and should divide different functions or signals into even and odd parts and observe the difference.

EXPERIMENT 6

Objective: Calculate following using Matlab

a) Define the symbolic variable x
b) Define the symbolic function y = exp(x)
c) Define the symbolic function y = exp(-x)
d) Using the results of previous two sections, calculate fodd(x)and feven(x) for the function y = exp(x)

Apparatus Required:

A PC installed with MATLAB software.

Theory:

To define any symbolic variable syms command is used in matlab. Input array, specified as a scalar, vector, matrix, or multidimensional array. Exponential is the basic signals with positive and negative slope. Command used for exponential signal is exp(x). where x is any variables.

Procedure:

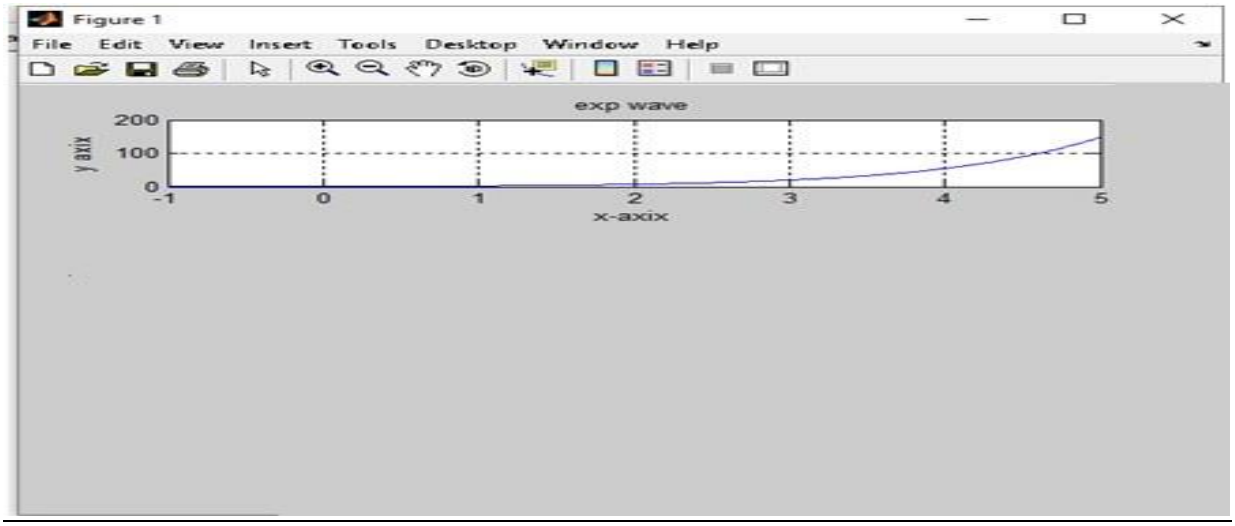
Open MATLAB in your PC.
Open a new script.
Write the code as mentioned in the next heading in the script.
Save the script.
Run the script.
Desired result will be displayed on the command window.

Code:

```
clc
clear all
close all
x=-1:1/100:5;
y2=exp(x);
plot(x,y2)
xlabel('x-axix')
ylabel('y axix')
title('exp wave')
gridon
```

```
clc
symsx;
f1=exp(x);
f1=inline(f1);
f2=subs(f1,x,-x);
f2=inline(f2);
feven=(f1(x)+f2(x))/2;
fodd=(f1(x)-f2(x))/2;
disp('even part:');
disp(feven);
disp('odd part:');
disp(fodd);
```

Expected Outcome:




```
Command Window
New to MATLAB? Watch this Video, see D
even part:
1/(2*exp(x)) + exp(x)/2

odd part:
exp(x)/2 - 1/(2*exp(x))
```

Assignments:

1. Find the mathematical and physical significance of exponential signal.
2. Find the shape of the even and odd signals when we use exponential signal.

Conclusion:

In this experiment, the motive was to understand how variables are defined and values are assigned to these variables in MATLAB.

At the end students are given the assignments to learn more about the inputs and outputs in MATLAB

EXPERIMENT 7

Objective: Write a MATLAB program to plot following waveforms

a) Sin wave
b) Cosine wave
c) Triangular wave
d) Square wave
e) Impulse function
f) Exponential function
g) Unit Ramp

Apparatus Required:

A PC installed with MATLAB software.

Theory:

Here with the help of matlab we identify the shape and behaviors of different signals.

Procedure:

Open MATLAB in your PC.
Open a new script.
Write the code as mentioned in the next heading in the script.
Save the script.
Run the script.
Desired result will be displayed on the command window.

Code:

Code 1.

```
clc
x=0:1/5:2*pi
y=sin(x)
Subplot(2,1,1);
plot(x,y,'-Or')
xlabel('x-axix')
ylabel('y axix')
title('sin wave')
gridon
```

```
subplot(2,1,2);
plot(x,cos(x),'green')
xlabel('x-axis')
ylabel('y axis')
title('cosine wave')
gridon
```

Code 2.

```
clc
x= -10:1/100:10;
y=square(x);
y1=sawtooth(x);

subplot(3,1,1)
plot(x,y)
xlabel('x-axix')
ylabel('y axix')
title('square wave')
gridon

subplot(3,1,2)
plot(x,y1)
xlabel('x-axix')
ylabel('y axix')
title('triangular wave')
gridon

subplot(3,1,3)
x=-1:1/100:5;
y2=exp(x);
plot(x,y2)
xlabel('x-axix')
ylabel('y axix')
title('exp wave')
gridon
```

Code 3.

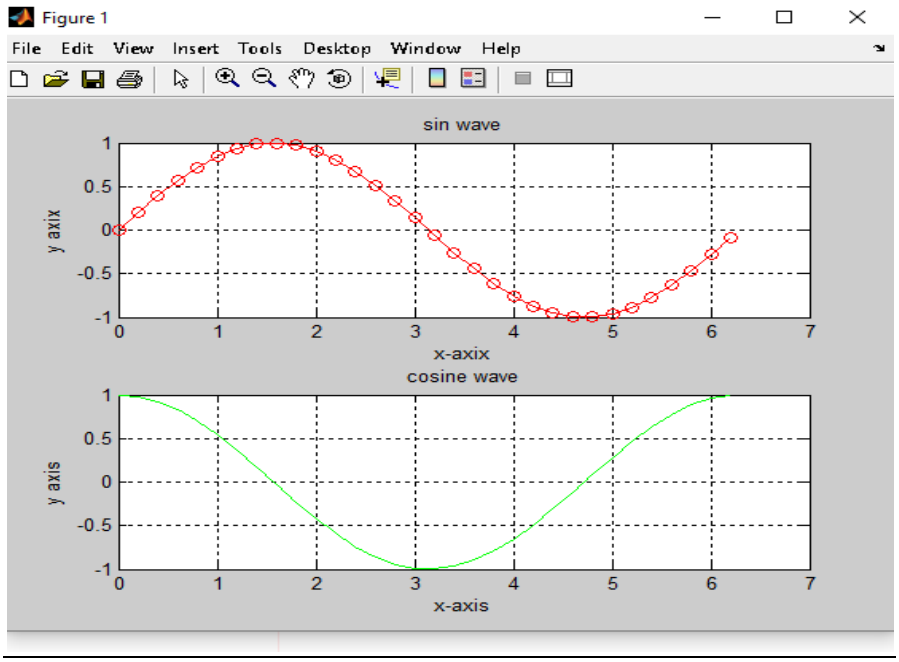
```
clc
x=1:1/100:5;
 y= [1; zeros(99,1)];

impz(y,1)
```

Code 4.

```
clc
t=1:1/100:5;
ramp_sig= t;
plot(ramp_sig)
title('unit ramp')
```

Expected Outcome:



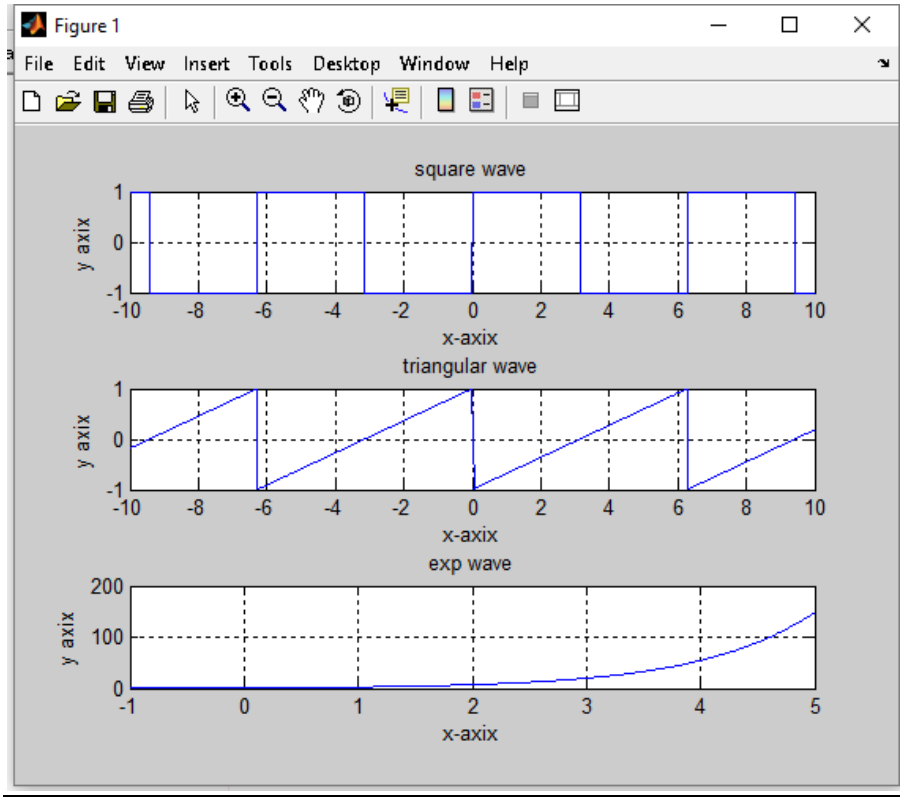


Figure 1
File Edit View Insert Tools Desktop Window Help
square wave
y axix
x-axix
triangular wave
y axix
x-axix
exp wave
y axix
x-axix

