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KARMVEER SHANTARAMBAPU KONDAJI WAVARE ARTS, COMMERCE & SCIENCE COLLEGE, CIDCO, NASHIK

DEPARTMENT OF PHYSICS

A

PROJECT REPORT

ON

"Java Program On Forces Acting On An Aircraft"

SUBMITTED BY

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M.Sc.II (Physics)

Academic Year: 2021-22

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CERTIFICATE

This is to certify that, **MR. Aadarsh Choudhary** has satisfactorily completed the project report entitled **"Java program for forces acting on an aircraft"** during the academic year 2021-2022. He submitted this project in the partial fulfillment for the award of MASTER'S DEGREE OF SCIENCE (PHYSICS) underSAVITRIBAI PHULE PUNE UNIVERSITY, PUNE.

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-Aadarsh Choudhary

ABSTRACT

The java programmer is used to develop a relation between the four forces acting on an aircraft. The four forces acting on an aircraft during time of flight are Thrust, Drag, Lift, and Weight.

By using various laws and principle we derive the relation between the four forces acting on that aircraft. We use newton's 1st, 2nd and 3rd law and derive the exact values of the forces acting on the aircraft during the time of flight. By using Bernoulli's principle we define the values at different momentum of the aircraft.

This system deals with various terms of physics like velocity, momentum, weight, thrust and force. By this java program we can state the amount of work done and force experienced by the aircraft and can be used in various aspects to make aircraft more efficiently and more reliable to work with.

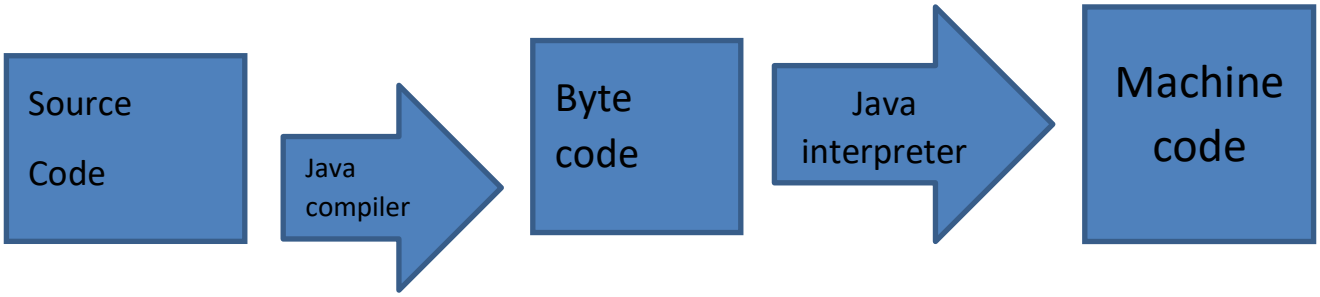
INTRODUCTION OF JAVA

Java was designed by "SUN MICROSYSTEM "of USA in 1991. Originally it was called as Oak language which is developed by James Gosling further in 1995 it was renamed as JAVA.

The main motivation for Java was to develop platform independent language which creates embedded software for consumer electronics devices.

 # Features of JAVA:

1] Compiled and interpreted language:



Java file class file

Java source code program can be compiling by using javac compiler which produces bytes code that is class file but this byte code is not exactly machine code so there is a need of java interpreterwhich converts this byte code to machine code which is directly executed by machine that's why java is known as compiled and interpreted language.

2] Object oriented language:

Java has been designed as a pure object oriented language which includes concept like class, encapsulation, inheritance etc. everything in java is a part of object the keyword new is used to create object of an class

Syntax:

Class name object=new class name ();

For example:

Demo T1 = new demo ();

Here T1 is the object or instance of class demo.

3] Robust and Secure Language:

There are three resources due to which java is known as robust and secure language.

a) Java is garbage collection language which means java releases the unused memory automatically.
b) Java supports the concept of exception handling to handle run time error.
c) By eliminating the pointer java unsure that user cannot access and modify data in the memory.

