SCIENTIFIC CALCULATOR

A PROJECT REPORT

Submitted by

AARTHI S (8115U23EC001)

in partial fulfillment of requirements for the award of the course

EGB1201 - JAVA PROGRAMMING

in

ELECTRONICS AND COMMUNICATION ENGINEERING

K. RAMAKRISHNAN COLLEGE OF ENGINEERING

(An Autonomous Institution, affiliated to Anna University Chennai and Approved by AICTE, New Delhi)

SAMAYAPURAM – 621 112

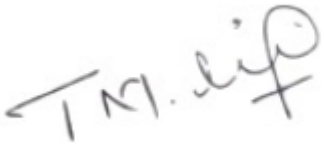
DECEMBER - 202

K. RAMAKRISHNAN COLLEGE OF ENGINEERING (AUTONOMOUS)

SAMAYAPURAM – 621 112

BONAFIDE CERTIFICATE

Certified that this project report on **"SCIENTIFIC CALCULATOR"** is the bonafide work of **AARTHI S (8115U23EC001)** who carried out the project work during the academic year 2024 - 2025 under my supervision.



SIGNATURE	**SIGNATURE**
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HEAD OF THE DEPARTMENT	**SUPERVISOR**
ASSOCIATE PROFESSOR	ASSISTANT PROFESSOR
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Samayapuram–621112.	Samayapuram–621112.

Submitted for the viva-voce examination held on 06/12/24.

INTERNAL EXAMINER

EXTERNAL EXAMINER

DECLARATION

I declare that the project report on **"SCIENTIFIC CALCULATOR"** is the result of original work done by us and best of our knowledge, similar work has not been submitted to **"ANNA UNIVERSITY CHENNAI"** for the requirement of Degree of **BACHELOR OF ENGINEERING**. This project report is submitted on the partial fulfilment of the requirement of the completion of the course **EGB1201 - JAVA PROGRAMMING.**

Signature

AARTHI S

Place: Samayapuram

Date: 06/12/2024

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It is with great pride that I express our gratitude and in-debt to our institution "**K.Ramakrishnan College of Engineering (Autonomous)**", for providing us with the opportunity to do this project.

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VISION OF THE INSTITUTION

To achieve a prominent position among the top technical institutions.

MISSION OF THE INSTITUTION

- M1: To bestow standard technical education par excellence through state of the art

  infrastructure, competent faculty and high ethical standards.

- M2: To nurture research and entrepreneurial skills among students in cutting edge technologies.

- M3: To provide education for developing high-quality professionals to transform the society.

VISION OF DEPARTMENT

To create eminent professionals of Computer Science and Engineering by imparting quality education.

MISSION OF DEPARTMENT

M1: To provide technical exposure in the field of Computer Science and Engineering through

state of the art infrastructure and ethical standards.

M2: To engage the students in research and development activities in the field of Computer

Science and Engineering.

M3: To empower the learners to involve in industrial and multi-disciplinary projects for addressing the societal needs.

PROGRAM EDUCATIONAL OBJECTIVES

Our graduates shall

PEO1: Analyse, design and create innovative products for addressing social needs.

PEO2: Equip themselves for employability, higher studies and research.

PEO3: Nurture the leadership qualities and entrepreneurial skills for their successful career.

PROGRAM SPECIFIC OUTCOMES (PSOs)

- **PSO1:** Apply the basic and advanced knowledge in developing software, hardware and firmware solutions addressing real life problems.

- **PSO2:** Design, develop, test and implement product-based solutions for their career enhancement.

PROGRAM OUTCOMES (POs)

Engineering students will be able to:

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences
3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations

4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions

5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations

6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice

7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development

8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. **Project management and finance:** Demonstrate knowledge and 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.

