

# **COMMUTATIONAL MATHEMATICS LABORATORY LAB MANUAL**

**Year** : 2016 - 2017  
**Subject Code** : AHS102  
**Regulations** : R16  
**Class** : I B.Tech II Semester  
**Branch** : AE / ME / CE

**Prepared By**

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**FRESHMAN ENGINEERING**  
**INSTITUTE OF AERONAUTICAL ENGINEERING**  
(Autonomous)  
Dundigal, Hyderabad - 500 043



# INSTITUTE OF AERONAUTICAL ENGINEERING

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<b>Program Outcomes</b>	
PO1	<b>Engineering knowledge:</b> Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2	<b>Problem analysis:</b> Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3	<b>Design/development of solutions:</b> 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.
PO4	<b>Conduct investigations of complex problems:</b> 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	<b>Modern tool usage:</b> 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	<b>The engineer and society:</b> 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.
PO7	<b>Environment and sustainability:</b> Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO8	<b>Ethics:</b> Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9	<b>Individual and team work:</b> Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10	<b>Communication:</b> 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.
PO11	<b>Project management and finance:</b> Demonstrate knowledge and understanding 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.
PO12	<b>Life-long learning:</b> 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.



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## Program Specific Outcomes - Aeronautical Engineering

PSO1	<b>Professional skills:</b> Able to utilize the knowledge of aeronautical/aerospace engineering in innovative, dynamic and challenging environment for design and development of new products
PSO2	<b>Problem solving skills:</b> imparted through simulation language skills and general purpose CAE packages to solve practical, design and analysis problems of components to complete the challenge of airworthiness for flight vehicles
PSO3	<b>Practical implementation and testing skills:</b> Providing different types of in house and training and industry practice to fabricate and test and develop the products with more innovative technologies.
PSO4	<b>Successful career and entrepreneurship:</b> To prepare the students with broad aerospace knowledge to design and develop systems and subsystems of aerospace and allied systems and become technocrats

## Program Specific Outcomes - Computer Science And Engineering

PSO1	<b>Professional Skills:</b> The ability to research, understand and implement computer programs in the areas related to algorithms, system software, multimedia, web design, big data analytics, and networking for efficient analysis and design of computer-based systems of varying complexity.
PSO2	<b>Problem-Solving Skills:</b> The ability to apply standard practices and strategies in software project development using open-ended programming environments to deliver a quality product for business success.
PSO3	<b>Successful Career and Entrepreneurship:</b> The ability to employ modern computer languages, environments, and platforms in creating innovative career paths, to be an entrepreneur, and a zest for higher studies.

## Program Specific Outcomes - Information Technology

PSO1	<b>Professional Skills:</b> The ability to research, understand and implement computer programs in the areas related to algorithms, system software, multimedia, web design, big data analytics, and networking for efficient analysis and design of computer-based systems of varying complexity.
PSO2	<b>Software Engineering practices:</b> The ability to apply standard practices and strategies in software service management using open-ended programming environments with agility to deliver a quality service for business success.
PSO3	<b>Successful Career and Entrepreneurship:</b> The ability to employ modern computer languages, environments, and platforms in creating innovative career paths, to be an entrepreneur, and a zest for higher studies.

## Program Specific Outcomes - Electronics And Communication Engineering

PSO1	<b>Professional Skills:</b> An ability to understand the basic concepts in Electronics & Communication Engineering and to apply them to various areas, like Electronics, Communications, Signal processing, VLSI, Embedded systems etc., in the design and implementation of complex systems.
PSO2	<b>Problem-solving Skills:</b> An ability to solve complex Electronics and communication Engineering problems, using latest hardware and software tools, along with analytical skills to arrive cost effective and appropriate solutions.
PSO3	<b>Successful Career and Entrepreneurship:</b> An understanding of social-awareness & environmental-wisdom along with ethical responsibility to have a successful career and to sustain passion and zeal for real-world applications using optimal resources as an Entrepreneur

### Program Specific Outcomes - Electrical And Electronics Engineering

PSO1	<b>Professional Skills:</b> Able to utilize the knowledge of high voltage engineering in collaboration with power systems in innovative, dynamic and challenging environment, for the research based team work.
PSO2	<b>Problem-Solving Skills:</b> Can explore the scientific theories, ideas, methodologies and the new cutting edge technologies in renewable energy engineering, and use this erudition in their professional development and gain sufficient competence to solve the current and future energy problems universally.
PSO3	<b>Successful Career and Entrepreneurship:</b> The understanding of technologies like PLC, PMC, process controllers, transducers and HMI one can analyze, design electrical and electronics principles to install, test , maintain power system and applications.

### Program Specific Outcomes - Mechanical Engineering

PSO1	To produce engineering professional capable of analyzing and synthesizing mechanical systems including allied engineering streams.
PSO2	An ability to adopt and integrate current technologies in the design and manufacturing domain to enhance the employability.
PSO3	To build the nation, by imparting technological inputs and managerial skills to become technocrats.

### Program Specific Outcomes - Civil Engineering

PSO1	Graduates will have an ability to describe, analyze and solve problems using mathematics and systematic problem-solving techniques.
PSO2	Graduates will have an ability to design a system, component or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety manufacturability and sustainability.
PSO3	Graduates will have a board education necessary to understand the impact of engineering solutions in a global, economic and societal context.
PSO4	To provide graduates many post graduate educational and research opportunities at top universities and research laboratories for its best engineering minds.
PSO5	Graduates will have an ability to function on multi disciplinary teams.



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## *Certificate*

*This is to certify that it is a bonafied record of practical work done by  
Sri/Kum. \_\_\_\_\_ bearing  
the Roll No. \_\_\_\_\_ of \_\_\_\_\_ class  
\_\_\_\_\_ branch in the  
\_\_\_\_\_ laboratory during the academic  
year \_\_\_\_\_ under our supervision.*

**Head of the Department**

**Lecturer In-Charge**

**External Examiner**

**Internal Examiner**

## ATTAINMENT OF PROGRAM OUTCOMES & PROGRAM SPECIFIC OUTCOMES

Expt. No.	Program Outcomes Attained	Program Specific Outcomes Attained		
		AE	ME	CE
I	PO1, PO2, PO3, PO4, PO5, PO9, PO12	PSO1, PSO2	PSO2	PSO3
II	PO1, PO2, PO3, PO4, PO5, PO9, PO12	PSO1, PSO2	PSO2	PSO3
III	PO1, PO2, PO3, PO4, PO5, PO9, PO12	PSO1, PSO2	PSO2	PSO3
IV	PO1, PO2, PO3, PO4, PO5, PO9, PO12	PSO1, PSO2	PSO2	PSO3
V	PO1, PO2, PO3, PO4, PO5, PO9, PO12	PSO1, PSO2	PSO2	PSO3
VI	PO1, PO2, PO3, PO4, PO5, PO9, PO12	PSO1, PSO2	PSO2	PSO3
VII	PO1, PO2, PO3, PO4, PO5, PO9, PO12	PSO1, PSO2	PSO2	PSO3
VIII	PO1, PO2, PO3, PO4, PO5, PO9, PO12	PSO1, PSO2	PSO2	PSO3
IX	PO1, PO2, PO3, PO4, PO5, PO9, PO12	PSO1, PSO2	PSO2	PSO3
X	PO1, PO2, PO3, PO4, PO5, PO9, PO12	PSO1, PSO2	PSO2	PSO3
XI	PO1, PO2, PO3, PO4, PO5, PO9, PO12	PSO1, PSO2	PSO2	PSO3
XII	PO1, PO2, PO3, PO4, PO5, PO9, PO12	PSO1, PSO2	PSO2	PSO3

# COMMUTATIONAL MATHEMATICS LABORATORY SYLLABUS

## Recommended Systems/Software Requirements:

Intel based desktop PC with minimum of 166 MHZ or faster processor with at least 64 MB RAM and 100MB free disk space. MATLAB compiler.