4] Distributed Language:

Java is designed as distributed language for creating an application over the network, it has an ability to share both data and program with the network. Java supports protocol like TCP, UDP, and FTP etc. These features enable multiple programmers for multiple remote locations to collaborate and work together on single project.

5] Multithreading and interactive language:

Multithreading is an ability of an application to execute more than one task (thread) at the same time. Java uses thread to utilized CPU ideal time due to this the performance of JAVA is very high as compared to c or c++.

Java supports the concept of AWT and saving using these we create stand art GUI application.

 # Meaning of public stat and void main:

1] Public:

It is the access specified that declare the main method and making it available or accessible throughout the class.

2] Static:

The keyword static allows main to call without creating any object.

3] Void:

The keyword void tells the compiler that main method does not return any value

4] **String args():**

The main function takes the away of string object as a parameter which stores the command line argument.

5] **System.out.print in**:

Here, system is a class out is the object and print in is the method of this class. It is similar to printf or count statement.

 # Primitive data type is characterized as follows:

Integer type:

byte – 1byte

Short – 2byte

Int – 4byte

Long – 8byte

Floating point type:

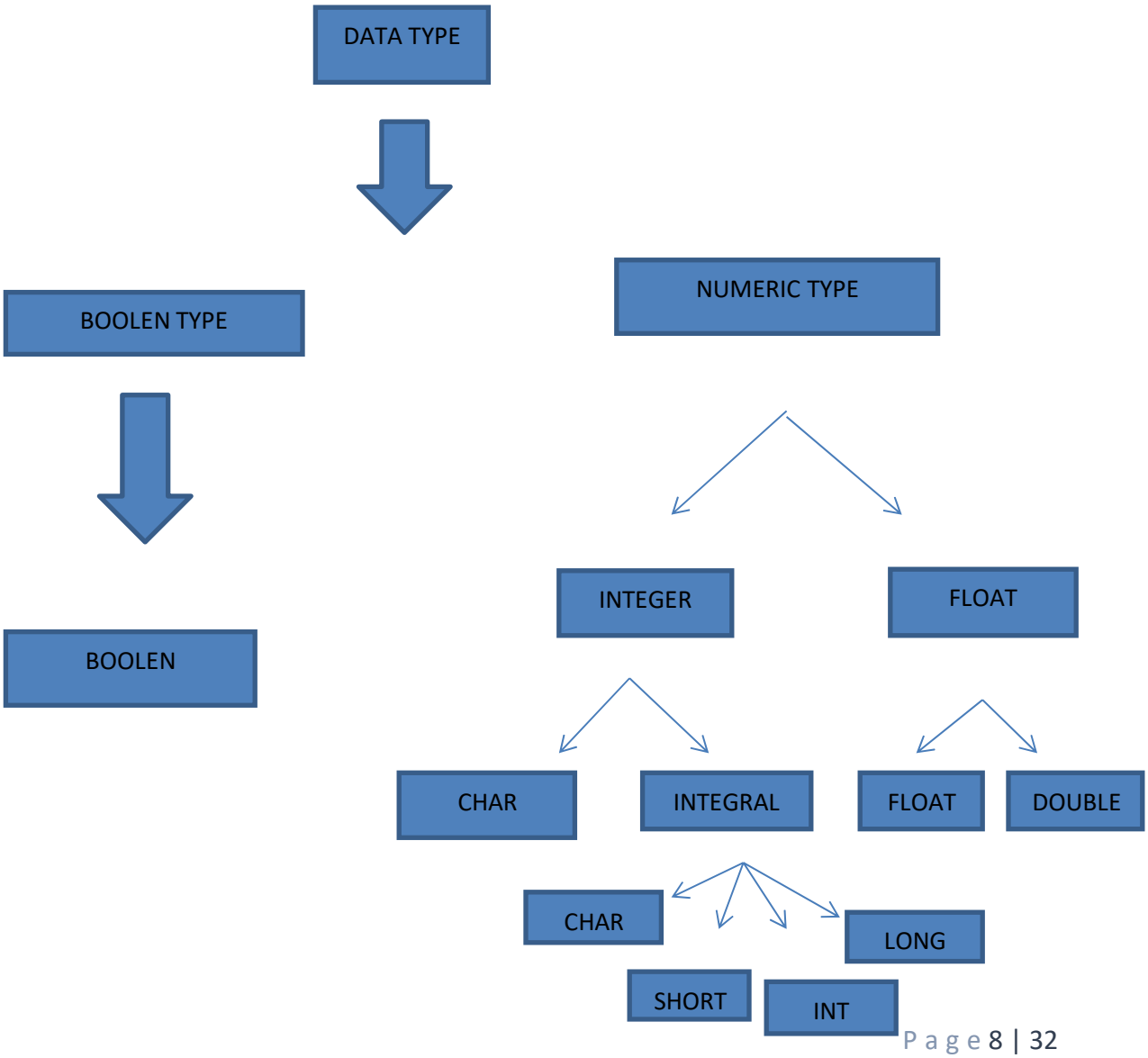
float – 4byte

Double- 8byte

Boolean type:

Boolean – 1byte (it only returns true value)

 # Data type in Java:



 # Characters in Java:

Character in java is not same as character in c and c++. In java it is of 16 bits that is 2 bytes. This character is known as universal or Unicode character in all human language that is it consist character from Greek, italic and Latin etc. There are total 65535 characters in java.

 # Types of conversion and costing:

To assign the value of one type of variable into another type if the two type of compatible (same group) then java will perform type conversion automatically. To perform this type of conversion two conditions are to be satisfied

1] Both the type of variable is compatible.

2] Sources type must be less than destination type that is byte can be converted into short, int, long, but the opposite conversion is not possible.

Type costing:

To create conversion between two incompatible type(float to int) then we must use caste operator that is explicit type conversion.

Syntax: (target data type) example:

For example: float a=3.5f;

Int 2=(int) a;

Output: 3

 # Classes and packages:

Class: class encapsulated a group of logically related data items and function together that works an them.

The variables which are declared inside the class are by default public or friendly. It means they are accessible throughout the program.