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

ABSTRACT

This project involves the development of a scientific calculator in Java, designed to handle both basic and advanced mathematical operations. The **Basic Mode** provides fundamental arithmetic functions such as addition, subtraction, multiplication, and division, ensuring user-friendly and error- free computations. Built with Java's robust libraries and object-oriented principles, the calculator is designed for cross-platform compatibility and maintainability. The project emphasizes clear error handling, including safeguards against invalid inputs like division by zero. By offering a seamless transition between basic and scientific modes, this calculator serves as a versatile tool for everyday use and more complex mathematical needs.

ABSTRACT WITH POs AND PSOs MAPPING

CO 5: BUILD JAVA APPLICATIONS FOR SOLVING REAL-TIME PROBLEMS.

ABSTRACT	POs MAPPED	PSOs MAPPED
This project involves the development of a scientific calculator in Java, designed to handle both basic and advanced mathematical operations. The **Basic Mode** provides fundamental arithmetic functions such as addition, subtraction, multiplication, and division, ensuring user- friendly and error-free computations. Built with Java's robust libraries and object- oriented principles, the calculator is designed for cross-platform compatibility and maintainability. The project emphasizes clear error handling, including safeguards against invalid inputs like division by zero. By offering a seamless transition between basic and scientific modes, this calculator serves as a versatile tool for everyday use and more complex mathematical needs.	**PO1** **PO2** **PO3** **PO4** **PO5** **PO6** **PO7** **PO8** **PO9** **PO10** **PO11** **PO12**	**PSO1** **PSO2**

Note: 1- Low, 2-Medium, 3- High

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CHAPTER 1

INTRODUCTION

1.1 Objective

The objective of this project is to create a scientific calculator in Java that combines both basic and advanced mathematical functionalities within a user-friendly interface. It aims to support fundamental arithmetic operations like addition, subtraction, multiplication, and division, while also providing advanced features such as trigonometric calculations, logarithms, and exponential functions. The calculator will include a seamless mode-switching capability between Basic and Scientific modes to cater to diverse user needs. With robust error handling for invalid inputs, the application ensures a reliable and smooth user experience. Leveraging Java's platform independence and maintainability, the project seeks to deliver a scalable and efficient solution for everyday and complex calculations.

1.2 Overview

This project is a Java-based scientific calculator that offers both basic and advanced mathematical functions. It includes **Basic Mode** for arithmetic operations (addition, subtraction, multiplication, division) and **Scientific Mode** for advanced functions (trigonometry, logarithms, exponentials). The calculator features a user-friendly interface, seamless mode switching, and robust error handling, ensuring reliability and ease of use. Built with Java’s libraries, it ensures cross-platform compatibility and maintainability.

1.3 Java Programming Concepts

1. **Object-Oriented Programming (OOP)**: Java uses OOP principles like **encapsulation**, **inheritance**, **polymorphism**, and **abstraction** to organize code into objects and classes.

2. **Classes and Objects**: A **class** defines the blueprint, and an **object** is an instance of that class.

3. **Methods and Functions**: Functions inside classes that define object behavior and perform tasks.

4. **Variables and Data Types**: Java uses **primitive types** (int, float) and **non-primitive types** (objects, arrays) to store data.

5. **Control Flow**: **if-else**, **switch**, and looping constructs like **for** and **while** manage the program's flow.

6. **Exception Handling**: **try-catch** blocks handle runtime errors like invalid input or division by zero.

7. **Arrays and Collections**: Use **arrays** for fixed-size data and **collections** like **ArrayList** for dynamic data storage.

8. **I/O**: Java handles user input/output via **Scanner** for input and **System.out** for output.

9. **Multithreading**: Java supports executing multiple threads for better performance in complex tasks.

10. **Packages and Libraries**: Java uses **packages** for code organization and offers built-in **libraries** (like `Math`) to extend functionality.