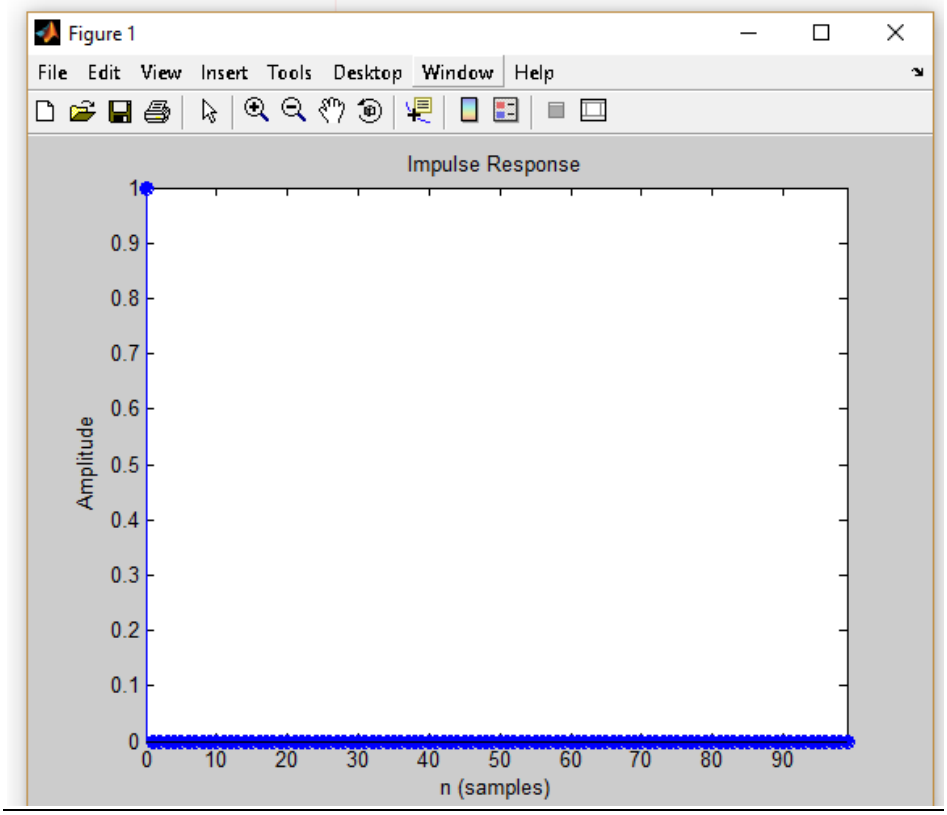
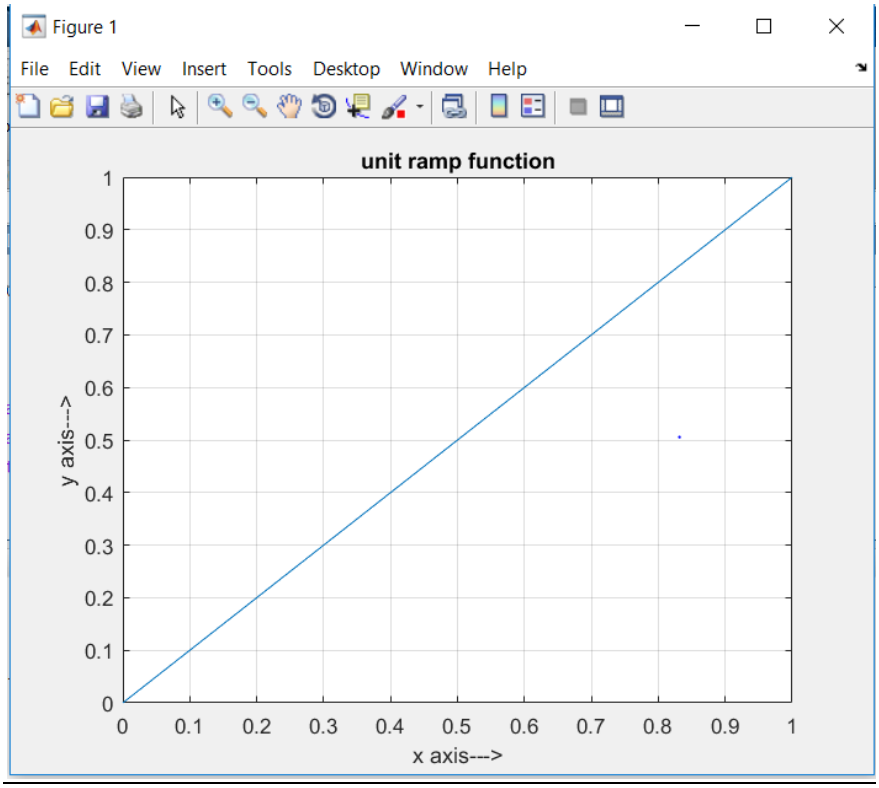


Figure 1
File Edit View Insert Tools Desktop Window Help
Impulse Response
Amplitude
n (samples)



Assignments:

2. Write a program to plot combined wave of sine and cosine signals.
3. Write a program to plot above signals in discrete form.

Conclusion:

In this experiment, the motive was to understand different commends used for basic signals in MATLAB.

At the end students are given the assignments to learn more about shape and behaviors of the different signals in MATLAB.

EXPERIMENT 8

Objective: Write a MATLAB program to plot following functions.

a) Sin(x)/x
b) x^2+1/x^2-4
c) [(10-x)^(1/3)-2]/(4-x^2)^1/2

Apparatus Required:

A PC installed with MATLAB software.

Theory:

To see the shape of different mathematical equations we use plot command in matlab.here we have three mathematical function to analysis their plot.

Procedure:

Open MATLAB in your PC.
Open a new script.
Write the code as mentioned in the next heading in the script.
Save the script.
Run the script.
Desired result will be displayed on the command window.

Code:

Code1:

```
clc
x = -5*pi:pi/15:5*pi;
y = sin(x)./x;
plot(x,y)
Xlabel('x-axis')
Ylabel('sin(x)/x')
gridon;
```

Code 2:

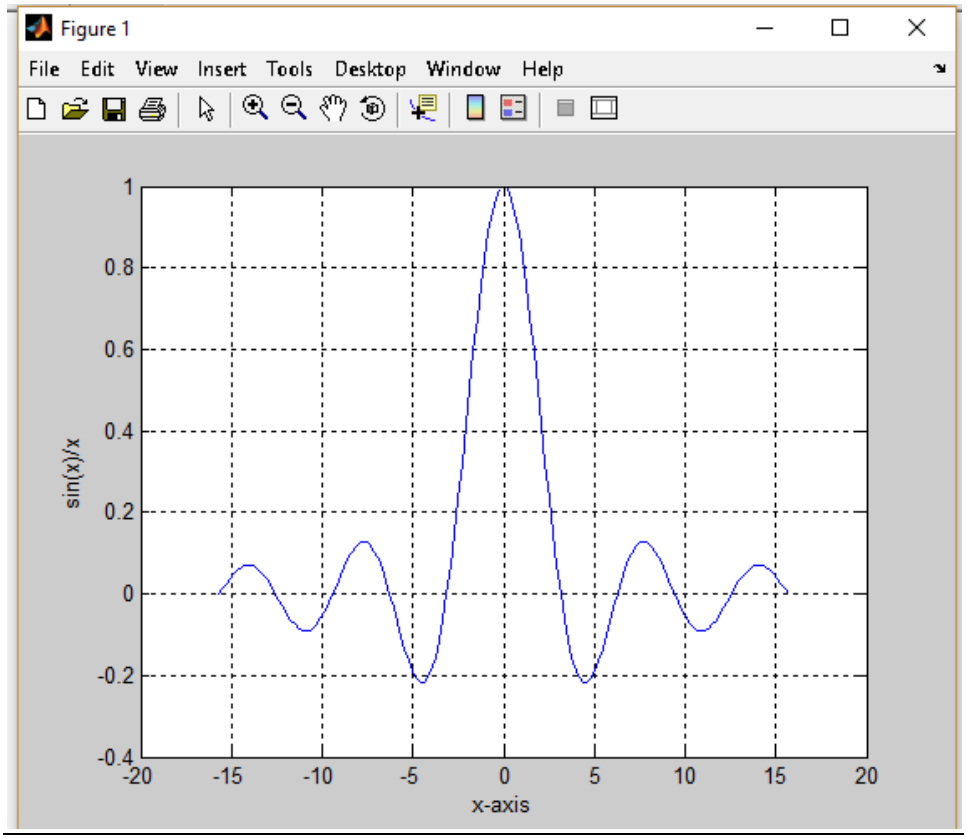
```
clc
x=-5:0.001:5;
y = (x.^2 + 1)./(x.^2-4);
plot(x,y)
```

```
xlabel('x-axis')
ylabel('y-axis')
gridon;
```

Code 3:

```
clc
x=-5:0.001:5;
y = ((10-x).^(1/3)-2)./(4-x.^2).^(1/2);
plot(x,y,'r')
xlabel('x-axis')
ylabel('y-axis')
gridon;
```

Expected Outcome:



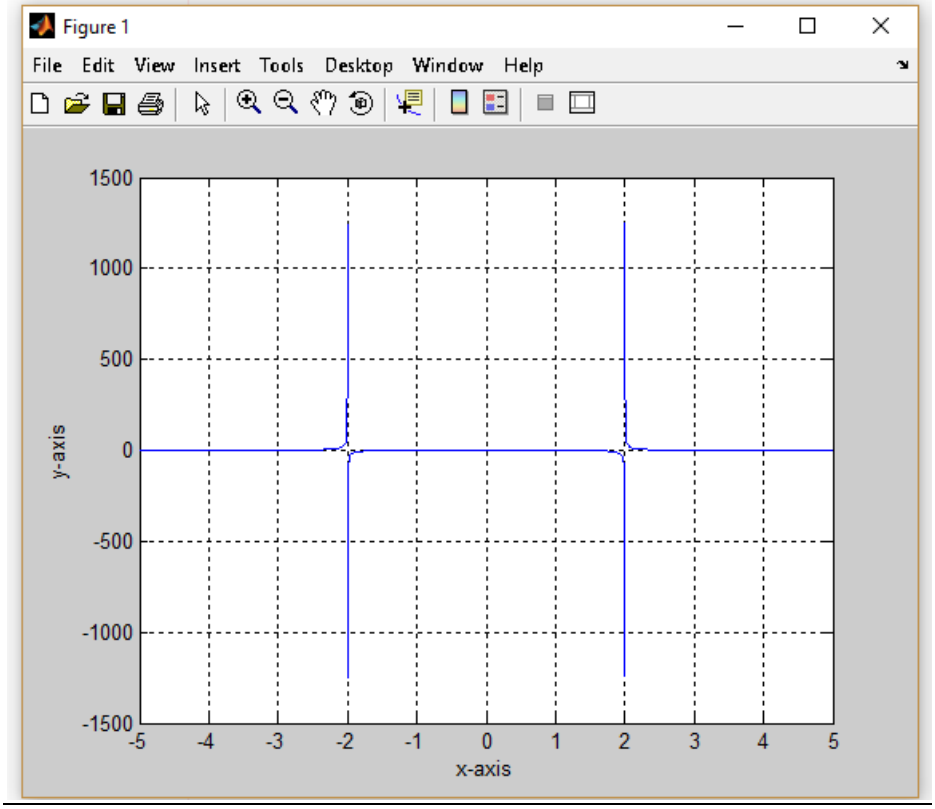


Figure 1
File Edit View Insert Tools Desktop Window Help
1500
1000
500
0
-500
-1000
-1500
y-axis
-5 -4 -3 -2 -1 0 1 2 3 4 5
x-axis