Object: once the class is defined then we can create object of that class through which we access methods or variables of a class.

Syntax:

Class name object=new class name ();

For example:

abc T= new abc ();

Garbage collection:

When an object of a class is no longer referred by any variable of a class then java automatically releases the memory occupied by that object it is known as garbage collection it is same as destructor in c++.

 # Java development tools:

TOOL NAME	DESCRIPTION
Javac	It is a java compiler which converts source code to byte code.
Java	It is an interpreter which is used to execute the byte code.
Java ap	It is a dissembler which works reverse to javac that coverts byte code into source code description.

Java doc	It creates html help file from java source code.
Jdb	It is java debugged which is used to set the break points and execute the program step by step.
JAR	It is java archive manager which combines and compress multiple file and directories into single file .
Applet viewer	It is used to execute java as applet program.

 # Variable in java:

There are two types of variables in java

1] **Instance variable**:

There are declared in the same way as that of local variable but there variable can access only inside the class.

2] **Class variable**:

There are global to a class and only instance of that class are access there type of variable. To declare class variable keyword statics is used. The default value of class variable is zero.

 # Methods in java

1] **Instant method**:

There are just like a normal function. Instant method can access both instance variable as well as class variable.

Syntax:

Return type method name (arguments)

{

Body;

}

For example: void display ()

{

:

}

2] **Class method**:

Class method is like a class variable. There are two conditions to be satisfied for class method.

a) There method can access only other classes' variable. They are not operated on instance variable.
b) To call the class method class name is required instead of object name.

Syntax: static return type method name([argument])

{

Body;

}

For example: static void display ()

{

:

}

 # Pre-defined classes

The java API (Application Programming Interface) provides rich set of classes and interfaces organized in package.

There are two important classes:

i) Object class
ii) Wrapper class

i) Object class:

The most important pre-defined class is the object class. It is at the top of class hierarchy in java. It is the most important because all the classes in java are derived from this class. The object class defined the basic state and behavior that all object must have such as ability to compare with another object, conversion string to object etc.

***Methods of object class:**

a) Equals()

Syntax: Boolean equals (object)

There method is used to compare two objects for their equality and returns true, if the objects of equal otherwise return false.