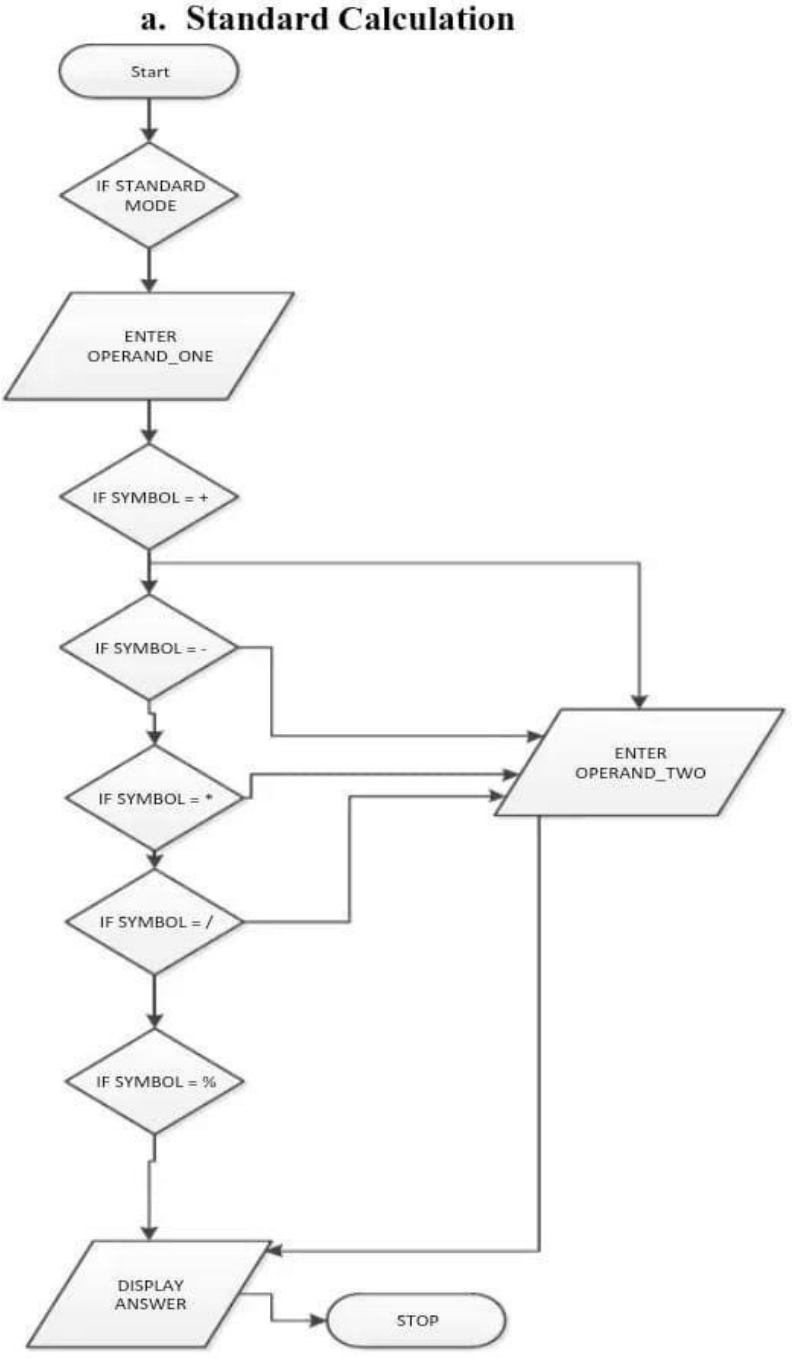
CHAPTER 2
PROJECT METHODOLOGY

2.1 Proposed Work

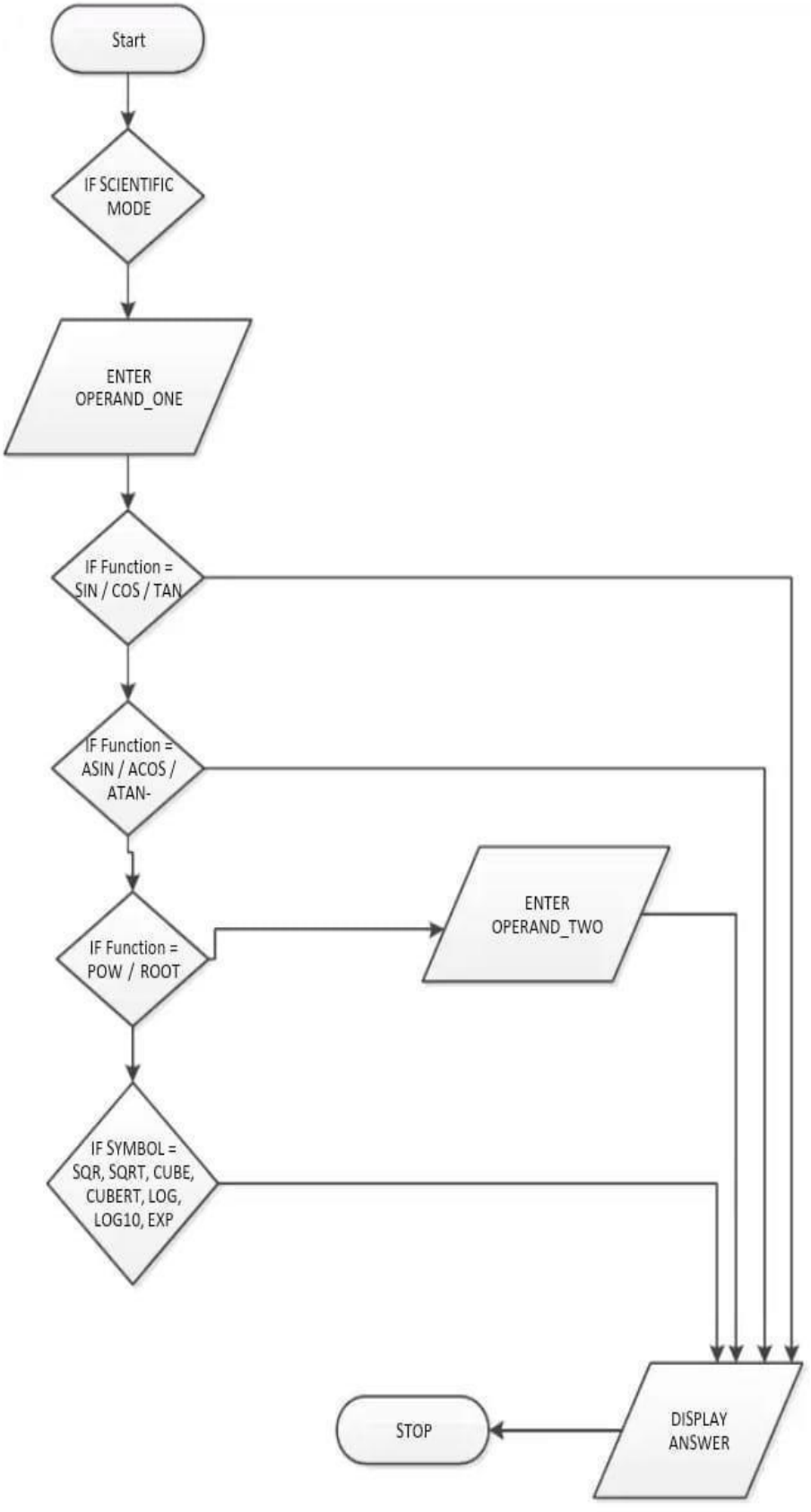
The proposed work involves developing a scientific calculator in Java with **Basic** and **Scientific** modes. Key tasks include:

1. **Basic Operations**: Implement core arithmetic functions (addition, subtraction, multiplication, division) with error handling.
2. **Scientific Operations**: Add advanced functions like trigonometry, logarithms, and exponentials using Java's **Math** library.
3. **User Interface**: Design a GUI with **Swing** or **JavaFX** for easy interaction and mode switching.
4. **Error Handling**: Implement input validation and meaningful error messages.
5. **Testing**: Test the application for accuracy and fix any issues.
6. **Documentation**: Provide clear user and technical documentation for the calculator.