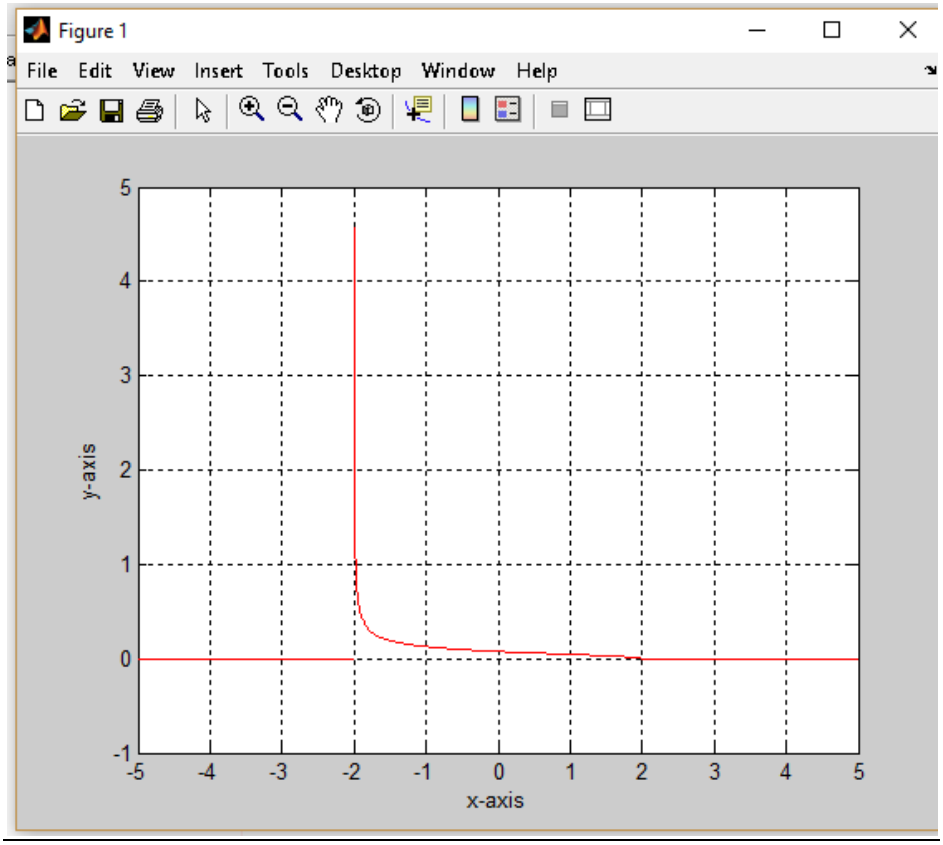


Figure 1
File Edit View Insert Tools Desktop Window Help
5
4
3
2
1
0
-1
y-axis
-5 -4 -3 -2 -1 0 1 2 3 4 5
x-axis

Assignments:

4. Plot mathematical function like equation of circle, parabola, hyperbola etc.
5. Marge all graph in the single graph with different color.

Conclusion:

In this experiment, the motive was to understand the shape of the different mathematical equations.

EXPERIMENT 9

Objective: Write a MATLAB program to draw the circle of radius r=5.

Apparatus Required:

A PC installed with MATLAB software.

Theory:

A circle is the locus of all points equidistant from a central point. The mathematical equations of the circle is $x^2 + y^2 = 5^2$. Where x and y are the coordinates of the circle and 5 is the radius of the circle.

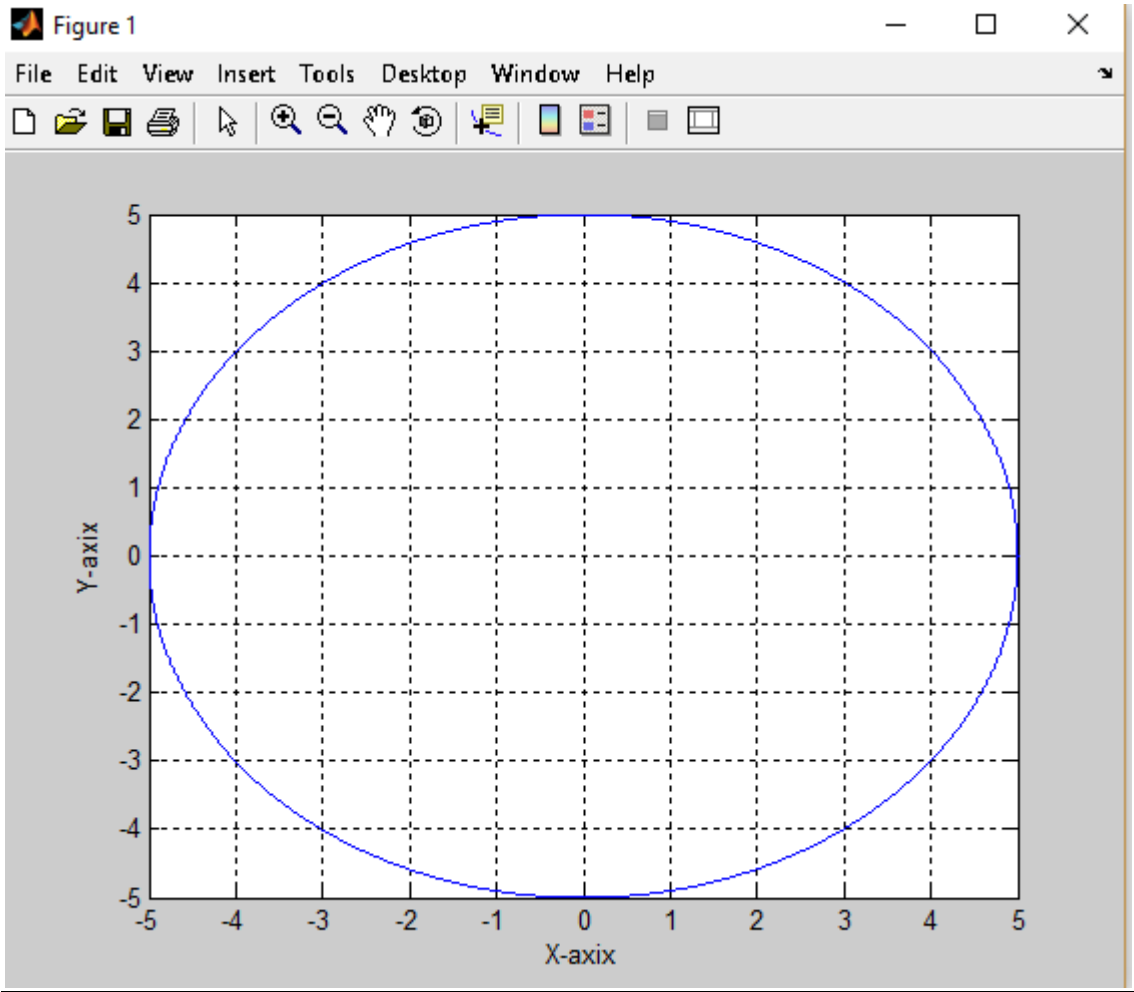
Procedure:

Open MATLAB in your PC.
Open a new script.
Write the code as mentioned in the next heading in the script.
Save the script.
Run the script.
Desired result will be displayed on the command window.

Code:

```
clc
clear all
close all
t = -2*pi:0.000001:2*pi;
x = 5*cos(t);
y = 5*sin(t);
plot(x,y);
Xlabel('X-axix');
Ylabel('Y-axix');
gridon;
```

Expected Outcome:



Assignments:

1. Evaluate the expression $x^2 + y^2$over the 2-D grid.
2. Create circle with concentric ring.

Conclusion:

In this experiment, the motive was to understand how to plot 2D shape of mathematical function.

At the end students are given the assignments to learn more about plotting of grids in MATLAB

EXPERIMENT 10

Objective: Write a MATLAB program to find factorial of number

Apparatus Required:

A PC installed with MATLAB software.

Theory:

In mathematics, the **factorial** of a non-negative integer n, denoted by n!, is the product of all positive integers less than or equal to n. For example, The value of 0! is 1, according to the convention for an empty product.

Procedure:

Open MATLAB in your PC.
Open a new script.
Write the code as mentioned in the next heading in the script.
Save the script.
Run the script.
Desired result will be displayed on the command window.

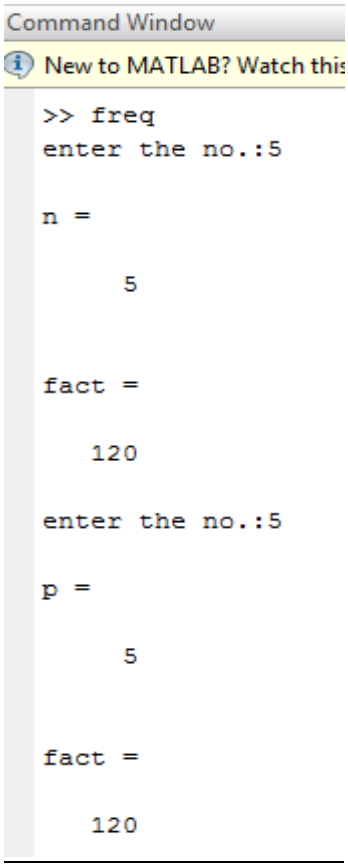
Code:

```
clc
clear all
close all
n=input('enter the no.:')
fact=1;
while n>=1
fact = fact* n;
   n=n-1;
end
fact


clc
clear all
close all
p=input('enter the no.:')
```

```
fact=1;
for i=1:1:p
fact = fact*i;
end
fact
```

Expected Outcome:



Assignments:

2. Solve factorial program using direct command.
3. Solve any mathematical sequence which has not fixed pattern.

Conclusion:

In this experiment, the motive was to understand how to solve factorial in MATLAB

At the end students are given the assignments to learn more about how to solve the differential equations with different conditions

EXPERIMENT 11

Objective: Write a MATLAB Program to compute the sum of all powers of 2 below 50 using While statement.

Apparatus Required:

A PC installed with MATLAB software.

Theory:

In mathematics, the **power** of any no simply means the multiplication of that number equal to the power times. To find the power of any number we can use ^ symbol in MATLAB.