Example:

```
String s1=new string ("hello")

String s2=new string ("hello")

    If (s1.equals (s2))

    Sop ("objects are equal ");

   Else

    Sop ("objects are not equal");
```

b) Clone ():

Syntax: Protected object. Clone ();

It creates and return copy of original objects if we made any changes in original object, it will not reflect on its clone.

c) To string ();

Syntax: it returns string representation of an object

ii) Wrapper class:

Java offers to convert primitive data type into object by using wrapper class. If java compiler can make automatic conversion between primitive data type into respective object is known as auto boxing.

When java converts wrapper class into primitive data type then it is known as unboxing.

Primitive data type		**wrapper class**
a) int	→	integer
b) Float	→	float
c) Char	→	character
d) Long	→	long
e) Double	→	double
f) Boolean	→	Boolean

#Types of computer languages

Just as human uses language to communicate, and different regions have different languages, computers also have their own languages that are specific to them.

Different kinds of languages have been developed to perform different types of works on the computer. Basically, languages can be divided into two categories according to how the computer understands them.

Two basic type of computer language

I] Low level language –A language that corresponds directly to a specific machine

II] High level language – Any language that is independent of the machine

There are also types of languages, which include

A] System languages - These are designed for low- level tasks, like memory and process management

B] Scripting languages – These tends to be high level and very powerful

C] Domain-specific languages – These are only used in very specific context

D] Visual languages – Languages that are not text-based

E] Esoteric languages – Languages that are jokes or are not intended for serious use

These languages are not mutually exclusive, and some languages can belong to multiple categories. The terms low- level and high-level are also open to interpretation, and some languages that were once considered high-level are now considered low-level as languages have continued to develop.

Low- level languages

Low- level computer languages are either machine codes or are very close to them. A computer cannot understand instructions given to it in high-level languages or in English. It can only understand and execute instructions given in the form of machine language i.e. binary. There are two types of low-level languages:

I] Machine Language: A language that is directly interpreted into the hardware

II] Assembly Language: A slightly more user-friendly language that directly corresponds to machine language.

Machine Language

Machine language is the lowest and most elementary level of programming language and was the first type of programming language to be developed. Machine language is basically the only language that a computer can understand and it is usually written in hex.

In fact, a manufacture designs a computer to obey just one language, its machine code, which is represented inside the computer by a string of binary digits (bits) 0and 1. The symbol 0 stands for the absence of an electric pulse and the 1 stands for the presence of an electric pulse. Since a computer is capable of recognizing electric signals.

Assembly Languages

Assembly language was developed to overcome some of the many inconveniences of machine language. This is another low-level but very important language in which operation codes and operands are given in the form of alphanumeric symbols instead of 0's and 1's.

These alphanumeric symbols are known as mnemonic codes and can combine in a maximum of five-letter combinations eg ADD for addition, SUB for subtraction, START, LABEL etc. Because of this feature, assembly language is also known as 'symbolic Programming Languages'.

This language is also very difficult and needs a lot of practice to master it because there is only a little English support in this language. Most assembly language is used to help in compiler orientation. The instructions of the assembly language are converted to machine codes by a language translator and then they are executed by computer.

 # Difference between c++ and Java

C++	Java
It is hybrid between procedural as well as object oriented language	It is pure object oriented language
C++ is platform dependent	Java is platform independent
C++ supports operator overloading	Java does not support operator overloading
It support multiple inheritance	It does not support multiple inheritance for that java has interface
C++ is not case sensitive	Java is case sensitive language
C++ support pointer concept	Java does not support pointer concept
C++ is only compiled program	Java is compiled as well as interpreter language
C++ support header file	Instead of header file java uses packages

Newton's first law

The first law states that if the Net force(the vector sum of all forces acting on an object) is zero, then the velocity of the object is constant. Velocity is a vector quantity which expresses both the object speed and the direction of its motion; therefore, the statement that the object's velocity is constant is a statement that both its speed and the direction of its motion are constant.

Newton's second law

The second law states that the rate of change of momentum of a body is directly proportional to the force applied, and this change in momentum takes place in the direction of the applied force.