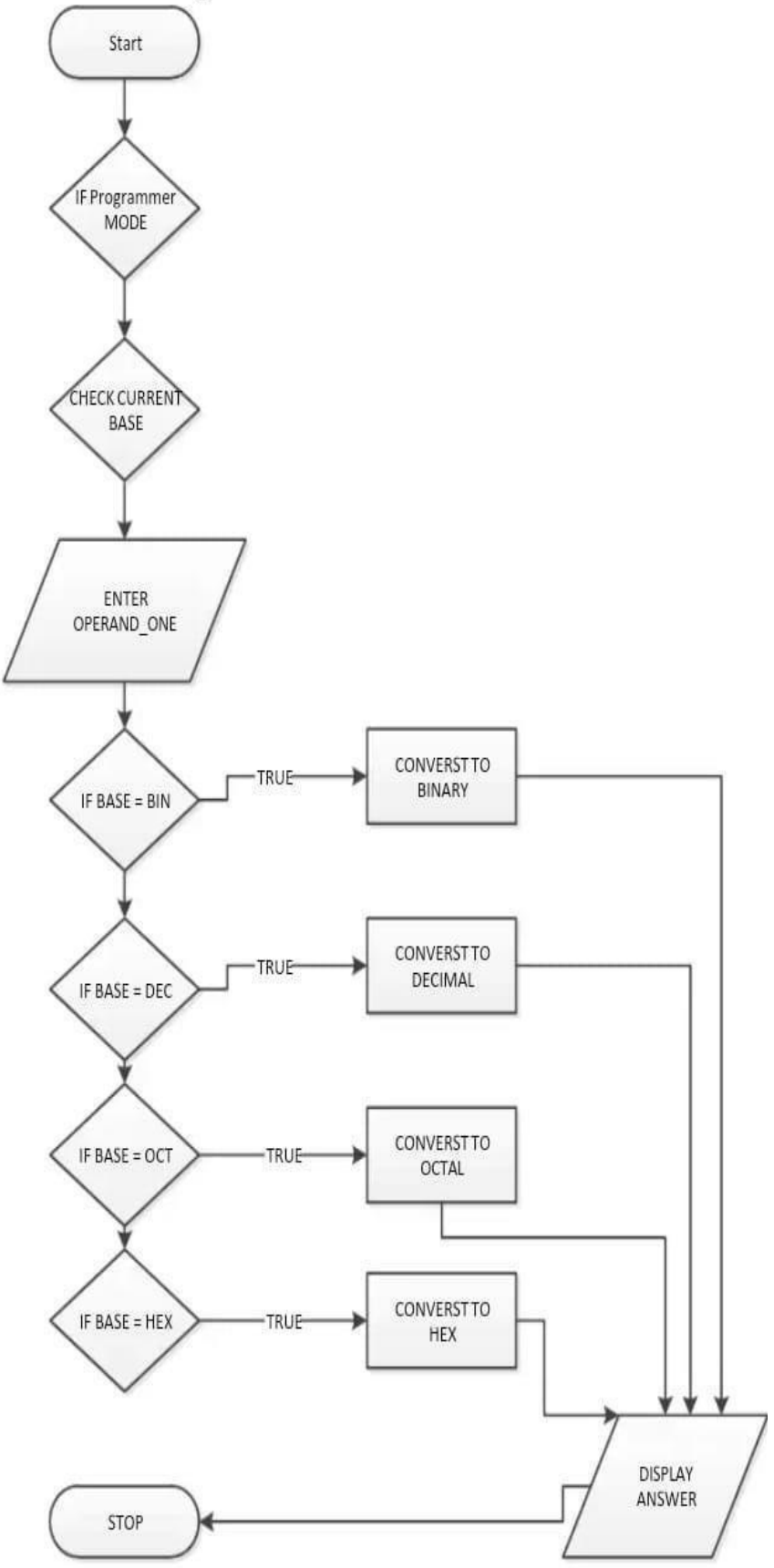
2.2 Block Diagram



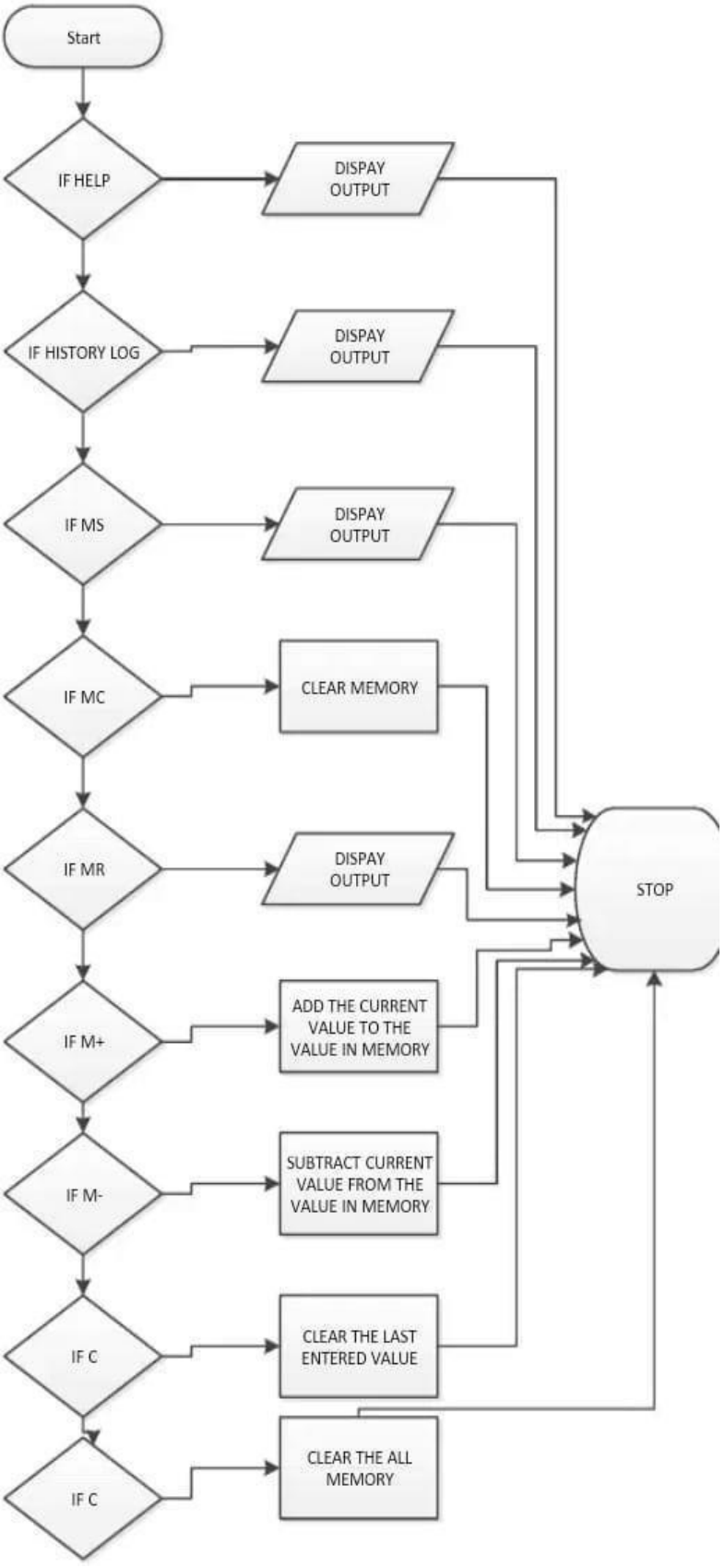
b. Scientific



c. Programmer



d. Other Functions



CHAPTER 3

MODULE DESCRIPTION

3.1 INPUT MODULE

This module manages user inputs, including numbers, mathematical operators, and mode selection (Basic or Scientific). It ensures the inputs are valid and appropriately formatted, and communicates them to the calculation modules. It also handles special cases like clearing inputs or performing calculations when the equals button is pressed.