Procedure:

Open MATLAB in your PC.
Open a new script.
Write the code as mentioned in the next heading in the script.
Save the script.
Run the script.
Desired result will be displayed on the command window.

Code:

```
clc
clear all
close all
x=2;
a=0;
sum=0
while a<50
y=x^a
sum=sum + y
a=a+1
end
sum
```

Expected Outcome:

```
sum = 1.1259e+015
```

Assignments:

1. Write a program to find sum of all even powers of 2 below 50.
2. Write a program to find sum of all odd powers of 2 below 50.

Conclusion:

In this experiment, the motive was to understand how variables are defined and values are assigned to these variables in MATLAB.

At the end students are given the assignments to learn more about iteration of loops in MATLAB

EXPERIMENT 12

Objective: Write a MATLAB Program to solve the equations:-

-6*x-2*y+2*z=15
-3*x+4*y-3*z=13
2*x+4*y-7*z=-9

Apparatus Required:

A PC installed with MATLAB software.

Theory:

We can use Y = inv(X) statement and coefficients of given equations to solve them.

Y = inv(X) returns the inverse of the square matrix X. A warning message is printed if X is badly scaled or nearly singular.

Procedure:

Open MATLAB in your PC.
Open a new script.
Write the code as mentioned in the next heading in the script.
Save the script.
Run the script.
Desired result will be displayed on the command window.

Code:

```
clc
clear all
close all
a=[15;13;-9]
b=[-6 -2 2;-3 4 -3; 2 4 -7]
 b1=inv (b)

 b2=b1*a;
 disp(['The values of x y z are ',num2str(b2')])
```

2ND METHOD

```
a= [15;13;-9]
```

```
b= [-6 -2 2;-3 4 -3; 2 4 -7]
[x y z]= solve ('-6*x-2*y+2*z=15','-3*x+4*y-3*z=13','2*x+4*y-7*z=-9')
```

Expected Outcome:

```
a = 15

13

-9

b =    -6    -2     2

-3     4    -3

2     4    -7

b1 =-0.1455   -0.0545   -0.0182

-0.2455    0.3455   -0.2182

  -0.1818    0.1818   -0.2727

The values of x y z are -2.7273      2.7727      2.0909
```

Output of 2nd method

```
a = 15

13

-9

b =-6    -2     2

-3     4    -3

2     4    -7

x =-30/11

y =61/22

z =23/11
```

Assignments:

1. Write a program to define and solve 4 variable equations.
2. Write a program to solve other equations by both the methods and compare the results.

Conclusion:

In this experiment, the motive was to learn and understand the different commands that can be used to solve complex equations in MATLAB.

At the end students are given the assignments to learn more about used commands in MATLAB.

EXPERIMENT 13

Objective: Write a MATLAB program to display the Fibonacci series up to a particular number.

Apparatus Required:

A PC installed with MATLAB software.

Theory:

The Fibonacci series starts with the numbers 0 and 1, the succeeding terms are sum of its two immediate predecessors.

We will use a equation that will calculate the sum of previous two numbers and then iterate a loop to print the required no of terms.

Procedure:

Open MATLAB in your PC.
Open a new script.
Write the code as mentioned in the next heading in the script.
Save the script.
Run the script.
Desired result will be displayed on the command window.

Code:

```
clc
clear all
close all
a=0;
b=1;
d=input('enter number of terms : ');
f=d-2;
fprintf('The fibonacci series is : \n%d\n',a)
fprintf('%d\n',b)
for x=1:f
c=a+b;
fprintf('%d\n',c)
a=b;
b=c;
```

```
end
```

Expected Outcome:

enter number of terms : 10

The fibonacci series is : 0 1 1 2 3 5 8 13 21 34

Assignments:

1. Write a program to print Fibonacci series using while loop.
2. Write a program to print Fibonacci series for some other no of terms .

Conclusion:

In this program the motive was to learn the concept of Fibonacci series and then use for loop along with some logical equations to print the required no of terms in the series.

EXPERIMENT 14

Objective: Write a MATLAB program for the calculation of following:-

1 – 1/2 +1/3 -1/4 +1/5…….n terms

Apparatus Required:

A PC installed with MATLAB software.

Theory:

We have to find the sum of series in which the sign of alternate terms are opposite and the total no of terms are to be entered by the user.

Procedure:

Open MATLAB in your PC.
Open a new script.
Write the code as mentioned in the next heading in the script.
Save the script.
Run the script.
Desired result will be displayed on the command window.

Code:

```
clc
clear all
close all
sum =0;
n=input ('number of terms: ')
for x=1:n
   sum =sum+ (-1)^(x+1)*(1/x);
end
fprintf('sum= %d', sum)
```

Expected Outcome:

number of terms : 3
sum =8.333333e-001

Assignments:

1. Evaluate the expression 1-1/1! +2/2! -3/3!.....upto n terms.
2. Write a Matlab program to calculate the above two series using while loop.

Conclusion:

In this experiment, the motive was to understand how to implement different logic to perform different tasks and how to use **for** loop in MATLAB

EXPERIMENT 15

Objective: Write a MATLAB program to generalize the following:-

Sum(n)= 1+ 1/2^2 + 1/3^2 +1/4^2+…… n terms

Apparatus Required:

A PC installed with MATLAB software.

Theory:

In mathematics, the **power** of any no simply means the multiplication of that number equal to the power times. To find the sum of any series we can simply calculate terms one by one and then add all these terms to find the sum of complete series.

Procedure:

Open MATLAB in your PC.
Open a new script.
Write the code as mentioned in the next heading in the script.
Save the script.
Run the script.
Desired result will be displayed on the command window.

Code:

```
clc
clear all
close all
sum=0;
n=input('Enter number of terms:')
for x=1:n
   sum=sum+ (1/x^2);
end
fprintf('The sum is = %f', sum)
```

Expected Outcome:

Enter number of terms: 5
n = 5
The sum is = 1.463611

Assignments:

1. Write a program to find the sum of same series as given above but with alternate signs.
2. Write a program to find the sum of same series as given above but using while loop.

Conclusion:

In this experiment, the motive was to understand how to find power of numbers and how to find the sum of complete series in MATLAB

At the end students are given the assignments to learn more about how to calculate different series with different patterns.

EXPERIMENT 16

Objective: The area A of a triangle with sides of length a, b and c is given by $A = \sqrt{s(s-a)(s-b)(s-c)}$, where s=(a+b+c)/2. Write a MATLAB function that will accept the values a, b and c as inputs and return the values of A as outputs.

Apparatus Required:

A PC installed with MATLAB software.

Theory:

The area of the triangle having sides a, b and c can be calculated by Heron's formula given by the following expression:

$$A = \sqrt{s(s-a)(s-b)(s-c)},$$

where s=(a+b+c)/2

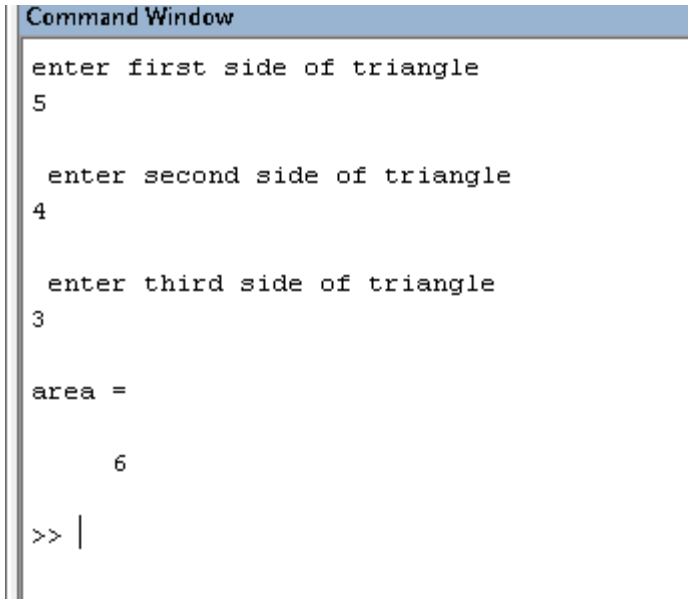
Procedure:

Open MATLAB in your PC.
Open a new script.
Write the code as mentioned in the next heading in the script.
Save the script.
Run the script.
Desired result will be displayed on the command window.

Code:

```
clc
clear all
close all
a = input('enter first side of triangle \n');
b = input('\n enter second side of triangle \n');
c = input('\n enter third side of triangle \n');
s = (a+b+c)/2;
area = sqrt(s*(s-a)*(s-b)*(s-c));
area
```

Expected Outcome:



Assignments:

1. Find the area of rectangle having sides a and b.
2. Find the area of a circle having radius a.

Conclusion:

In this experiment, the motive was to understand how variables are defined and values are assigned to these variables in MATLAB.

At the end students are given the assignments to learn more about the inputs and outputs in MATLAB

EXPERIMENT 17

Objective: Write a MATLAB program for a positive number to compute and display the even power of 2 less than or equal to positive number**.**

Apparatus Required:

A PC installed with MATLAB software.

Theory:

Any integer that can be divided exactly by 2 is an **even number**.The last digit is 0, 2, 4, 6 or 8.

Any integer that cannot be divided exactly by 2 is an **odd number**. The last digit is 1, 3, 5, 7 or 9.

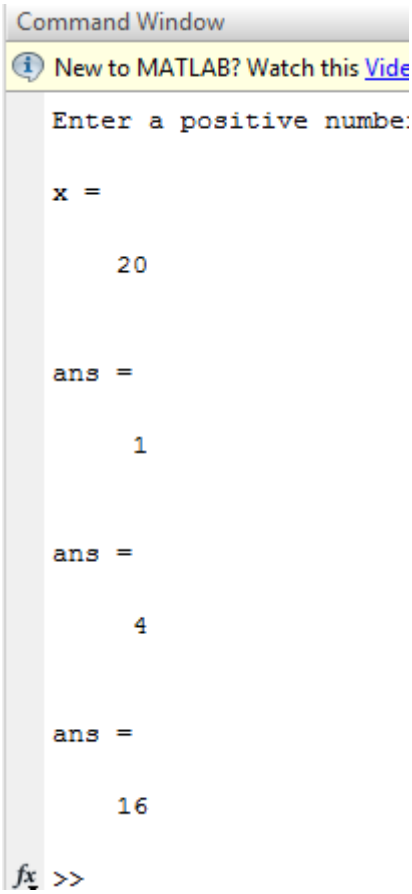
Procedure:

Open MATLAB in your PC.
Open a new script.
Write the code as mentioned in the next heading in the script.
Save the script.
Run the script.
Desired result will be displayed on the command window.

Code:

```
clc
clear all
close all
x = input('Enter a positive number ')
n=0;
while 2^n<=x
   2^n
   n=n+2;
end
```

Expected Outcome:



Assignments:

4. Write a program to compute and display the even powers of 3 and 5.
5. Write a program to compute and display the odd powers of 3 and 5.