F=ma

F=force acting on the body m=mass of the body

a= acceleration of the body

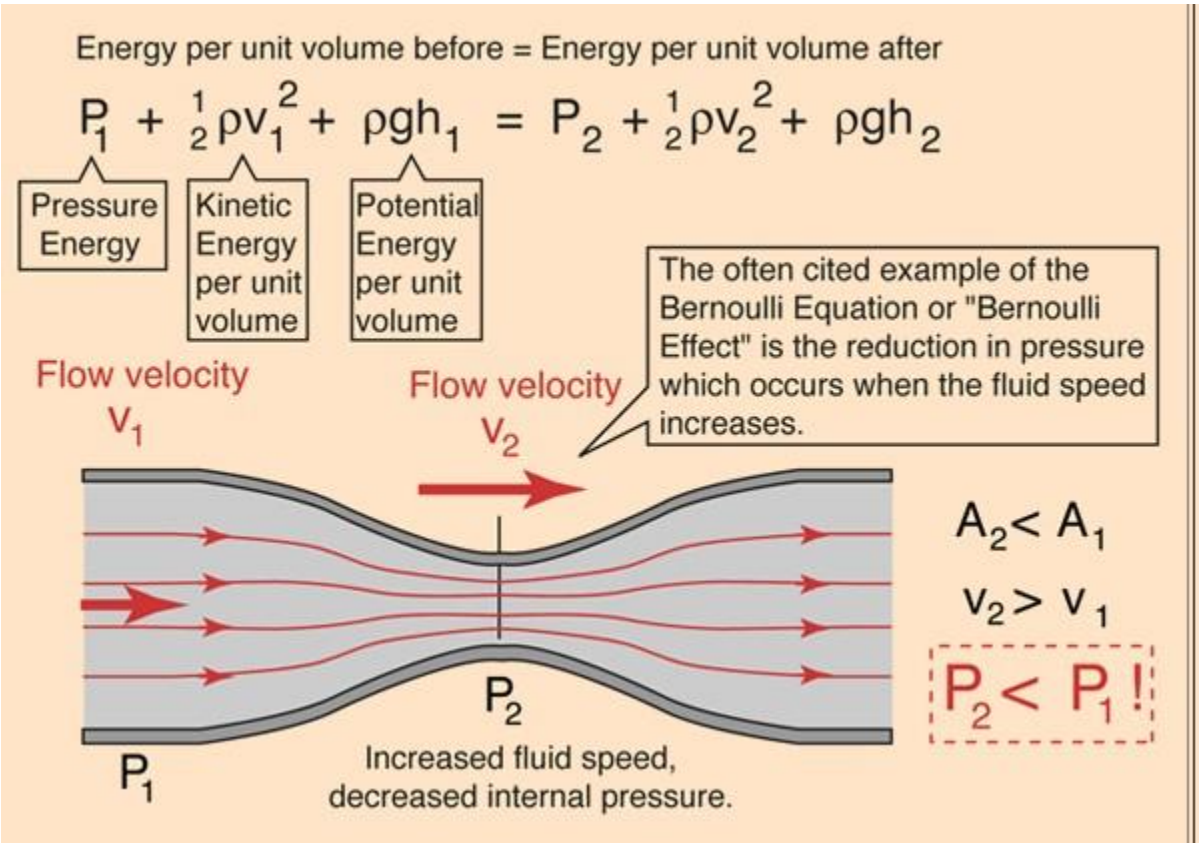
The second law can also be stated in terms of an object's acceleration. Since Newton's second law is valid only for constant-mass systems, *m* can be taken outside the differentiation operator by the constant factor rule in differentiation.

Newton's Third Law

To every action there is always an equal and contrary reaction; or the mutual actions of any two bodies are always equal and oppositely directed along the same straight line

Bernoulli's principle

Bernoulli's principle can be derived from the principle of conservation of energy. This states that in a steady flow the sum of all forms of energy in a fluid along streamlined is the same at all points on that streamlined .This requires that the sum of Kinetic energy , Potential energy an internal energy remains constant.