### LIST OF EXPERIMENTS

	LIST OF EXPERIMENTS
<b>Week-1</b>	<b>BASIC FEATURES</b>
	a. To Know the history and features of MATLAB b. To Know the local environment of MATLAB
<b>Week-2</b>	<b>ALGEBRA</b>
	a. Find the roots of the equations $6x^5 - 41x^4 + 97x^3 - 97x^2 + 41x - 6$ b. Find the values of x,y,z of the equations $x+y+z=3, x+2y+3z=4, x+4y+9z=6$ c. For $f(x)=8x^8 - 7x^7 + 12x^6 - 5x^5 + 8x^4 + 13x^3 - 12x + 9$ compute $f(2)$ , roots of $f(x)$ and plot for $0 \leq x \leq 20$
<b>Week-3</b>	<b>CALCULUS</b>
	a. Verification of basic properties of limits for the functions $f(x) = (3x + 5)/(x - 3)$ and $g(x) = x^2 + 1$ as $x$ ends to 4. b. Find the derivative of $(x+2)(x^2+3)$ c. Calculate the area enclosed between the x-axis, and the curve $y=x^3 - 2x+5$ and the ordinates $x = 1$ and $x = 2$ .
<b>Week-4</b>	<b>MATRICES</b>
	a. Find the addition, subtraction and multiplication of matrix $A = \begin{bmatrix} 1 & 2 & -9 \\ 2 & -1 & 2 \\ 3 & -4 & 3 \end{bmatrix}, B = \begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & 9 \end{bmatrix}$
	b. Find the transpose of matrix $A = \begin{bmatrix} 1 & 2 & -9 \\ 2 & -1 & 2 \\ 3 & -4 & 3 \end{bmatrix}$
	c. Find the inverse of matrix $A = \begin{bmatrix} 1 & 2 & 3 \\ 2 & 3 & 2 \\ 1 & 2 & 5 \end{bmatrix}$
<b>Week-5</b>	<b>SYSTEM OF LINEAR EQUATIONS</b>
	a. Find the rank of matrix $A = \begin{bmatrix} 1 & 2 & 3 \\ 5 & 6 & 7 \\ 9 & 10 & 11 \\ 13 & 14 & 15 \end{bmatrix}$
	b. Find the row echelon form $A = \begin{bmatrix} 1 & 2 & 3 \\ 5 & 6 & 7 \\ 9 & 10 & 11 \\ 13 & 14 & 15 \end{bmatrix}$
	c. Find the LU decomposition of the matrix $\begin{bmatrix} 2 & -3 & -1 \\ 1/2 & 1 & -1 \\ 0 & 1 & -1 \end{bmatrix}$

<b>Week-6</b>	<b>LINEAR TRANSFORMATION</b>
a.	Find the characteristics equation of the matrix $\begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & 0 \end{bmatrix}$
b.	Find the Eigen values of the matrix $\begin{bmatrix} 1 & 8 & -10 \\ -4 & 2 & 4 \\ -5 & 2 & 8 \end{bmatrix}$
c.	Find the Eigen vector of the matrix $\begin{bmatrix} 3 & 1 & 1 \\ 1 & 0 & 2 \\ 1 & 2 & 0 \end{bmatrix}$
<b>Week-7</b>	<b>DIFFERENTIATION AND INTEGRATION</b>
a.	solve $(D^2 + 5D + 6)y = e^x$
b.	solve $\int_0^5 \int_0^{x^2} x(x^2 + y^2) dx dy$
c.	solve $\int_0^3 \int_0^{3-x} \int_0^{3-x-y} xyz dx dy dz$
<b>Week-8</b>	<b>INTERPOLATION AND CURVE FITTING</b>
a.	Find the lagrange's polynomial for the following data (0,2),(1,3),(2,12),(5,147)
b.	Fit a straight line for the following data (0,12),(5,15),(10,17),(15,22),(20,24),(25,30)
c.	Fit a polynomial curve for the following data (0,1),(1,1.8),(2,1.3),(3,2.5),(4,6.3)
<b>Week-9</b>	<b>ROOT FINDING</b>
	write a program to find the root of the equation by using $x^3 - 5x + 3$
a.	Bisection Method
b.	Regula Falsi
c.	Newton Raphson Method
<b>Week-10</b>	<b>NUMERICAL DIFFERENTIATION AND INTEGRATION</b>
a.	Evaluate $\int_0^{1.2} e^x$ by using trapezoidal and Simpson's method
b.	Evaluate $y' = x + y$ , $y(0) = 1$ of size $h = 0.2$ by using Euler's and Runge-Kutta method
<b>Week-11</b>	<b>3D PLOTTING</b>
a.	Evaluate $\iint (3x^2 - 8y^2) dx + (4y - 6xy) dy$ Where region is bounded by $y = x^2$ , $y = \sqrt{x}$
b.	Plot the surface for $f = (2 - \cos \pi x)e^y$
c.	Plot the surface for $2 + \cos t$
<b>Week-12</b>	<b>VECTOR CALCULUS</b>
a.	Find grad f where $f = x^3 + y^3 + 3xyz$ at (1,1,1)
b.	If $\vec{f} = xy^2i + 2x^2yzj - 3yz^2k$ find $\text{div } \vec{f}$ at the point (1,-1,1)
c.	If $\vec{f} = xy^2i + 2x^2yzj - 3yz^2k$ find $\text{curl } \vec{f}$ at the point (1,-1,1)



## **EXPERIMENT-I**

### **1.1 OBJECTIVES**

- a. To Know the history and features of MATLAB
- b. To Know the local environment of MATLAB

#### **1.1.1 CONTENT**

##### **Introduction**

MATLAB is a high-level language and interactive environment for numerical computation, visualization, and programming. Using MATLAB, you can analyse data, develop algorithms, and create models and applications. The language, tools, and built-in math functions enable you to explore multiple approaches and reach a solution faster than with spread sheets or traditional programming languages, such as C/C++ or Java. You can use MATLAB for a range of applications, including signal processing and communications, image and video processing, control systems, test and measurement, computational finance, and computational biology. More than a million engineers and scientists in industry and academia use MATLAB, the language of technical computing.

##### **History**

- Developed primarily by Cleve Moler in the 1970's Derived from FORTRAN subroutines LINPACK and EISPACK, linear and eigenvalue systems.
- Developed primarily as an interactive system to access LINPACK and EISPACK.
- Gained its popularity through word of mouth, because it was not socially distributed.
- Rewritten in C in the 1980's with more functionality, which include plotting routines.
- The Math Works Inc. was created (1984) to market and continue development of MATLAB.

##### **Strengths**

- MATLAB may behave as a calculator or as a programming language
- MATLAB combine nicely calculation and graphic plotting.
- MATLAB is relatively easy to learn
- MATLAB is interpreted (not compiled), errors are easy to fix
- MATLAB is optimized to be relatively fast when performing matrix operations
- MATLAB does have some object-oriented elements

##### **Weaknesses**

- MATLAB is not a general purpose programming language such as C, C++, or FORTRAN
- MATLAB is designed for scientific computing, and is not well suitable for other applications
- MATLAB is an interpreted language, slower than a compiled language such as C++
- MATLAB commands are specific for MATLAB usage. Most of them do not have a direct equivalent with other programming language commands

##### **Competition**

One of MATLAB's competitors is Mathematica the symbolic computation program. MATLAB is more convenient for numerical analysis and linear algebra. It is frequently used in engineering community. Mathematica has superior symbolic manipulation, making it popular among physicists.

There are other competitors: Scilab, GNU Octave, and Rlab

## **Key Features**

- It is a high-level language for numerical computation, visualization and application development.
- It also provides an interactive environment for iterative exploration, design and problem solving.
- It provides vast library of mathematical functions for linear algebra, statistics, Fourier analysis, filtering, optimization, numerical integration and solving ordinary differential equations.
- It provides built-in graphics for visualizing data and tools for creating custom plots.
- MATLAB's programming interface gives development tools for improving code quality, maintainability, and maximizing performance.
- It provides tools for building applications with custom graphical interfaces.
- It provides functions for integrating MATLAB based algorithms with external applications and languages such as C, Java, .NET and Microsoft Excel.