Conclusion:

In this experiment, the motive was to understand how even and odd powers can be calculated in MATLAB.

At the end students are given the assignments to learn more about the calculations of power in MATLAB.

EXPERIMENT 18

Objective: Use command plot3(x,y,z) to plot a circular helix.

Apparatus Required:

A PC installed with MATLAB software.

Theory:

Helix is a type of smooth space curve, i.e. a curve in three-dimensional space. It has the property that the tangent line at any point makes a constant angle with a fixed line called the axis. Examples of helices are coil springs and the handrails of spiral staircases. A "filled-in" helix – for example, a "spiral" (helical) ramp – is called a helicoid. Helices are important in biology, as the DNA molecule is formed as two intertwined helices, and many proteins have helical substructures, known as alpha helices.

Types:

A **double helix** consists of two (typically congruent) helices with the same axis, differing by a translation along the axis.

A **conic helix** may be defined as a spiral on a conic surface, with the distance to the apex an exponential function of the angle indicating direction from the axis. An example is the Corkscrew roller coaster at Cedar Point amusement park.

A **circular helix**, (i.e. one with constant radius) has constant band curvature and constant torsion.

A curve is called a **general helix** or **cylindrical helix** if its tangent makes a constant angle with a fixed line in space. A curve is a general helix if and only if the ratio of curvature to torsion is constant.

A curve is called a **slant helix** if its principal normal makes a constant angle with a fixed line in space. It can be constructed by applying a transformation to the moving frame of a general helix.

plot3(X1, Y1, Z1,...), where X1, Y1, Z1 are vectors or matrices, plots one or more lines in three-dimensional space through the points whose coordinates are the elements of X1, Y1, and Z1. The values in X1, Y1, and Z1 can be numeric, date time, duration, or categorical values.

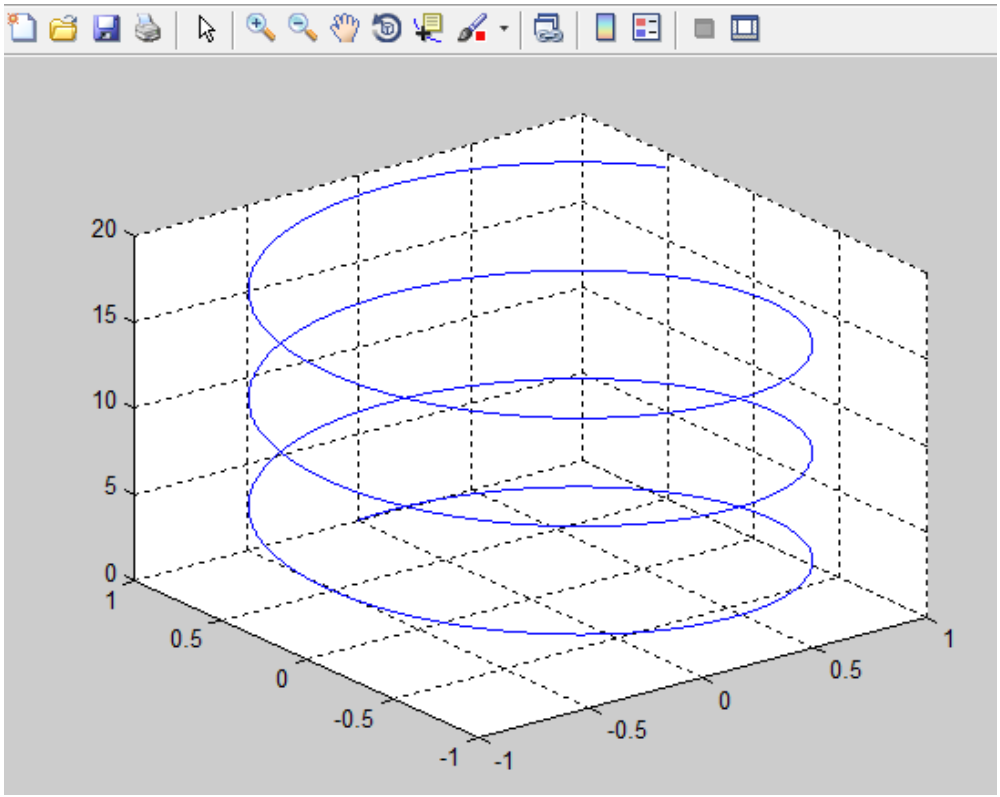
Procedure:

Open MATLAB in your PC.
Open a new script.
Write the code as mentioned in the next heading in the script.
Save the script.
Run the script.
Desired result will be displayed on the command window.

Code:

```
clc
clear all
close all
t=0:0.0002:20;
x=sin(t);
y=cos(t);
plot3(x,y,t)
grid on;
```

Expected Outcome:



Assignments:

1. Define t as values between 0 and 10π. Define s_t and c_t as vectors of sine and cosine values. Plot a 3-D helix.
2. Draw a conical helix by using command plot3.

Conclusion:

In this experiment, the motive was to understand how 3D plots are plotted in MATLAB

At the end students are given the assignments to learn more about 3D plots

EXPERIMENT 19

Objective: Plot the surface defined by the function using MATLAB

$$f(x,y) = (x-3)^2 + (y-2)^2 \; for \; 2 < x < 4 \; and \; 1 < y < 3$$

Apparatus Required:

A PC installed with MATLAB software.

Theory:

[X,Y] = meshgrid(x,y) returns 2-D grid coordinates based on the coordinates contained in vectors x and y. X is a matrix where each row is a copy of x, and Y is a matrix where each column is a copy of y. The grid represented by the coordinates X and Y has length(y) rows and length(x) columns.

[X,Y] = meshgrid(x) is the same as [X,Y] = meshgrid(x,x), returning square grid coordinates with grid size length(x)-by-length(x).

[X,Y,Z] = meshgrid(x,y,z) returns 3-D grid coordinates defined by the vectors x, y, and z. The grid represented by X, Y, and Z has size length(y)-by-length(x)-by-length(z).

[X,Y,Z] = meshgrid(x) is the same as [X,Y,Z] = meshgrid(x,x,x), returning 3-D grid coordinates with grid size length(x)-by-length(x)-by-length(x).

Procedure:

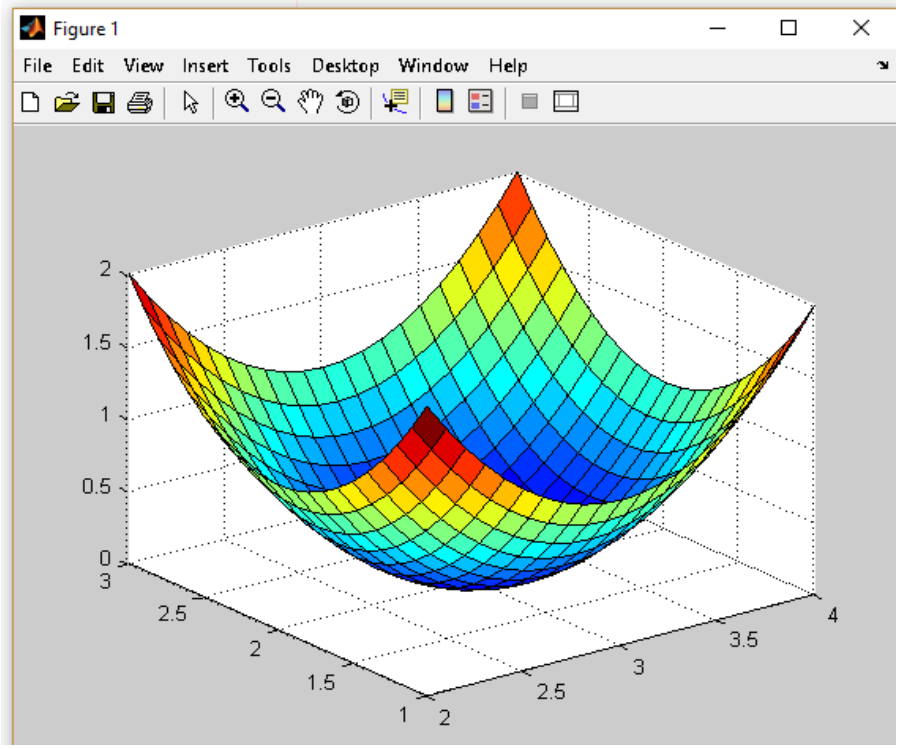
Open MATLAB in your PC.
Open a new script.
Write the code as mentioned in the next heading in the script.
Save the script.
Run the script.
Desired result will be displayed on the command window.

Code:

```
clc
clear all
close all
```

```
[x,y] = meshgrid(2:.1:4,1:.1:3)
f = (x-3).^2 + (y-2).^2;
surf(x,y,f);
```

Expected Outcome:



Assignments:

1. Evaluate the expression $x^2 + y^2$over the 2-D grid.
2. Create 3-D grid coordinates from x-, y-, and z-coordinates defined in the interval [0,6], and evaluate the expression$x^2 + y^2 + z^2$

Conclusion:

In this experiment, the motive was to understand how to plot 2D and 3D grids

At the end students are given the assignments to learn more about plotting of grids in MATLAB

EXPERIMENT 20

Objective: Find the solution of first order ODE.

Dy = 2x + 5sin(x) , x(0)=1

Apparatus Required:

A PC installed with MATLAB software.

Theory:

Differential equations are equations that relate a function with one or more of its derivatives.

Command 'dsolve(eqn)'in MATLAB solves the differential equation eqn, where eqn is a symbolic equation. Use diff and == to represent differential equations. For example, diff(y,x) == y represents the equation dy/dx=y. Solve a system of differential equations by specifying eqn as a vector of those equations.

'dsolve(eqn,cond)' solves eqn with the initial or boundary condition cond.

'dsolve(eqn,cond,Name,Value)' uses additional options specified by one or more Name,Value pair arguments.

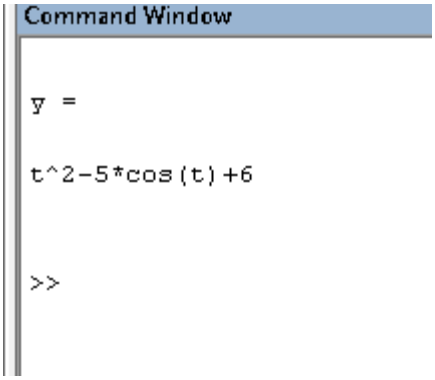
Procedure:

Open MATLAB in your PC.
Open a new script.
Write the code as mentioned in the next heading in the script.
Save the script.
Run the script.
Desired result will be displayed on the command window.