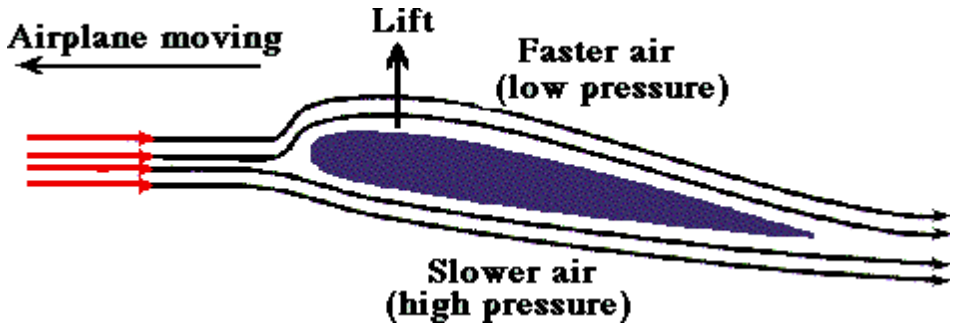


Forces Acting on An Airplane

There are four forces acting on the airplane all the time during airplane is flying. The four forces are

(1) Lift, (2) Gravity force or Weight, (3) Thrust, and (4) Drag. Lift and Drag are considered aerodynamics forces because they exist due to the movement of the Airplane through the Air.

1)Lift: is produced by a lower pressure created on the upper surface of an airplane's wings compared to the pressure on the wing's lower surfaces,causing the wing to be LIFTED upward. The special shape of the airplane wing (airfoil) is designed so that air flowing over it will have to travel a greater distance and faster resulting in a lower pressure area (see illustration) thus lifting the wing upward. Lift is that force which opposes the force of gravity (or weight).



Lift depends upon (1) shape of the airfoil (2) the angle of attack (3) the area of the surface exposed to the airstream (4) the square of the air speed (5) the air density

LIFT EQUATION

$$L = C_L \times d \times \frac{V^2}{2} \times A$$

L = Lift d = Density of Air

C_L = Lift Coefficient V = Velocity of Air

A = Wing Area

2) Weight: The weight acts vertically downward from the center of gravity (CG) of the airplane.

W= mass of aircraft + mass of fuel and passengers

W=m + m°

3) Thrust: is defined as the forward direction pushing or pulling force developed by aircraft engine. This includes reciprocating engines , turbojet engines, turboprop engines.

THRUST EQUATION

Thrust is a Force Force is the change in Momentum with time

$$F = \frac{([MV]_e - [MV]_0)}{(t_e - t_0)}$$

$m^{\cdot}$ = mass flow rate = mass / time

$m^{\cdot} = d \times V \times A$ = Density x Velocity x Area

Thus $F = m^{\cdot}_e V_e - m^{\cdot}_0 V_0$

4)Drag: is the force which opposes the forward motion of airplane. specifically, drag is a retarding force acting upon a body in motion through a fluid, parallel to the direction of motion of a body. It is the friction of the air as it meets and passes over an airplane and its components. Drag is created by air impact force, skin friction, and displacement of the air.