3.2 BASIC OPERATION MODULE

This module handles fundamental arithmetic operations such as addition, subtraction, multiplication, and division. It is responsible for performing and returning the results of these operations. Additionally, it includes error handling to ensure that invalid operations, like division by zero, are managed gracefully**.**

3.3 Scientific Operations Module

This module provides advanced mathematical functions such as trigonometric operations (sine, cosine, tangent), logarithms, and exponential functions. It utilizes Java's built-in **Math** library to perform these calculations and returns accurate results based on user input.

3.4 User Interface (UI) Module

The UI module creates and manages the graphical user interface (GUI) of the calculator, enabling the user to interact with the application. It allows users to switch between Basic and Scientific modes, displays input and output, and ensures that the layout is intuitive and responsive. This module is built using Java's Swing or JavaFX libraries for cross-platform compatibility.

3.5 Error Handling Module:

This module ensures that the application behaves reliably by detecting and managing errors such as invalid inputs, division by zero, or unsupported operations. It displays appropriate error messages, helping users understand what went wrong and guiding them to provide valid inputs.

CHAPTER 4

CONCLUSION& FUTURE SCOPE

4.1 CONCLUSION

In conclusion, the Java-based scientific calculator project successfully integrates both basic and advanced mathematical operations into a single, user-friendly application. By implementing essential arithmetic functions alongside complex scientific calculations like trigonometry, logarithms, and exponentials, the calculator serves as a versatile tool for a wide range of users. The modular design—comprising input handling, basic operations, scientific functions, user interface, and error handling—ensures smooth functionality and robustness. Additionally, the graphical user interface (GUI) enhances the overall user experience, providing intuitive interaction and seamless mode switching. With error handling in place to manage invalid inputs, the calculator offers reliability and accuracy. This project demonstrates the power of Java in building cross-platform, maintainable, and scalable applications while meeting the needs of both casual and advanced users.

4.2 FUTURE SCOPE

The future scope of a scientific calculator in Java includes:

1. AI Integration: Enhancing user experience with predictive inputs and learning preferences.
2. Advanced Calculations: Supporting domains like physics, engineering, and data science.

3. Cross-Platform Access: Developing web/mobile apps and cloud storage.
4. Graphical Features: Adding 3D plotting and interactive UI.
5. Educational Tools: Offering step-by-step solutions and gamified learning.
6. IoT Connectivity: Integrating with smart devices and voice assistants.
7. Open Source Growth: Encouraging community-driven innovations.