Code:

```
clc
clear all
close all
y = dsolve('Dy-2*t-5*sin(t)','y(0)=1')
```

Expected Outcome:



Assignments:

1. Solve $\frac{dy}{dt} = ay$ and $\frac{d^2y}{dt^2} = ay$
2. Solve $\frac{d^2y}{dt^2} = a^2y$ with initial conditions y(0)=b and y′(0)=1.

Conclusion:

In this experiment, the motive was to understand how to solve differential equations in MATLAB

At the end students are given the assignments to learn more about how to solve the differential equations with different conditions

EXPERIMENT 21

Objective: To Plot $r^2 = 2\sin 5t$, for $0 \leq x \leq 2\pi$ using polar command in matlab.

Apparatus Required:

A PC installed with MATLAB software.

Theory:

The polar function accepts polar coordinates, plots them in a Cartesian plane, and draws the polar grid on the plane.

polar (theta,rho) creates a polar coordinate plot of the angle theta versus the radius rho. theta is the angle from the *x*-axis to the radius vector specified in radians; rho is the length of the radius vector specified in dataspace units.

polar (theta,rho,LineSpec)LineSpec specifies the line type, plot symbol, and color for the lines drawn in the polar plot.

polar (axes_handle,...) plots into the axes with the handle axes_handle instead of into the current axes (gca).

h = polar (...) returns the line object in h.

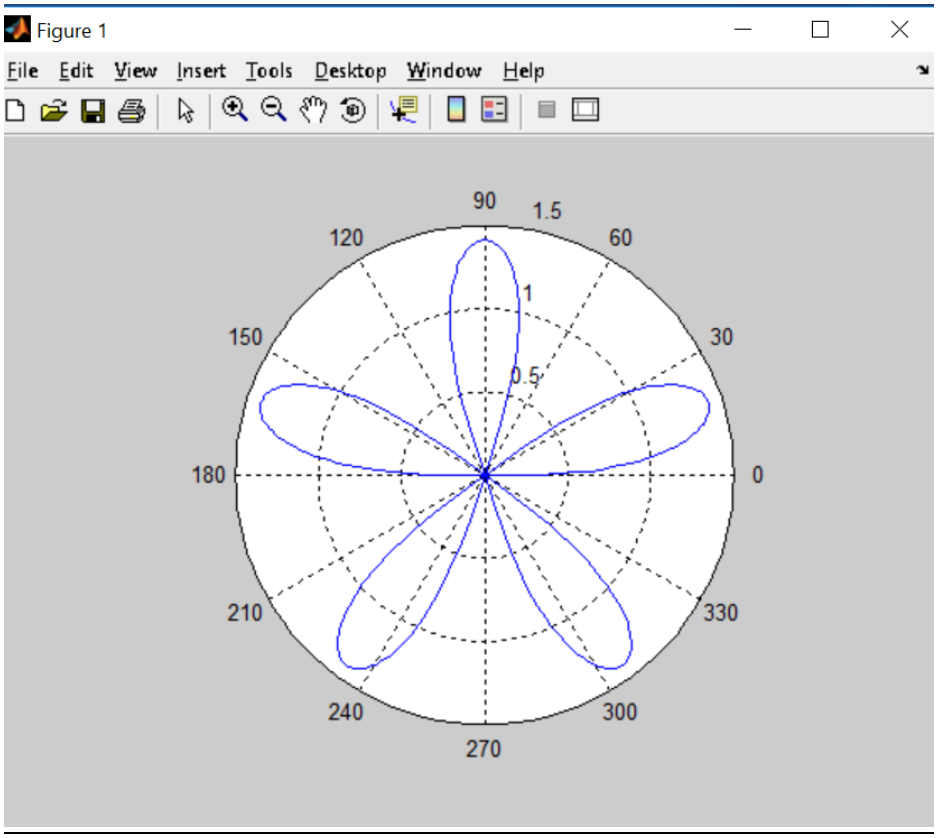
Procedure:

Open MATLAB in your PC.
Open a new script.
Write the code as mentioned in the next heading in the script.
Save the script.
Run the script.
Desired result will be displayed on the command window.

Code:

```
t=0:0.01:2*pi;
polar(t,sqrt(2*sin(5*t)))
% polar() is used to draw a curve in polar coordinates .
```

Expected Outcome:



Assignments:

1. Find r using polar command.
2. Find lobes at various angles.

Conclusion:

In this experiment, the motive was to understand how this polar() command is used to draw a curve in polar coordinates.
At the end students are given the assignments to learn more about the inputs and outputs in MATLAB.

EXPERIMENT 22

Objective:

Write a MATLAB program to compute and plot z= $\frac{5}{1+x^2+y^2}$, for |x|≤ 3, |y|≤3 using contour3 command in Matlab.

Apparatus Required:

A PC installed with MATLAB software.

Theory:

A contour plot displays isoclines of matrix Z. Label the contour lines using clabel.

contour(Z) draws a contour plot of matrix Z, where Z is interpreted as heights with respect to the *x*-*y* plane. Z must be at least a 2-by-2 matrix that contains at least two different values. The *x* values correspond to the column indices of Z and the *y* values correspond to the row indices of Z. The contour levels are chosen automatically.

contour(Z,n) draws a contour plot of matrix Z with n contour levels where n is a scalar. The contour levels are chosen automatically.

contour(Z,v) draws a contour plot of matrix Z with contour lines at the data values specified in the monotonically increasing vector v. To display a single contour line at a particular value, define v as a two-element vector with both elements equal to the desired contour level. For example, to draw contour lines at level k, use contour(Z,[k k]). Specifying the vector v sets the LevelListMode property to manual.

Procedure:

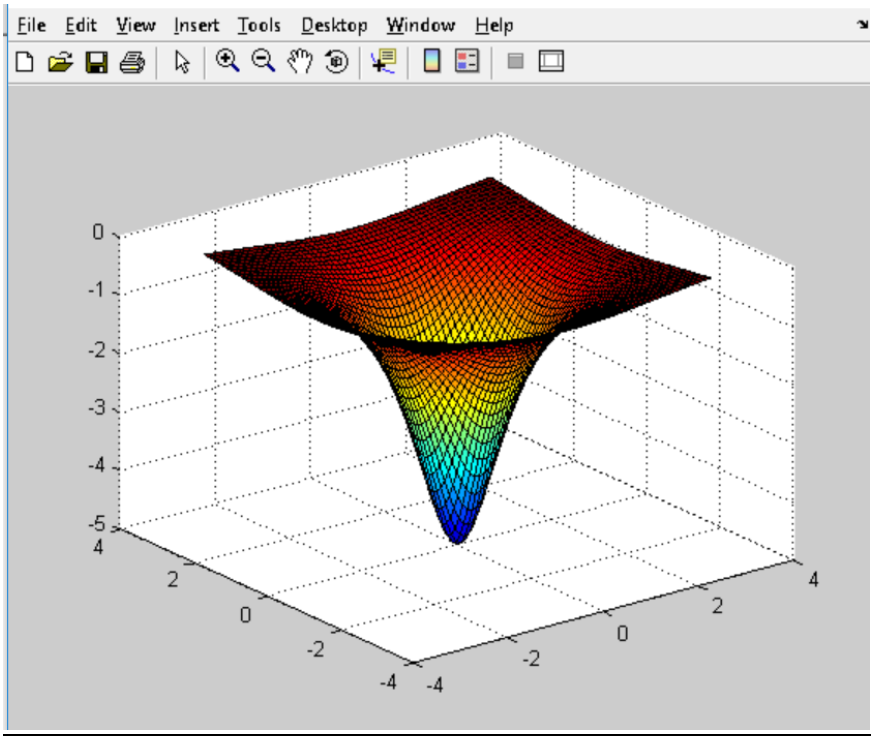
Open MATLAB in your PC.
Open a new script.
Write the code as mentioned in the next heading in the script.
Save the script.
Run the script.
Desired result will be displayed on the command window.

Code:

```
[x,y]=meshgrid([-3:.1:3]);
z=-5./(1+x.^2+y.^2);
contour3(x,y,z);                    %to find the contours of the curve
```

surf(x,y,z) %to draw the surface of the function

Expected Outcome:



Assignments:

1. Write a program to compute z for $|x| \leq 3$ using contour3.
2. Write a program to compute z for $|y| \leq 3$ and display it using contour3.

Conclusion:

In this experiment, the motive was to understand how z value can be calculated using x and y in MATLAB.

At the end students are given the assignments to learn more about the calculations of power in MATLAB.

EXPERIMENT 23

Objective: Compute the following integral $\iint_0^2 (1 - 6x^2 y) dxdy$; using -1<y<1 in matlab.

Apparatus Required:

A PC installed with MATLAB software.

Theory:

q = dblquad (fun,xmin,xmax,ymin,ymax) calls the quad function to evaluate the double integral fun(x,y) over the rectangle xmin<= x <= xmax, ymin<= y <= ymax. The input argument, fun, is a function handle that accepts a vector x, a scalar y, and returns a vector of integrand values.

q = dblquad(fun,xmin,xmax,ymin,ymax,tol) uses a tolerance tol instead of the default, which is 1.0e-6.

q = dblquad(fun,xmin,xmax,ymin,ymax,tol,method) uses the quadrature function specified as method, instead of the default quad. Valid values for method are @quadl or the function handle of a user-defined quadrature method that has the same calling sequence as quad and quadl.

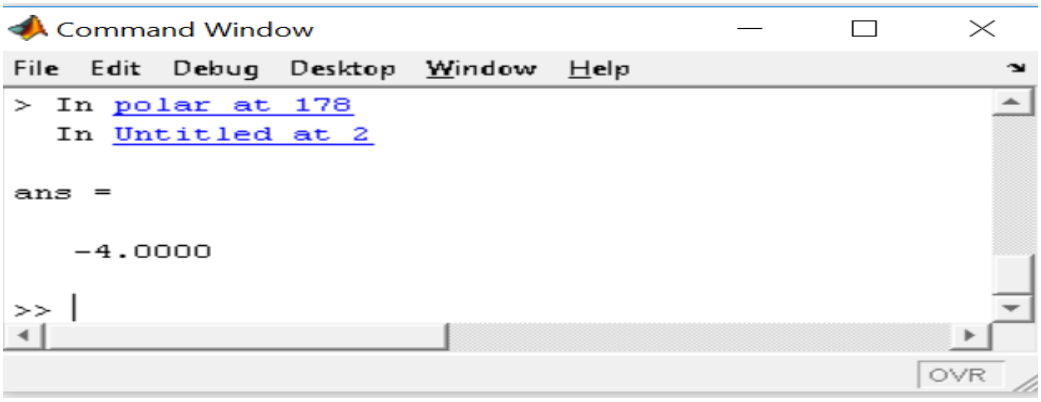
Procedure:

Open MATLAB in your PC.
Open a new script.
Write the code as mentioned in the next heading in the script.
Save the script.
Run the script.
Desired result will be displayed on the command window.