## **MATLAB's Power of Computational Mathematics**

MATLAB is used in every facet of computational mathematics. Following are some commonly used mathematical calculations where it is used most commonly:

- Dealing with Matrices and Arrays
- 2-D and 3-D Plotting and graphics
- Linear Algebra
- Algebraic Equations
- Non-linear Functions
- Statistics
- Data Analysis
- Calculus and Differential Equations
- Numerical Calculations
- Integration
- Transforms
- Curve Fitting
- Various other special functions

## **Uses of MATLAB**

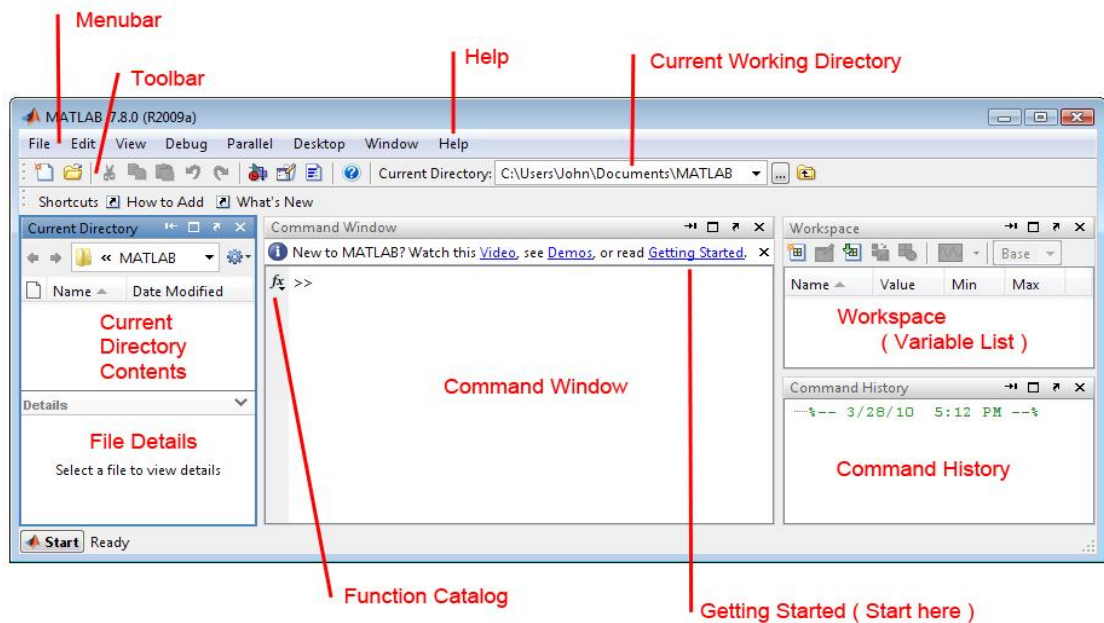
MATLAB is widely used as a computational tool in science and engineering encompassing the fields of physics, chemistry, math and all engineering streams. It is used in a range of applications including:

- Signal processing and Communications
- Image and video Processing
- Control systems
- Test and measurement
- Computational finance
- Computational biology

## **Understanding the MATLAB Environment**

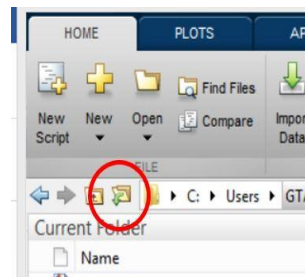
MATLAB development IDE can be launched from the icon created on the desktop. The main working window in MATLAB is called the desktop. When MATLAB is started, the desktop appears in its default layout:

# The MATLAB Work Environment

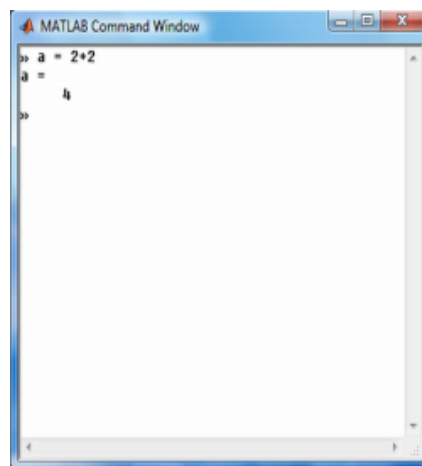


The desktop includes these panels:

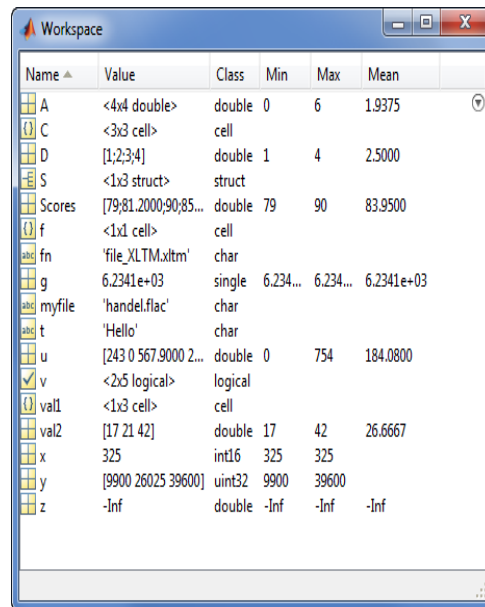
**Current Folder** - This panel allows you to access the project folders and files.



**Command Window** - This is the main area where commands can be entered at the command line. It is indicated by the command prompt (`>>`).

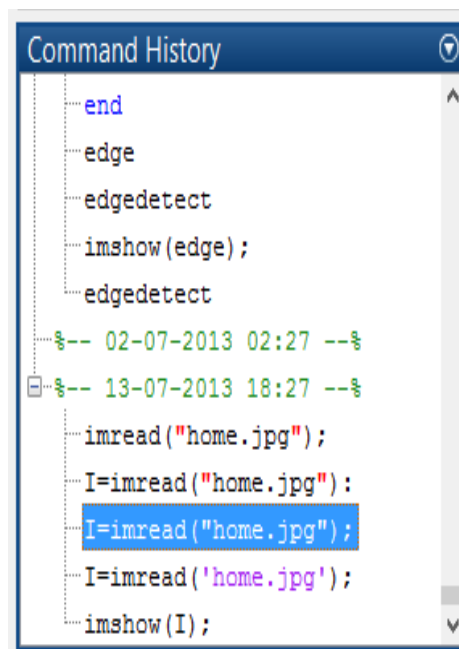


**Workspace** - The workspace shows all the variables created and/or imported from files.

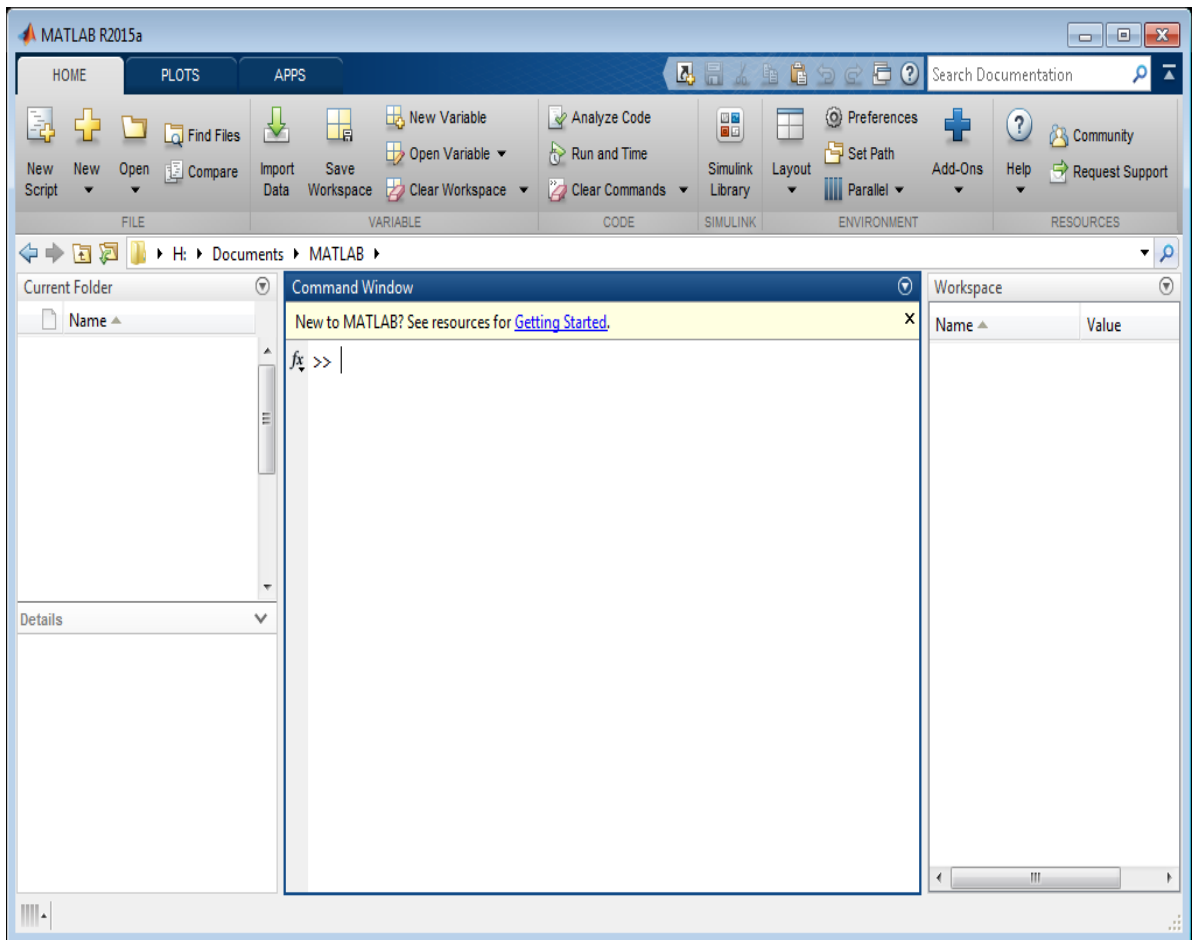


Name	Value	Class	Min	Max	Mean
A	<4x4 double>	double	0	6	1.9375
C	<3x3 cell>	cell			
D	[1;2;3;4]	double	1	4	2.5000
S	<1x3 struct>	struct			
Scores	[79;81;2000;90;85...	double	79	90	83.9500
f	<1x1 cell>	cell			
fn	'file_XLTM.xltx'	char			
g	6.2341e+03	single	6.234...	6.234...	6.2341e+03
myfile	'handel.flac'	char			
t	'Hello'	char			
u	[243 0 567.9000 2...	double	0	754	184.0800
v	<2x5 logical>	logical			
val1	<1x3 cell>	cell			
val2	[17 21 42]	double	17	42	26.6667
x	325	int16	325	325	
y	[9900 26025 39600]	uint32	9900	39600	
z	-Inf	double	-Inf	-Inf	-Inf