DRAG EQUATION

$$D = C_D \times d \times \frac{V^2}{2} \times A$$

D = Drag d = Density of Air

C_D= Drag Coefficient V = Velocity of Air

A = Wing Area

#Program based on forces acting on an aircraft

```
import java.util.Scanner;
class demo
{
	public static void main(String args[])
	{
		int num;
		System.out.println("Please select the formula you want to
use.");
		System.out.println("1. Thrust Equation\n2. Drag
Equation\n3. Lift Equation\n4. Weight");
		Scanner input = new Scanner(System.in);
		num = input.nextInt();
		switch(num)
		{
			case 1: double f, M,Ve,Vo;

	System.out.println("********************Thrust
Equation**********************");
				System.out.println("Enter Mass: ");
				M = input.nextDouble();
				System.out.println("Enter initial vilocity: ");
				Ve = input.nextDouble();
				System.out.println("Enter final vilocity: ");
				Vo = input.nextDouble();

				f = M*Ve - M*Vo;
				System.out.println("Thrust Equation (F)= "
+ f + " N");
```

```
                    break;

                case 2: double D, cd, v, A,d;

        System.out.println("********************Drag
Equation**********************");
                    System.out.println("Please enter values: ");
                    System.out.println("Enter the drag
coefficient: ");
                     cd = input.nextDouble();
                    System.out.println("Enter density of air: ");
                    d = input.nextDouble();
                    System.out.println("Enter velocity in air: ");
                    v = input.nextDouble();
                    System.out.println("Enter Wing area: ");
                     A = input.nextDouble();

                     D = cd * d * (v*v)*A/2 ;
                    System.out.println("Drag Equation (D)= " +
D +" N");
                    break;

                case 3:
System.out.println("********************Lift
Equation**********************");
                        double lift,cl,a;
                System.out.println("Enter the Density = ");
                d = input.nextFloat();
                        System.out.println("Enter the Velocity = ");
                v = input.nextFloat();
```

```
                    System.out.println("Enter the Wing Area =
");
                    a = input.nextFloat();
                System.out.println("Enter the Wing lift Coefficient
= ");
                cl = input.nextFloat();
                lift = cl*((d*((v*v)*a/2)));
                System.out.println("Lift Equation (L)= "+lift+ "
N");
                    break;

                case 4:
System.out.println("********************Weight**********************");
                double mass;
                double weight;
                double Gp;
                System.out.println("Enter weight of aircraft: ");
                mass = input.nextDouble();
                System.out.println("Enter the weight of
passengers/fuel: ");
                Gp= input.nextDouble();

                    weight = mass+Gp;
                System.out.println("Weight (W)= "+weight +
"kg/N");
                    break;


                default: System.out.println("Invalid Input! Please
try again...");
```

```
                    break;

                }
            }
}
```

#OUTPUT

```
C:\java>javac demo.java

C:\java>java demo

Please select the formula you want to use.

1. Thrust Equation

2. Drag Equation

3. Lift Equation

4. Weight

1

**********Thrust Equation**********

Enter Mass:

4953.22

Enter initial velocity:

619.44

Enter final velocity:
```

277.778

Thrust Equation (F)= 1692327.0516400002 N

F = 1692.330 KN

C:\java>java demo

1. Thrust Equation

2. Drag Equation

3. Lift Equation

4. Weight

2

**********Drag Equation**********

Please enter values:

Enter the drag coefficient:

0.09

Enter density of air:

1.225

Enter velocity in air:

619.44

Enter Wing area:

7.15

Drag Equation (D)= 151235.28768348004 N

C:\java>java demo

Please select the formula you want to use.

1. Thrust Equation

2. Drag Equation

3. Lift Equation

4. Weight

3

**********Lift Equation**********

Enter the Density =

1.225

Enter the Velocity =

619.44

Enter the Wing Area =

7.15

Enter the Wing lift Coefficient =

0.11

Lift Equation (L)= 184843.13590938773 N

C:\java>java demo

Please select the formula you want to use.

1. Thrust Equation

2. Drag Equation

3. Lift Equation

4. Weight

4

**********Weight**********

Enter weight of aircraft:

4953.229

Enter the weight of passengers/fuel:

2000

Weight (W)= 6953.229kg/N

C:\java>

RESULT AND FUTURE PROSPECT

1) Hence we have found out the various forces acting on the aircraft at the time of flight .

2) We have calculated the four forces value acting simultaneously on the aircraft for the mig-21 fighter aircraft. i.e.

i) Thrust = 169233.127N
ii) Drag = 151235.287N
iii) Lift = 184843.129N
iv) Weight = 6953.229Kg/N

3) By knowing the values we can help in constructing the aircraft more efficiently.

4) By knowing the ratios of Thrust/drag and Lift/weight we can calculate the amount of passengers and fuel capacity much more effectively.

5) wing span length of the aircraft can be determined effectively by the program.

6) this program is applicable for all types of aircraft from carriers to fighter to passengers aircraft.

REFRANCE

1) Java for absolute beginners: learn to program fundamentals
2) Core java - The practical guide for beginners.
3) NCC Air wing book.
4) 11th class NCERT book.