Code:

```
dblquad(@(x,y)1-6*x.*x.*y, 2, 0, -1, 1)     %dblquad computes the value of double integral functions
```

Expected Outcome:



Assignments:

1. dblquad computes the value of double integral functions

Conclusion:

In this experiment, the motive was to computes the value of double integral dblquad in MATLAB

At the end students are given the assignments to learn more about 3D plots

EXPERIMENT 24

Objective: Compute the first order differential equation $\frac{dy}{dx} = x + t$ with initial condition x(0)=0.

Apparatus Required:

A PC installed with MATLAB software.

Theory:

S= dsolve(eqn) solves the differential equation eqn, where eqn is a symbolic equation. Use diff and == to represent differential equations. For example, diff(y,x) == y represents the equation dy/dx=y. Solve a system of differential equations by specifying eqn as a vector of those equations.
S = dsolve(eqn,cond) solves eqn with the initial or boundary condition cond.
S = dsolve(eqn,cond,Name,Value) uses additional options specified by one or more Name,Value pair arguments.
example
[y1,...,yN] = dsolve(___) assigns the solutions to the variables y1,...,yN.

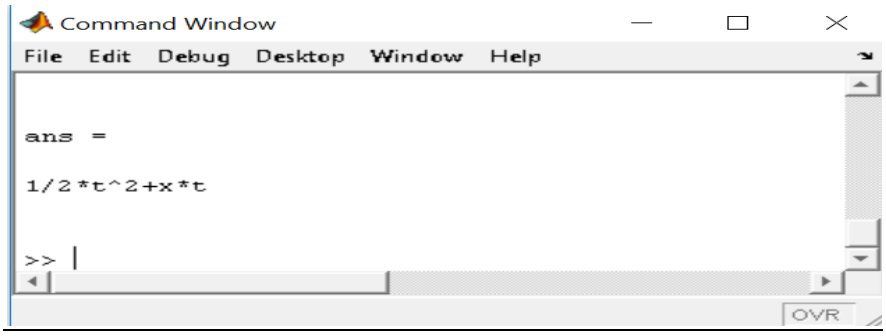
Procedure:

Open MATLAB in your PC.
Open a new script.
Write the code as mentioned in the next heading in the script.
Save the script.
Run the script.
Desired result will be displayed on the command window.

Code:

```
dsolve ('Dy = x + t', 'y(0)=0' )
```

Expected Outcome:



Assignments:

1. Evaluate the first order differential equation $\frac{dy}{dx} = x + t$.
2. Evaluate the expression $x^2 + y^2 + z^2$ using dsolve command.

Conclusion:

In this experiment, the motive was to solve the first order differential equation.

At the end students are given the assignments to learn more about plotting of grids in MATLAB

EXPERIMENT 25

Objective: Compute the following transcendental equation using Matlab:

sinx = e^x – 5 here initial value x(0) = 1**.**

Apparatus Required:

A PC installed with MATLAB software.

Theory:

S = solve(eqn,var) solves the equation eqn for the variable var. If you do not specify var, the symvar function determines the variable to solve for. For example, solve(x + 1 == 2, x) solves the equation $x + 1 = 2$ for x.
S = solve(eqn,var,Name,Value) uses additional options specified by one or more Name,Value pair arguments.
Y = solve(eqns,vars) solves the system of equations eqns for the variables vars and returns a structure that contains the solutions. If you do not specify vars, solve uses symvar to find the variables to solve for. In this case, the number of variables that symvar finds is equal to the number of equations eqns.
Y= solve(eqns,vars,Name,Value) uses additional options specified by one or more Name,Value pair arguments

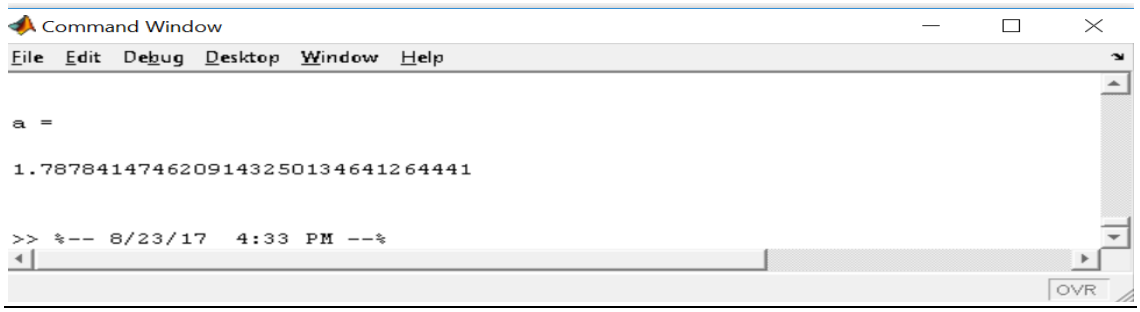
Procedure:

Open MATLAB in your PC.
Open a new script.
Write the code as mentioned in the next heading in the script.
Save the script.
Run the script.
Desired result will be displayed on the command window.

Code:

```
a = solve('sin(x)-exp(x)+5')
%solve() is used to solve equations.
```

Expected Outcome:



Assignments:

1. Solve sinx = e^x – 5 here initial value x(0) = 1

Conclusion:

In this experiment, the motive was to understand how to solve transcendental equation in MATLAB

At the end students are given the assignments to learn more about how to solve the transcendental equation with different conditions.

EXPERIMENT 26

Objective: To find the convolution of 1/ (1+t^2) with itself.

Apparatus Required:

A PC installed with MATLAB software.

Theory:

Convolution is the relationship between a system's input signal, output signal, and impulse response. Convolution is a mathematical way of combining two signals to form a third signal. It is the single most important technique in Digital Signal Processing. Using the strategy of impulse decomposition, systems are described by a signal called the impulse response.

Convolution is similar to cross-correlation. For discrete real valued signals, they differ only in a time reversal in one of the signals. For continuous signals, the cross-correlation operator is the ad joint operator of the convolution operator.

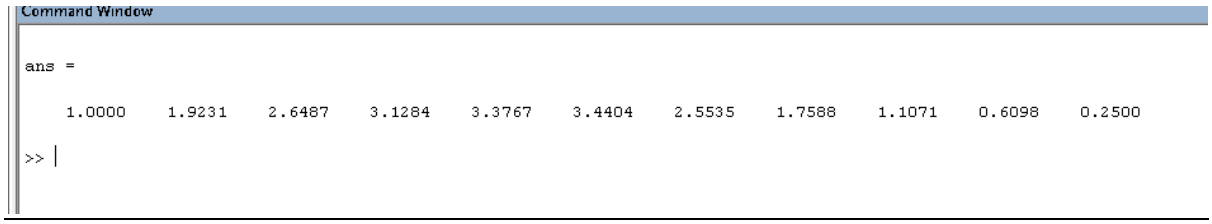
Procedure:

Open MATLAB in your PC.
Open a new script.
Write the code as mentioned in the next heading in the script.
Save the script.
Run the script.
Desired result will be displayed on the command window.

Code:

```
clc
t= 0:0.2:1;
u=1./(1+t.^2);
conv(u,u)
```

Expected Outcome:



Assignment:

1. Calculate 1/(1+t^2) with itself

Conclusion:

In this experiment, the motive was to introduce Convolution in MATLAB.

At the end, student should try to learn as much as they can from this experiment and should try different Convolution problems in MATLAB.

EXPERIMENT 27

Objective: To compute cross correlation between two sequences (1 2 -1 3) (3 -2 1 4).

Apparatus Required:

A PC installed with MATLAB software.

Theory:

Cross-correlation is a measure of similarity of two series as a function of the displacement of one relative to the other. 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 tomography, averaging, cryptanalysis, and neurophysiology.

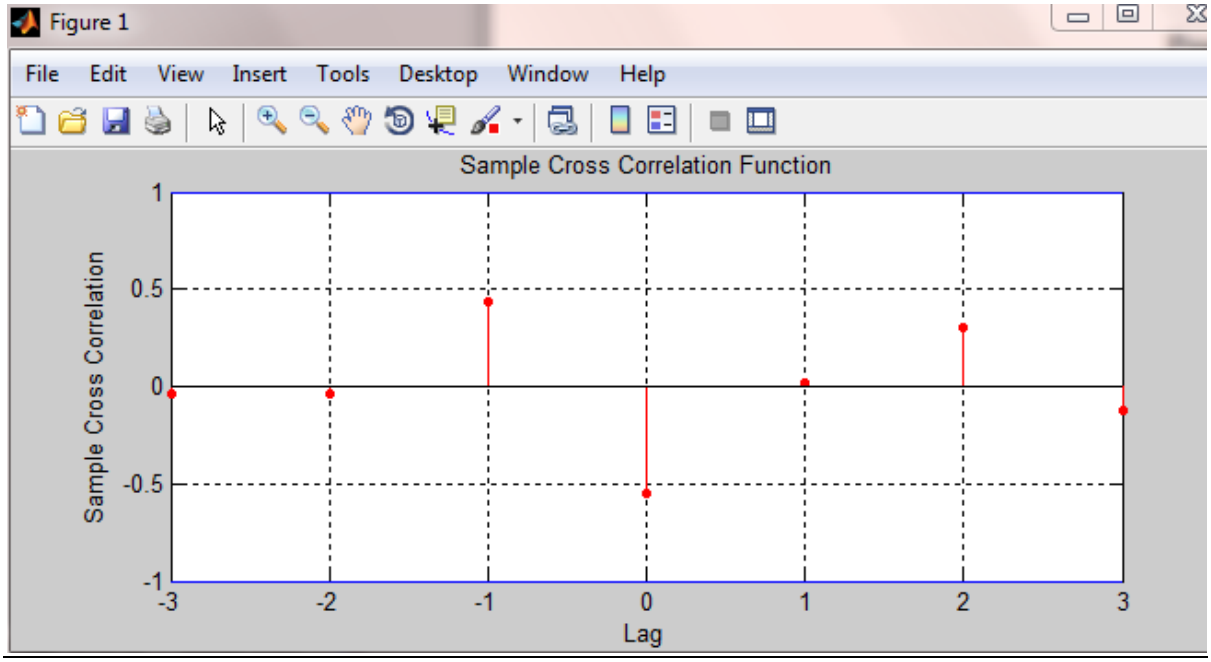
Procedure:

Open MATLAB in your PC.
Open a new script.
Write the code as mentioned in the next heading in the script.
Save the script.
Run the script.
Desired result will be displayed on the command window.