**Command History** - This panel shows or rerun commands that are entered at the command line.



```
end
edge
edgedetect
imshow(edge);
edgedetect
$-- 02-07-2013 02:27 --$
$-- 13-07-2013 18:27 --$
imread("home.jpg");
I=imread("home.jpg");
I=imread('home.jpg');
imshow(I);
```



You are now faced with the MATLAB desktop on your computer, which contains the prompt (>>) in the Command Window. Usually, there are 2 types of prompt:

>> For full version  
 EDU> for educational version

**Note:**

1. To simplify the notation, we will use this prompt, >>, as a standard prompt sign, though our MATLAB version is for educational purpose.
2. MATLAB adds variable to the workspace and displays the result in the Command Window.

**Managing workspace and file commands**

Command	Description
cd	Change current directory
clc	Clear the Command Window
clear (all)	Removes all variables from the workspace
clear x	Remove x from the workspace
copy file	Copy file or directory
delete	Delete files

dir	Display directory listing
exist	Check if variables or functions are defined
help	Display help for MATLAB functions
look for	Search for specified word in all help entries
mkdir	Make new directory
move file	Move file or directory
pwd	Identify current directory
rmdir	Remove directory
type	Display contents of file
what	List MATLAB files in current directory
which	Locate functions and files
who	Display variables currently in the workspace
whos	Display information on variables in the workspace

### Commonly used Operators and Special Characters

MATLAB supports the following commonly used operators and special characters:

Operator	Purpose
+	Plus; addition operator.
-	Minus; subtraction operator.
*	Scalar and matrix multiplication operator.
.*	Array multiplication operator.
^	Scalar and matrix exponentiation operator.
.^	Array exponentiation operator.
\	Left-division operator.
/	Right-division operator.
.\	Array left-division operator.
./	Array right-division operator.
:	Colon; generates regularly spaced elements and represents an entire row or column.
()	Parentheses; encloses function arguments and array indices; overrides precedence.
[]	Brackets; enclosures array elements.
.	Decimal point.
...	Ellipsis; line-continuation operator
,	Comma; separates statements and elements in a row
;	Semicolon; separates columns and suppresses display.
%	Percent sign; designates a comment and specifies formatting.

_	Quote sign and transpose operator.
·_	Non-conjugated transpose operator.
=	Assignment operator.

**Note:**

If you end a statement with a semicolon, MATLAB performs the computation, but suppresses the display of output in the Command Window.

**Special Variables and Constants**

MATLAB supports the following special variables and constants:

Name	Meaning
ans	Most recent answer.
eps	Accuracy of floating-point precision.
i,j	The imaginary unit $\sqrt{-1}$ .
Inf	Infinity.
NaN	Undefined numerical result (not a number).
pi	The number $\pi$

**Naming Variables**

Variable names consist of a letter followed by any number of letters, digits or underscore.

MATLAB is **case-sensitive**.

Variable names can be of any length; however, MATLAB uses only first N characters, where N is given by the function **namelengthmax**.

**Saving Your Work**

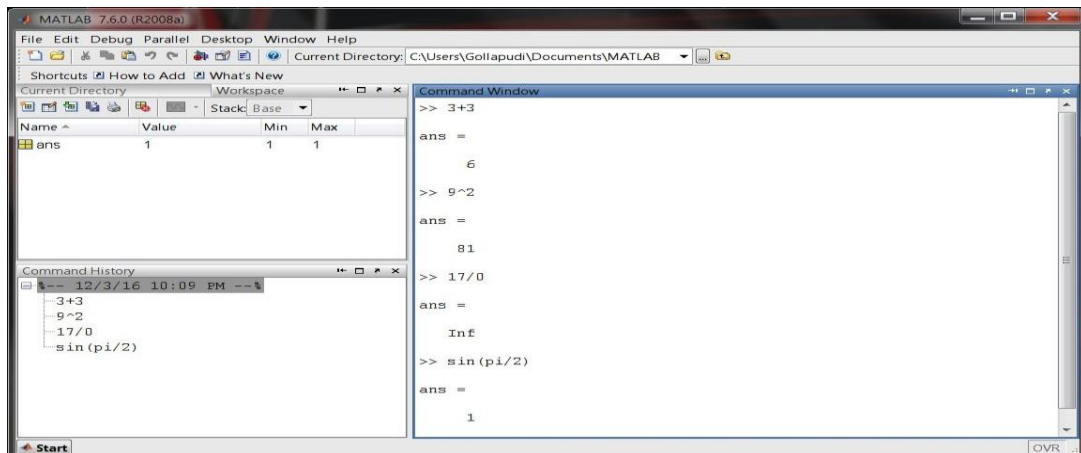
The **save** command is used for saving all the variables in the workspace, as a file with .mat extension, in the current directory.

For example, save myfile

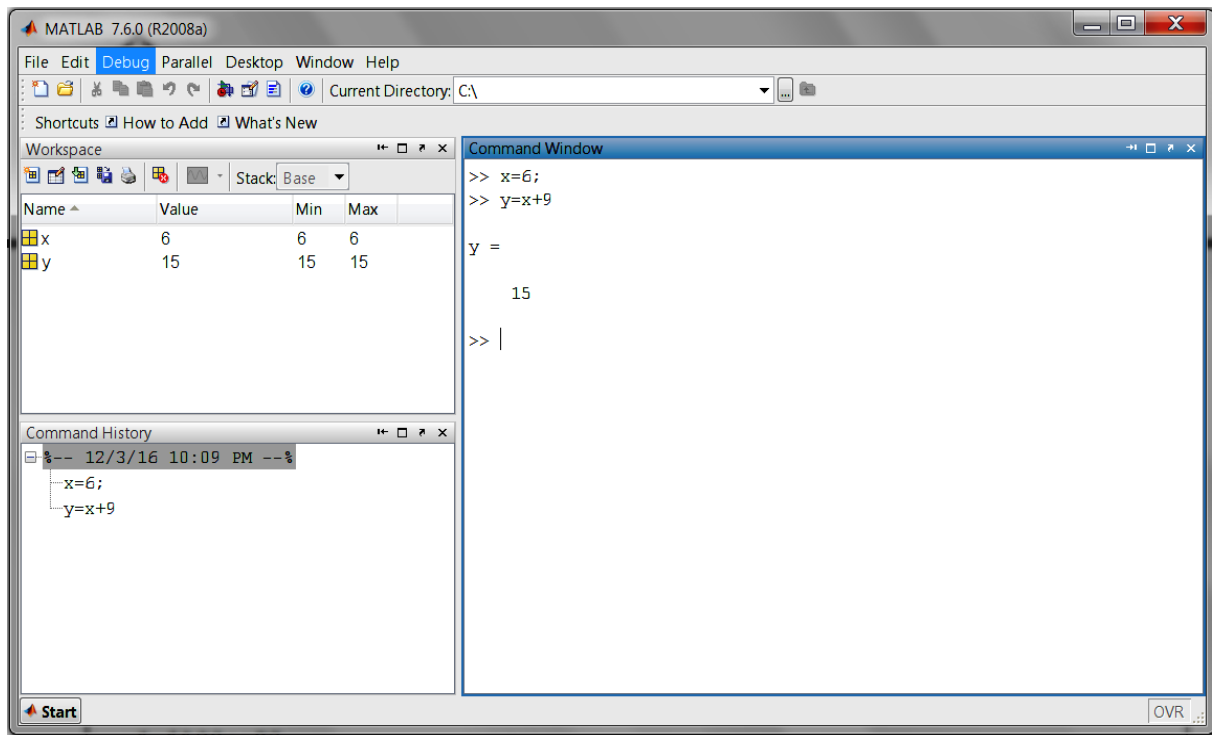
You can reload the file anytime later using the **load** command.

load myfile

**Example 1:**

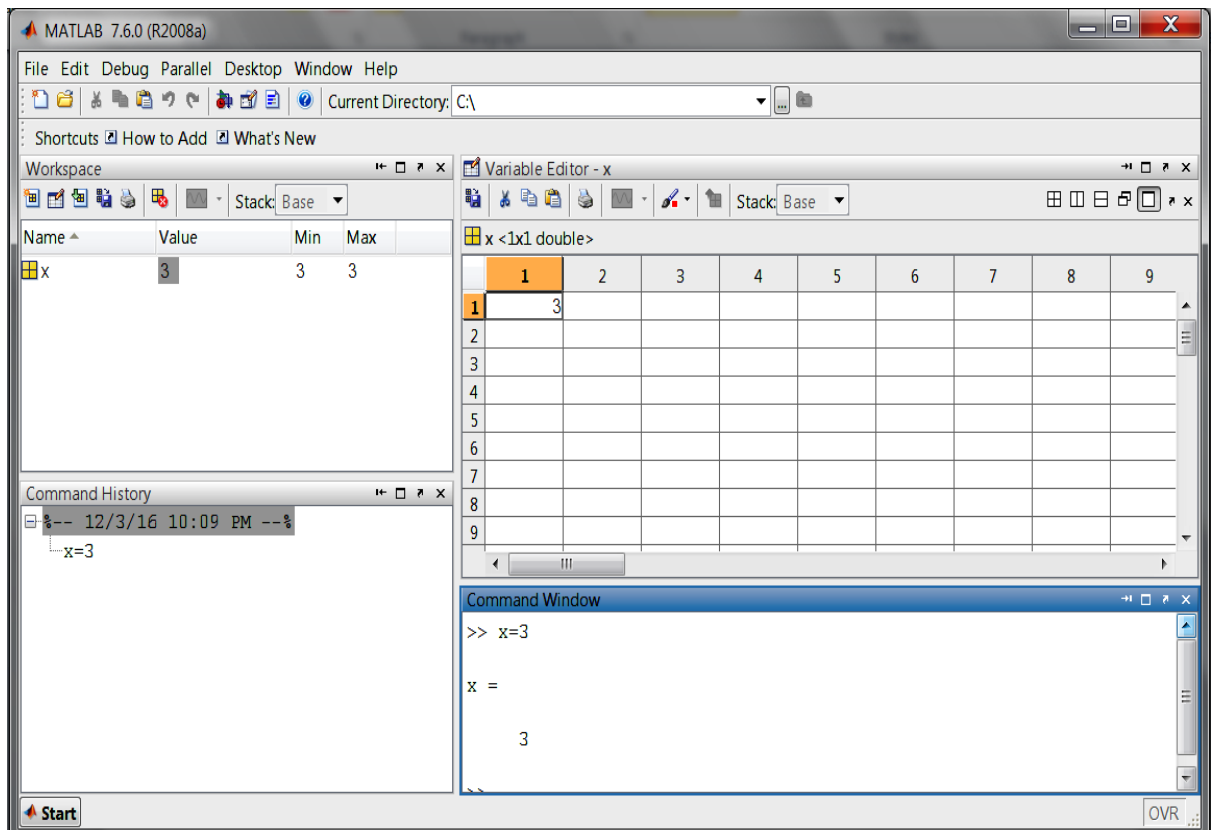


## Example 2:



In MATLAB environment, every variable is an array or matrix.

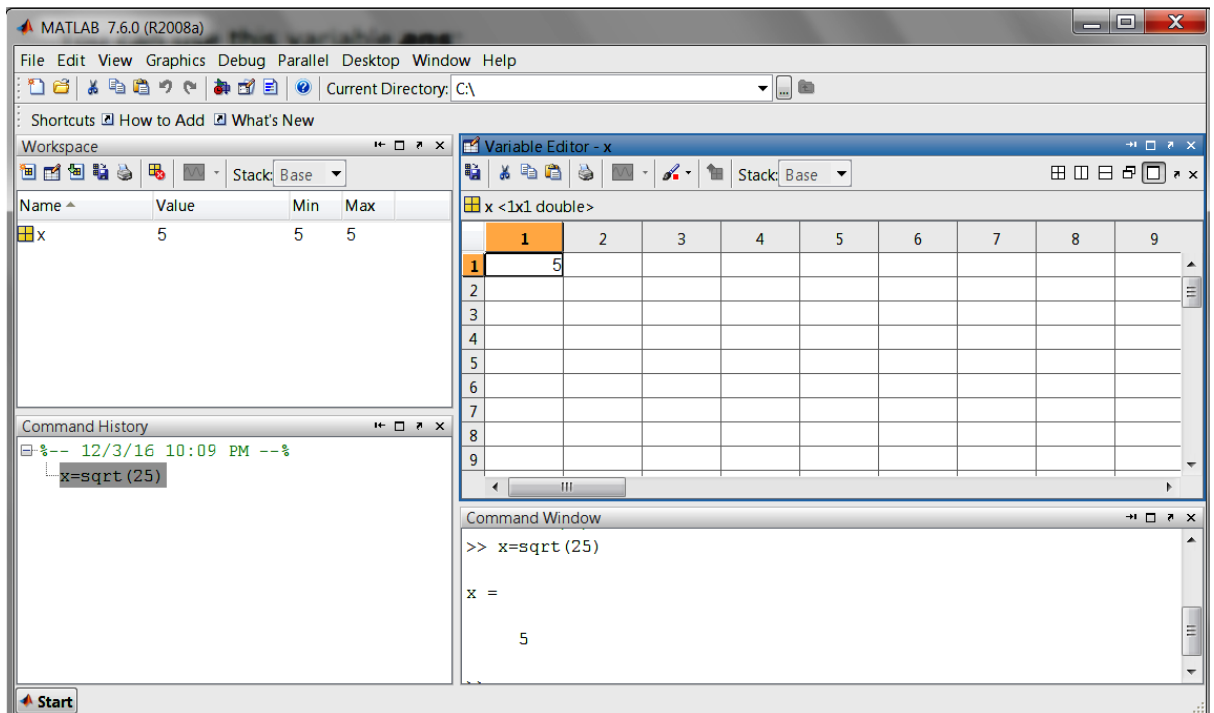
## Example 3:



In the above example it creates a 1-by-1 matrix named 'x' and stores the value 3 in its element.



#### Example 4:

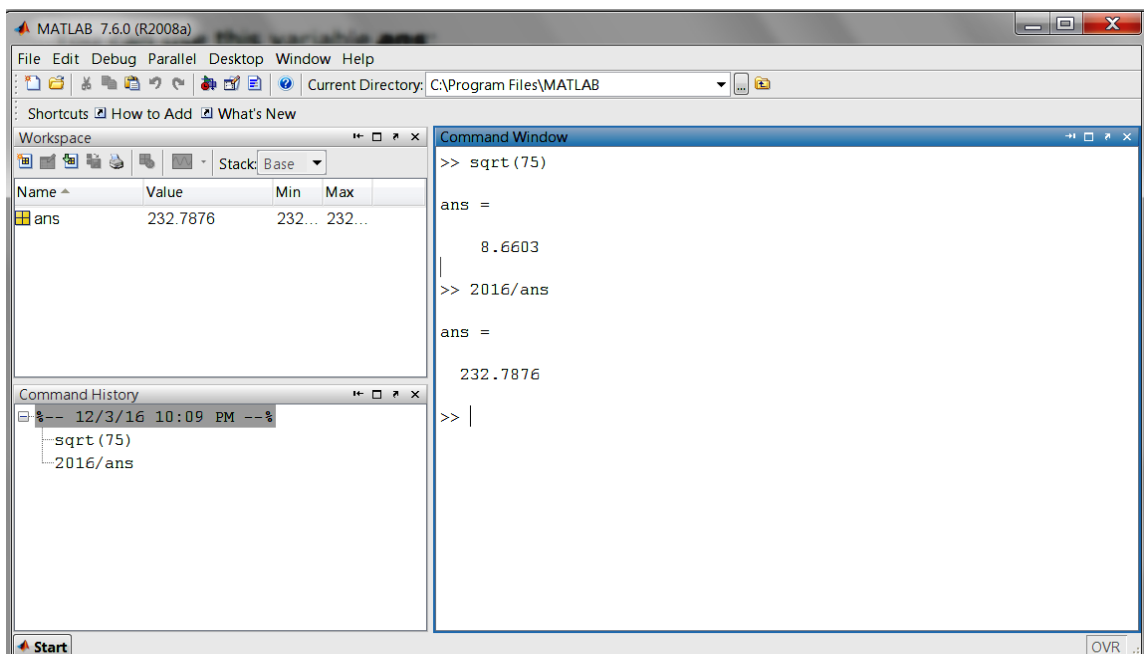


In this example x is to find the square root of 25 it creates a 1-by-1 matrix named 'x' and stores the value 5 in its element

#### Note:

- Once a variable is entered into the system, you can refer to it later.
- Variables must have values before they are used.
- When you do not specify an output variable, MATLAB uses the variable `ans`, short for *answer*, to store the results of your calculation.