Code:

```
clc
clear all
close all
crosscorr([1 2 -1 3],[3 -2 1 4])
```

Expected Outcome:



Assignments:

1 Find the cross correlation between two sequences (1 2 -1 3) (3 -2 1 4).
2 Find the cross correlation between two sequences (3 5 -8) (4 -7 5)

Conclusion:

In this experiment, the motive was to understand the Cross correlation in MATLAB.

At the end students are given the assignments to learn more about the Cross correlation problems in MATLAB.

EXPERIMENT 28

Objective: Write a MATLAB program to decompose x (n) into odd and even components where x=(1 2 -1 3) = u(n)-u(n-10)

Apparatus Required:

A PC installed with MATLAB software.

Theory:

Even and odd signals bear some important symmetry properties. Under reversal of independent variable, these signals either remain the same (even signal) or get reflected or flipped (odd signal) about the horizontal axis. Equations or definitions (1) and (2) mathematically express these properties for both continuous and discrete time cases.

Even Signals: $x(t) = x(-t)$, $x[n] = x[-n]$ (1)

Odd Signals: $x(t) = -x(-t)$, $x[n] = -x[-n]$ (2)

The even part and odd part of a signal can be determined by the given formula:

E{u(n)} = [u(n) + u(-n)]/2 and O{u(n)} = [u(n) - u(-n)]/2.

Procedure:

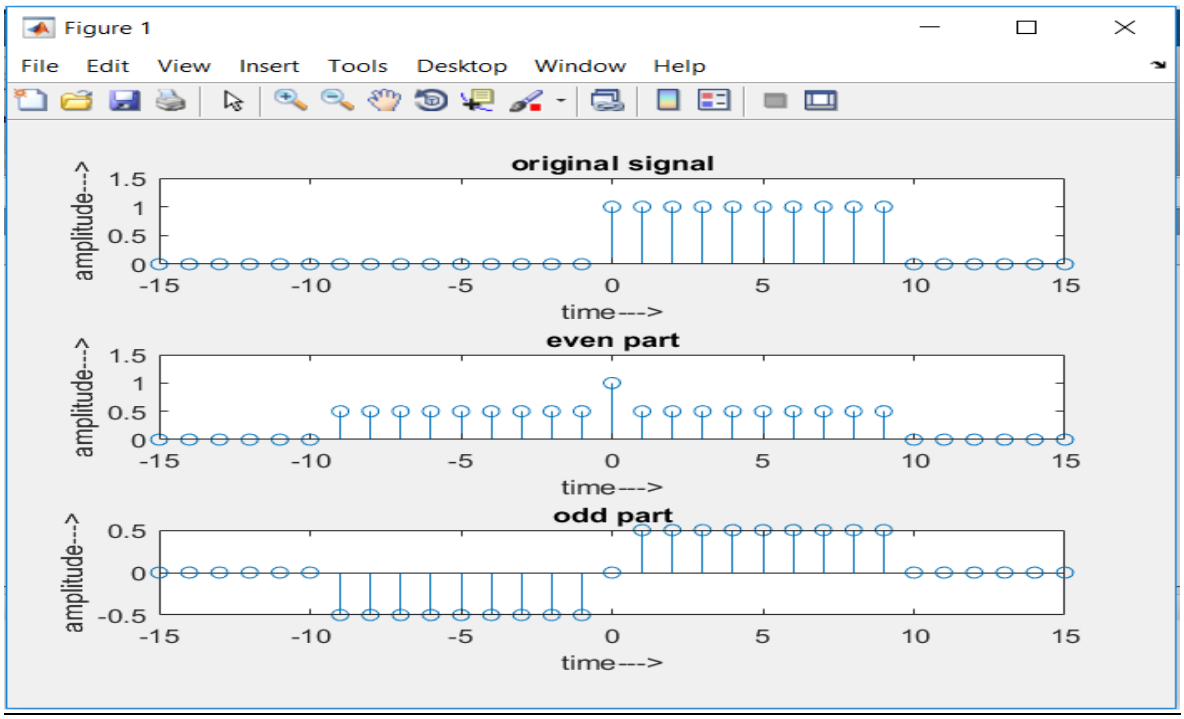
Open MATLAB in your PC.
Open a new script.
Write the code as mentioned in the next heading in the script.
Save the script.
Run the script.
Desired result will be displayed on the command window.

Code:

```
n=-10:15;
x=[zeros(1,10) ones(1,10) zeros(1,6)];
m=-fliplr(n);
m1=min([m,n]);
m2=max([m,n]);
m=m1:m2;
nm=n(1)-m(1);
n1=1:length(n);
x1=zeros(1,length(m));
x1(n1+nm)=x;
x=x1;
```

```
xe=0.5*(x+fliplr(x));
xo=0.5*(x-fliplr(x));
figure
t=-15:15;
subplot(3,1,1);
stem(t,x)
axis([-15 15 0 1.5]);
title('original signal');
xlabel('time--->');
ylabel('amplitude--->');
subplot(3,1,2);
stem(t,xe)
axis([-15 15 0 1.5]);
title('even part');
xlabel('time--->');
ylabel('amplitude--->');
subplot(3,1,3);
stem(t,xo)
axis([-15 15 -0.5 0.5]);
title('odd part');
xlabel('time--->');
ylabel('amplitude--->');
```

Expected Outcome:



Assignments:

Break a signal x(n) into even and odd parts

Conclusion:

Here the MATLAB tool is used to break a signal or function in even and odd parts. At the end, student should try to learn as much as they can from this experiment and should divide different functions or signals into even and odd parts and observe the difference.

EXPERIMENT 29

Objective: To form samples of x(t) at fs=500 samples/sec to obtain x(n)

Apparatus Required:

A PC installed with MATLAB software.

Theory:

A sample is a value or set of values at a point in time and/or space.Sampling can be done for functions varying in space, time, or any other dimension, and similar results are obtained in two or more dimensions.

Sampling period : For functions that vary with time, let s(t) be a continuous function (or "signal") to be sampled, and let sampling be performed by measuring the value of the continuous function every T seconds, which is called the sampling interval or the sampling period.

Sampling frequency: The sampling frequency or sampling rate, f_s, is the average number of samples obtained in one second (samples per second), thus $f_s = 1/T$.

Procedure:

Open MATLAB in your PC.
Open a new script.
Write the code as mentioned in the next heading in the script.
Save the script.
Run the script.
Desired result will be displayed on the command window.

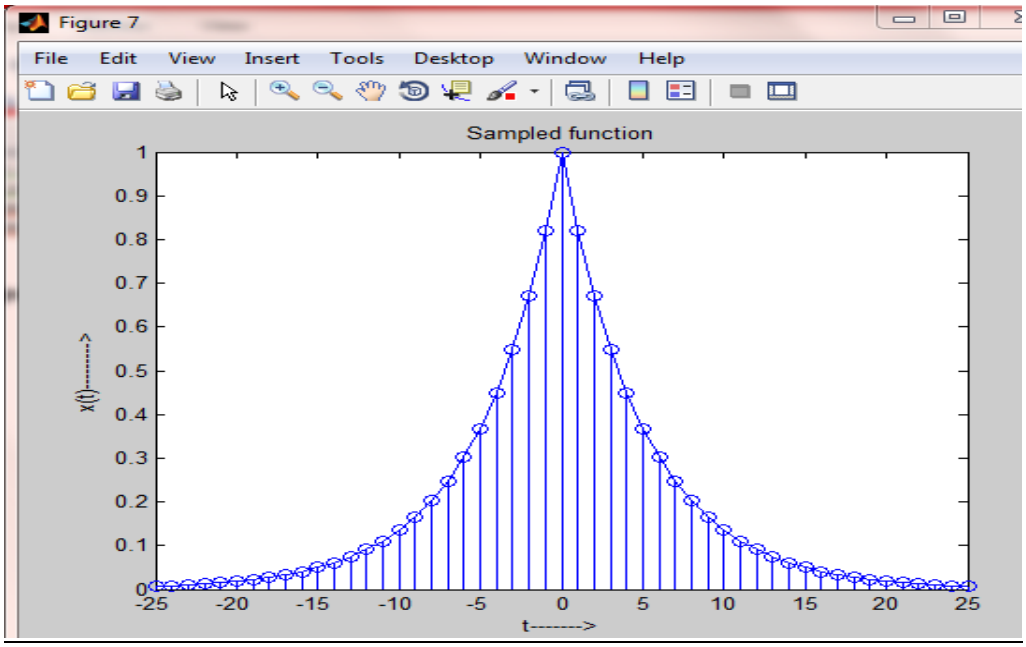
Code:

```
ts=0.0002;

n=-25:1:25;
nts=n*ts;
x=exp(-1000*abs(nts));
dt=0.0002;
t=-0.005:dt:0.005;
fs=5000;
xt=x*sinc(fs*(ones(length(n),1)*t-nts'*ones(1,length(t))));
figure;
stem(n,x);
```

```
holdon;
plot(-25:25,xt);
title('Sampled function');
ylabel('x(t)--------->');
xlabel('t------->');
```

Expected Outcome:



Assignments:

Form samples of x(t) at fs=500 samples/sec to obtain x(n)

Conclusion:

In this experiment, the motive was to form samples using MATLAB.

At the end, student should try to learn as much as they can from this experiment.

EXPERIMENT 30

Objective: Determine the laplace transformation of following function

a) t*exp(-at)
b) sin(at) + cos(bt)

Apparatus Required:

A PC installed with MATLAB software.

Theory:

Laplace transform is an integral transform named after its discoverer Pierre-Simon Laplace. It takes a function of a real variable t (often time) to a function of a complex variable s (frequency). The Laplace transform is very similar to the Fourier transform. In mathematics, Laplace's equation is a second-order partial differential equation. This is often written as: where $\Delta = \nabla^2$ is the Laplace operator and is a scalar function.

The inverse Laplace transform takes a function of a complex variable s (often frequency) and yields a function of a real variable t (time)..

Procedure:

Open MATLAB in your PC.
Open a new script.
Write the code as mentioned in the next heading in the script.
Save the script.
Run the script.
Desired result will be displayed on the command window.

Code:

```
clc
symstreal
symsareal
symsbreal
f= t* exp(-a*t)
m = sin(a*t) + cos(b*t)
laplace(f)
laplace(m)
```

Expected Outcome:

```
Command Window

f =

t*exp(-a*t)



m =

sin(a*t)+cos(b*t)



ans =

1/(s+a)^2



ans =

a/(s^2+a^2)+s/(s^2+b^2)


>>
```

Assignments:

The Laplace transformation of following function

a) t*exp(-at)
b) sin(at) + cos(bt)

Conclusion:

In this experiment, the motive was to introduce Laplace Transformation in MATLAB.

At the end, student should try to learn as much as they can from this experiment and should try different Laplace transformation problems in MATLAB.