#### Example 6:



## Example 7:

The image shows the MATLAB 7.6.0 (R2008a) interface. The workspace window displays the following variables:

Name	Value	Min	Max
ans	0	0	0
x	3	3	3
y	15	15	15
z	0	0	0

The Variable Editor window shows a 1x1 double array 'z' with the value 0.

The Command Window shows the following commands and output:

```
>> x=3;  
>> y=15;  
>> x+y  
ans =  
    18  
  
>> z/ans  
ans =  
     0  
  
>> |
```

The Command History window shows the following commands:

```
x=5;  
y=x+19  
z+2  
c1c  
x=3;  
y=15;  
x+y  
z/ans
```

In the above example we have multiple assignments

## EXPERIMENT-2

### 2.1 OBJECTIVES

- Find the roots of the equations  $6x^5 - 41x^4 + 97x^3 - 97x^2 + 41x - 6$
- Find the values of  $x, y, z$  of the equations  $x+y+z=3, x+2y+3z=4, x+4y+9z=6$
- For  $f(x)=8x^8 - 7x^7 + 12x^6 - 5x^5 + 8x^4 + 13x^3 - 12x + 9$  compute  $f(2)$ , roots of  $f(x)$  and plot for  $0 \leq x \leq 20$

### 2.2 SOFTWARE REQUIRED

- MATLAB R2013a.
- Windows 7/XP SP2.

### 2.3 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

### 2.4 PROGRAM

#### Roots of the equations $6x^5 - 41x^4 + 97x^3 - 97x^2 + 41x - 6$

```
v = [6, -41, 97, -97, 41, -6]; % writing the coefficients
s = roots(v);
disp('The first root is: '), disp(s(1));
disp('The second root is: '), disp(s(2));
disp('The third root is: '), disp(s(3));
disp('The fourth root is: '), disp(s(4));
disp('The fifth root is: '), disp(s(5));
```

#### Values of $x, y, z$ of the equations $x+y+z=3, x+2y+3z=4, x+4y+9z=6$

```
A=[1,1,1;1,2,3;1,4,9];
b=[3;4;6];
A\b
```

#### $f(2)$ , roots and plot of $f(x)$

```
p=[8 -7 12 -5 8 13 0 -12 9];
polyval(p,2)
roots(p)
x=0:0.1:20;
y=polyval(p,x);
plot(x,y)
```

### 2.5 OUTPUT

#### Roots of the equations $6x^5 - 41x^4 + 97x^3 - 97x^2 + 41x - 6$

```
The first root is: 3.0000
The second root is: 2.0000
The third root is: 1.0000
The fourth root is: 0.5000
The fifth root is: 0.3333
```

**Values of x,y,z of the equations  $x+v+z=3,x+2v+3z=4,x+4v+9z=6$**

ans =

2

1

0

**f(2),roots and plot of f(x)**

ans = 1977

ans =  $-0.2079 + 1.3091i$

$-0.2079 - 1.3091i$

$-0.8053 + 0.4306i$

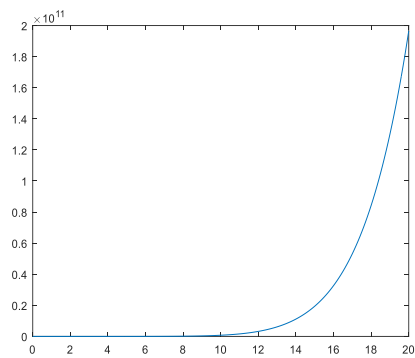
$-0.8053 - 0.4306i$

$0.8878 + 0.9318i$

$0.8878 - 0.9318i$

$0.5629 + 0.3828i$

$0.5629 - 0.3828i$



## EXPERIMENT-3

### 3.1 OBJECTIVES

- Verification of basic properties of limits for the functions  $f(x) = (3x + 5)/(x - 3)$  and  $g(x) = x^2 + 1$  as  $x$  tends to 4.
- Find the derivative of  $(x+2)(x^2+3)$
- Calculate the area enclosed between the x-axis, and the curve  $y=x^3 - 2x+5$  and the ordinates  $x = 1$  and  $x = 2$ .

### 3.2 SOFTWARE REQUIRED

- MATLAB R2013a.
- Windows 7/XP SP2.

### 3.3 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

### 3.4 PROGRAM

#### Properties of limits

```
f = (3*x + 5)/(x-3);  
g = x^2 + 1;  
l1 = limit(f, 4)  
l2 = limit (g, 4)  
lAdd = limit(f + g, 4)  
lSub = limit(f - g, 4)  
lMult = limit(f*g, 4)  
lDiv = limit (f/g, 4)
```

#### Derivative

```
syms x  
f=(x+2)*(x^2+3)  
diff(f)  
diff(ans)  
diff(ans)  
diff(ans)
```

#### Integration

```
syms x  
f = x^3 - 2*x + 5;  
a = int(f, 1, 2)  
display('Area: '), disp(double(a));
```

### 3.5 OUTPUT

#### Properties of limits

$$l1 = 17$$

$$l2 = 17$$

$$lAdd = 34$$

$$lSub = 0$$

$$lMult = 289$$

$$lDiv = 1$$

#### Derivative

$$f = (x+2)*(x^2+3)$$

$$ans = x^2+3+2*(x+2)*x$$

$$ans = 6*x+4$$

$$ans = 6$$

$$ans = 0$$

#### Integration

$$a = 23/4$$

$$\text{Area: } 5.7500$$

## EXPERIMENT-4

### 4.1 OBJECTIVES

- a. Find the addition, subtraction and multiplication of matrix

$$A = \begin{bmatrix} 1 & 2 & -9 \\ 2 & -1 & 2 \\ 3 & -4 & 3 \end{bmatrix}, B = \begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & 9 \end{bmatrix}$$

- b. Find the transpose of matrix A =  $\begin{bmatrix} 1 & 2 & -9 \\ 2 & -1 & 2 \\ 3 & -4 & 3 \end{bmatrix}$

- c. Find the inverse of matrix A =  $\begin{bmatrix} 1 & 2 & 3 \\ 2 & 3 & 2 \\ 1 & 2 & 5 \end{bmatrix}$

### 4.2 SOFTWARE REQUIRED

1. MATLAB R2013a.
2. Windows 7/XP SP2.

### 4.3 PROCEDURE

1. Open MATLAB
2. Open new M-file
3. Type the program
4. Save in current directory
5. Compile and Run the program
6. For the output see command window\ Figure window

### 4.4 PROGRAM

#### Addition, Subtraction and Multiplication of matrix

```
a=[1 2 -9 ; 2 -1 2; 3 -4 3];
b=[1 2 3; 4 5 6; 7 8 9];
disp('The matrix a= ');a
disp('The matrix b= ');b
% to find sum of a and b
c=a+b;
disp('The sum of a and b is ');c
% to find difference of a and b
d=a-b;
disp('The difference of a and b is ');d
%to find multiplication of a and b
e=a*b;
disp('The product of a and b is ');e
% to find element-by-element multiplication
```

#### Transpose of matrix

```
A=[1,2,-9;2,-1,2;3,-4,3]
B = A.'
```

**Inverse of matrix**

a = [ 1 2 3; 2 3 4; 1 2 5]

inv (a)

**4.5 OUTPUT**

**Addition, Subtraction and Multiplication of matrix**

The matrix a=

a =

1 2 -9  
2 -1 2  
3 -4 3

The matrix b=

b =

1 2 3  
4 5 6  
7 8 9

The sum of a and b is

c =

2 4 -6  
6 4 8  
10 4 12

The difference of a and b is

d =

0 0 -12  
-2 -6 -4  
-4 -12 -6

The product of a and b is

e =

-54 -60 -66  
12 15 18  
8 10 12

**Transpose of matrix**

A =

1 2 -9  
2 -1 2  
3 -4 3

B =

1 2 3  
2 -1 -4  
-9 2 3

**Inverse of matrix**

a =

1 2 3  
2 3 4  
1 2 5

ans =

-3.5000 2.0000 0.5000  
3.0000 -1.0000 -1.0000  
-0.5000 0 0.5000



## EXPERIMENT-5

### 5.1 OBJECTIVES

a. Find the rank of matrix  $A = \begin{bmatrix} 1 & 2 & 3 \\ 5 & 6 & 7 \\ 9 & 10 & 11 \\ 13 & 14 & 15 \end{bmatrix}$

b. Find the row echelon form  $A = \begin{bmatrix} 1 & 2 & 3 \\ 5 & 6 & 7 \\ 9 & 10 & 11 \\ 13 & 14 & 15 \end{bmatrix}$

c. Find the LU decomposition of the matrix  $\begin{bmatrix} 2 & -3 & -1 \\ 1/2 & 1 & -1 \\ 0 & 1 & -1 \end{bmatrix}$

### 5.2 SOFTWARE REQUIRED

1. MATLAB R2013a.
2. Windows 7/XP SP2.

### 5.3 PROCEDURE

1. Open MATLAB
2. Open new M-file
3. Type the program
4. Save in current directory
5. Compile and Run the program
6. For the output see command window\ Figure window

### 5.4 PROGRAM

#### Rank of matrix

$A = [1, 2, 3; 5, 6, 7; 9, 10, 11; 13, 14, 15]$   
 $\text{rank}(A)$

#### Row echelon form

$A = [1, 2, 3; 5, 6, 7; 9, 10, 11; 13, 14, 15]$   
 $R = \text{rref}(A)$

#### LU decomposition

$A = [2 -3 -1; 1/2 1 -1; 0 1 -1]$   
 $[L, U] = \text{lu}(A)$

## 5.5 OUTPUT

### Rank of matrix

A =

$$\begin{pmatrix} 1 & 2 & 3 \\ 5 & 6 & 7 \\ 9 & 10 & 11 \\ 13 & 14 & 15 \end{pmatrix}$$

ans = 2

### Row echelon form

A =

$$\begin{pmatrix} 1 & 2 & 3 \\ 5 & 6 & 7 \\ 9 & 10 & 11 \\ 13 & 14 & 15 \end{pmatrix}$$

R =

$$\begin{pmatrix} 1 & 0 & -1 \\ 0 & 1 & 2 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \end{pmatrix}$$

### LU decomposition

L =

$$\begin{pmatrix} 1.0000 & 0 & 0 \\ 0.2500 & 1.0000 & 0 \\ 0 & 0.5714 & 1.0000 \end{pmatrix}$$

U =

$$\begin{pmatrix} 2.0000 & -3.0000 & -1.0000 \\ 0 & 1.7500 & -0.7500 \\ 0 & 0 & -0.5714 \end{pmatrix}$$

## EXPERIMENT-6

### 6.1 OBJECTIVES

- a. Find the characteristics equation of the matrix  $\begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & 0 \end{bmatrix}$
- b. Find the Eigen values of the matrix  $\begin{bmatrix} 1 & 8 & -10 \\ -4 & 2 & 4 \\ -5 & 2 & 8 \end{bmatrix}$
- c. Find the Eigen vector of the matrix  $\begin{bmatrix} 3 & 1 & 1 \\ 1 & 0 & 2 \\ 1 & 2 & 0 \end{bmatrix}$

### 6.2 SOFTWARE REQUIRED

1. MATLAB R2013a.
2. Windows 7/XP SP2.

### 6.3 PROCEDURE

1. Open MATLAB
2. Open new M-file
3. Type the program
4. Save in current directory
5. Compile and Run the program
6. For the output see command window\ Figure window

### 6.4 PROGRAM

#### Characteristics equation

```
A = [1 2 3; 4 5 6; 7 8 0]
p = poly(A)
```

#### Eigen values

```
A = [1 8 -10; -4 2 4; -5 2 8]
e = eig(A)
```

#### Eigen vector

```
A=[3,1,1;1,0,2;1,2,0];
[eigenvector, eigenvalue] = eig(A)
```

### 6.5 OUTPUT

#### Characteristics equation

```
A =
     1     2     3
     4     5     6
     7     8     0
p=1.0000 -6.0000 -72.0000 -27.0000
```

**Eigen values**

A =

1	8	-10
-4	2	4
-5	2	8

e =

11.6219  
-0.3110 + 2.6704i  
-0.3110 - 2.6704i

**Eigen vector**

eigenvector =

-0.0000	0.5774	-0.8165
0.7071	-0.5774	-0.4082
-0.7071	-0.5774	-0.4082

eigenvalue =

-2.0000	0	0
0	1.0000	0
0	0	4.0000

## EXPERIMENT-7

### 7.1 OBJECTIVES

- a. solve  $(D^2 + 5D + 6)y = e^x$
- b. solve  $\int_0^5 \int_0^{x^2} x(x^2 + y^2) dx dy$
- c. solve  $\int_0^3 \int_0^{3-x} \int_0^{3-x-y} xyz dx dy dz$

### 7.2 SOFTWARE REQUIRED

1. MATLAB R2013a.
2. Windows 7/XP SP2.

### 7.3 PROCEDURE

1. Open MATLAB
2. Open new M-file
3. Type the program
4. Save in current directory
5. Compile and Run the program
6. For the output see command window\ Figure window

### 7.4 PROGRAM

#### Higher order differential

```
dsolve('D2y+5*Dy+6*y=exp(x)', 'x')
```

#### Double Integration

```
syms x y  
firstint=int(x*(x^2+y^2),y,0,x^2)  
answer=int(firstint,x,0,5)
```

#### Triple Integration

```
syms x y z  
firstans=int(int(int(x*y*z,z,0,3-x-y),y,0,3-x),x,0,3)
```

### 7.5 OUTPUT

#### Higher order differential

```
ans = exp(-2*x)*C2+exp(-3*x)*C1+1/12*exp(x)
```

#### Double Integration

```
firstint = 1/3*x^7+x^5  
answer = 453125/24
```

#### Triple Integration

```
firstans = 81/80
```

## EXPERIMENT-8

### 8.1 OBJECTIVES

- Find the lagrange's polynomial for the following data (0,2),(1,3),(2,12),(5,147)
- Fit a straight line for the following data (0,12),(5,15),(10,17),(15,22),(20,24),(25,30)
- Fit a polynomial curve for the following data (0,1),(1,1.8),(2,1.3),(3,2.5),(4,6.3)

### 8.2 SOFTWARE REQUIRED

- MATLAB R2013a.
- Windows 7/XP SP2.

### 8.3 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

### 8.4 PROGRAM

#### Lagrange's polynomial

```
x=[0 1 2 5];  
y=[2 3 12 147];  
disp([x;y])  
v=vander(x)  
c=v\y'
```

#### Straight Line

```
x=[0 5 10 15 20 25];  
y=[12 15 17 22 24 30];  
disp([x;y])  
p=polyfit(x,y,1);  
disp(p);
```

#### Polynomial curve

```
x=[0 1 2 3 4];  
y=[1 1.8 1.3 2.5 6.3];  
disp([x;y])  
p=polyfit(x,y,2);  
disp(p);
```

### 8.5 OUTPUT

#### Lagrange's polynomial

```
0 1 2 5  
2 3 12 147  
  
v=0 0 0 1  
1 1 1 1  
8 4 2 1  
125 25 5 1
```

c =1.0000  
1.0000  
-1.0000  
2.0000

**Straight Line**

0 5 10 15 20 25  
12 15 17 22 24 30

0.6971 11.2857

**Polynomial curve**

0 1.0000 2.0000 3.0000 4.0000  
1.0000 1.8000 1.3000 2.5000 6.3000

0.5500 -1.0700 1.4200

## EXPERIMENT-9

### 9.1 OBJECTIVES

write a program to find the root of the equation by using  $x^3-5x+3$

- Bisection Method
- Regula Falsi
- Newton Raphson Method

### 9.2 SOFTWARE REQUIRED

- MATLAB R2013a.
- Windows 7/XP SP2.

### 9.3 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

### 9.4 PROGRAM

#### Bisection Method

```
f=@(x) x^3-5*x+3;
display('Equation is x^3-5*x+3= 0')
i=1;
while(i)
    xl=input('Enter lower value:');
    xu=input('Enter upper value: ');
    e=input('Enter accuracy: ');
    if f(xl)*f(xu)<0
        i=0;
    else
        warning('Enter proper range');
    end
end
if f(xl)<0
    xn=xl;
    xp=xu;
else
    xn=xu;
    xp=xl;
end
while (abs(xn-xp)>e)
    xm=(xn+xp)/2;
    if f(xm)<0
        xn=xm;
    else
        xp=xm;
    end
end
end
Root=xm
```



### **Regula Falsi**

```
f=@(x) x^3-5*x+3;
display('Equation is x^3-5*x+3= 0')
i=1;
while(i)
    xl=input('Enter lower value:');
    xu=input('Enter upper value: ');
    e=input('Enter accuracy: ');
    if f(xl)*f(xu)<0
        i=0;
    else
        warning('Enter proper range');
    end
end
if f(xl)<0
    xn=xl;
    xp=xu;
else
    xn=xu;
    xp=xl;
end
xm=xl;
while (abs(f(xm))>e)
    xm=(xn*f(xp)-xp*f(xn))/(f(xp)-f(xn));
    if f(xm)<0
        xn=xm;
    else
        xp=xm;
    end
end
end
Root=xm
```

### **Newton Raphson Method**

```
syms x
f= x^3-5*x+3;
fdash=diff(f);
disp('The equation is: '),disp(f);
disp('The derivative of equation is: '),disp(fdash);
y=inline(f);
dy=inline(fdash);
x0=input('Enter approximate root: ');
e=input('Enter the accuracy: ');
while abs(feval(y,x0))>e
    h=-feval(y,x0)/feval(dy,x0);
    x0=x0+h;
end
root=x0
```

## **9.5 OUTPUT**

### **Bisection Method**

```
Equation is x^3-5*x+3= 0
Enter lower value: 1
Enter upper value: 2
Enter accuracy: 0.0001
Root =1.8343
```

**Regula Falsi**

Equation is  $x^3-5x+3=0$

Enter lower value: 1

Enter upper value: 2

Enter accuracy: 0.0001

Root =1.8342

**Newton Raphson Method**

The equation is:  $x^3-5x+3$

The derivative of equation is:  $3x^2-5$

Enter approximate root: 1.5

Enter the accuracy: 0.0001

root =1.8343

## EXPERIMENT-10

### 10.1 OBJECTIVES

- Evaluate  $\int_0^{1.2} e^x$  by using trapezoidal and Simpson's method
- Evaluate  $y' = x + y$ ,  $y(0) = 1$  of size  $h = 0.2$  by using Euler's and Runge-Kutta method

### 10.2 SOFTWARE REQUIRED

- MATLAB R2013a.
- Windows 7/XP SP2.

### 10.3 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

### 10.4 PROGRAM

#### Trapezoidal Method:

```
x=0:0.2:1.2;  
y=exp(x);  
trapz(x,y)
```

#### Simpson's Method:

```
quad('exp(x)',0,1.2)
```

#### Euler's and Runge-Kutta method

```
f=@(x,y) (x+y);  
[x,y]=ode23(f,[0:0.2:1],1)  
[x,y]=ode45(f,[0:0.2:1],1)
```

### 10.5 OUTPUT

#### Trapezoidal Method:

```
ans =2.3278
```

#### Simpson's Method:

```
ans =2.3201
```

#### Euler's method

```
x =  
0  
0.2000  
0.4000  
0.6000  
0.8000  
1.0000
```

```
y =1.0000  
1.2428
```

1.5836  
2.0442  
2.6510  
3.4364

**Runge-Kutta method**

$x = 0$   
0.2000  
0.4000  
0.6000  
0.8000  
1.0000

$y = 1.0000$   
1.2428  
1.5836  
2.0442  
2.6511  
3.4366

## EXPERIMENT-11

### 11.1 OBJECTIVES

- Evaluate  $\int\int (3x^2 - 8y^2)dx + (4y - 6xy)dy$  Where region is bounded by  $y = x^2$ ,  $y = \sqrt{x}$
- Plot the surface for  $f = (2 - \cos \pi x)e^y$
- Plot the surface for  $2 + \cos t$

### 11.2 SOFTWARE REQUIRED

- MATLAB R2013a.
- Windows 7/XP SP2.

### 11.3 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

### 11.4 PROGRAM

#### Line Integral

```
clear all
clc
syms x y
f=[3*x.^2-8*y.^2 4*y-6*x*y];
disp('Along the curve y=x.^2')
a=subs(f,y,x.^2);
b=diff(x.^2,x);
c=b*a(2);
d=int(a(1),x,0,1);
e=int(c,x,0,1);
u=d+e
disp('Along the curve y=sqrt(x)')
p=subs(f,y,sqrt(x));
q=diff(sqrt(x),x);
r=q*p(2);
s=int(p(1),x,1,0);
t=int(r,x,1,0);
v=s+t
I=u+v
x=-2:0.5:2;
y2=sqrt(x);
y1=x.^2;
plot(x,y1,'r', x,y2,'g');
grid on
```

#### Surface

```
x=-1:1:1;y=0:1:1.5;
[X,Y]=meshgrid(x,y);
F=(2-cos(pi*X)).*exp(Y);
```

```
surf(X,Y,F);  
xlabel('x');  
ylabel('y');
```

### Volume

```
t = 0:pi/10:2*pi;  
figure  
[X,Y,Z] = cylinder(2+cos(t));  
surf(X,Y,Z)  
axis square
```

## 11.5 OUTPUT

### Line Integral

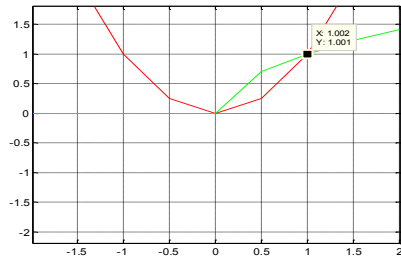
Along the curve  $y=x.^2$

$u = -1$

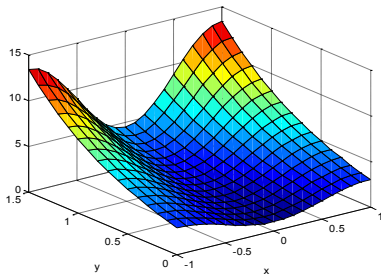
Along the curve  $y=\sqrt{x}$

$v = 5/2$

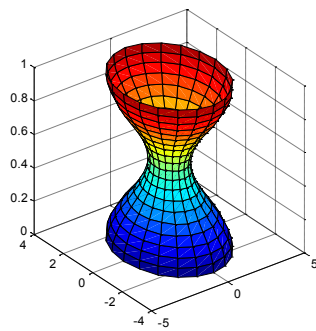
$I = 3/2$



### Surface



### Volume



## EXPERIMENT-12

### 12.1 OBJECTIVES

- Find grad  $f$  where  $f=x^3+y^3+3xyz$  at  $(1,1,1)$
- If  $\vec{f} = xy^2i + 2x^2yzj - 3yz^2k$  find  $\text{div } \vec{f}$  at the point  $(1,-1,1)$
- If  $\vec{f} = xy^2i + 2x^2yzj - 3yz^2k$  find  $\text{curl } \vec{f}$  at the point  $(1,-1,1)$

### 12.2 SOFTWARE REQUIRED

- MATLAB R2013a.
- Windows 7/XP SP2.

### 12.3 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

### 12.4 PROGRAM

#### Gradient

```
syms x y z
f=x.^3+y.^3+3*x*y*z;
p = diff(f,x)
q = diff(f,y)
r = diff(f,z)
w=[p q r]
subs(w, {x,y,z}, {1,1,1})
```

#### Divergent

```
syms x y z
f=[x*y.^2 2*x.^2*y*z -3*y*z.^2];
p = diff(f(1),x)
q = diff(f(2),y)
r = diff(f(3),z)
w = p + q + r
subs(w, {x,y,z}, {1,-1,1})
```

#### Curl

```
syms x y z
f=[x*y.^2 2*x.^2*y*z -3*y*z.^2];
p=diff(f(3),y)-diff(f(2),z)
q=diff(f(3),x)-diff(f(1),z)
r=diff(f(2),x)-diff(f(1),y)
w=[p q r]
subs(w, {x,y,z}, {1,-1,1})
```

## 12.5 OUTPUT

### Gradient

$$p = 3x^2 + 3y^2z$$

$$q = 3y^2 + 3xz$$

$$r = 3xy$$

$$w = [3x^2 + 3y^2z, 3y^2 + 3xz, 3xy]$$

$$\text{ans} = \begin{bmatrix} 6 & 6 & 3 \end{bmatrix}$$

### Divergent

$$p = y^2$$

$$q = 2x^2z$$

$$r = -6yz$$

$$w = y^2 + 2x^2z - 6yz$$

$$\text{ans} = 9$$

### Curl

$$p = -3z^2 - 2x^2y$$

$$q = 0$$

$$r = 4xyz - 2xy$$

$$w = [-3z^2 - 2x^2y, 0, 4xyz - 2xy]$$

$$\text{ans} = \begin{bmatrix} -1 & 0 & -2 \end{bmatrix}$$