APPENDIX

(SOURCE CODE)

```
import java.util.Scanner;


public class ScientificCalculator {

// Trigonometric calculations
   public static double calculateSine(double value) { return
Math.sin(Math.toRadians(value)); }
   public static double calculateCosine(double value) { return
Math.cos(Math.toRadians(value)); }
   public static double calculateTangent(double value) { return
Math.tan(Math.toRadians(value)); }
   public static double calculateSineInverse(double value) { return
Math.toDegrees(Math.asin(value)); }
   public static double calculateCosineInverse(double value) { return
Math.toDegrees(Math.acos(value)); }
   public static double calculateTangentInverse(double value) { return
Math.toDegrees(Math.atan(value)); }

// Logarithmic and exponential calculations
     public static double calculateNaturalLog(double value) { return
  Math.log(value); }
   public static double calculateLogBase10(double value) { return
Math.log10(value); }
public static double calculateExponential(double value) { return
```

```
Math.exp(value); }

// Conversion calculations
    public static String decimalToBinary(int decimal) { return
Integer.toBinaryString(decimal); }
    public static int binaryToDecimal(String binary) { return
Integer.parseInt(binary, 2); }
    public static String decimalToHexadecimal(int decimal) { return
Integer.toHexString(decimal).toUpperCase(); }
    public static int hexadecimalToDecimal(String hexa) { return
Integer.parseInt(hexa, 16); }
    public static String decimalToOctal(int decimal) { return
Integer.toOctalString(decimal); }
    public static int octalToDecimal(String octal) { return Integer.parseInt(octal,
8); }
    public static String binaryToOctal(String binary) { return
decimalToOctal(binaryToDecimal(binary)); }
    public static String octalToBinary(String octal) { return
decimalToBinary(octalToDecimal(octal)); }

public static void main(String[] args) { Scanner scanner = new Scanner(System.in);
    while (true) {
    System.out.println("1. Trigonometric Calculations"); System.out.println("2.
    Logarithmic and Exponential Calculations");System.out.println("3. Conversion
    Calculations");
```

```
System.out.println("0. Exit");

\System.out.print("Enter your choice: ");


    int choice = scanner.nextInt();
    switch (choice) {case 1:
    System.out.println("1. Sine"); System.out.println("2. Cosine");
    System.out.println("3. Tangent"); System.out.println("4. Sine Inverse");
    System.out.println("5. Cosine Inverse"); System.out.println("6. Tangent
    Inverse");System.out.print("Enter your choice: "); int trigChoice =
    scanner.nextInt(); System.out.print("Enter the value: "); double value =
    scanner.nextDouble();
    switch (trigChoice) {
    case 1: System.out.println("Sin(" + value + ") = " +calculateSine(value)); break;

    case 2: System.out.println("Cos(" + value + ") = " +calculateCosine(value));

    break;

    case 3: System.out.println("Tan(" + value + ") = " +calculateTangent(value));

    break;

    case 4: System.out.println("Sin Inverse(" + value + ") = " +

    calculateSineInverse(value)); break;

    case 5: System.out.println("Cos Inverse(" + value + ") = " +

    calculateCosineInverse(value));

    break;
```

```
    case 6: System.out.println("Tan Inverse(" + value + ") = " +
calculateTangentInverse(value)); break;


default: System.out.println("Invalid choice.");
}
break;case 2:
System.out.println("1. Natural Logarithm");System.out.println("2.
Logarithm Base 10");System.out.println("3. Exponential");
System.out.print("Enter your choice: ");
int logExpChoice = scanner.nextInt(); System.out.print("Enter the value: ");
value = scanner.nextDouble();
switch (logExpChoice) {
case 1: System.out.println("Log(" + value + ") = calculateNaturalLog(value));
break;
case 2: System.out.println("Log10(" + value + ") = " +
calculateLogBase10(value)); break;
case 3: System.out.println("Exp(" + value + ") = " +
calculateExponential(value)); break;
                default: System.out.println("Invalid choice.");
}
   break;case 3:
System.out.println("1. Decimal to Binary");System.out.println("2. Binary to
Decimal");
```

```
System.out.println("3. Decimal to Hexadecimal");
System.out.println("4. Hexadecimal to Decimal");
System.out.println("5. Decimal to Octal");
System.out.println("6. Octal to Decimal");
System.out.println("7. Binary to Octal");
System.out.println("8. Octal to Binary");
System.out.print("Enter your choice: ");

int convChoice = scanner.nextInt();switch (convChoice) {
case 1: System.out.print("Enter decimal number: "); int decimal
= scanner.nextInt(); System.out.println(decimal + " in binary is " +
decimalToBinary(decimal)); break;
case 2: System.out.print("Enter binary number: "); Stringbinary =
scanner.next(); System.out.println(binary + " in decimal is " +
binaryToDecimal(binary)); break;
case 3: System.out.print("Enter decimal number: "); decimal =
scanner.nextInt(); System.out.println(decimal + " in hexadecimal is " +
decimalToHexadecimal(decimal)); break;
case 4: System.out.print("Enter hexadecimal number: "); Stringhexa =
scanner.next(); System.out.println(hexa + " in decimal is " +
hexadecimalToDecimal(hexa)); break;
case 5: System.out.print("Enter decimal number: "); decimal =
scanner.nextInt(); System.out.println(decimal + " in octal is " +
decimalToOctal(decimal)); break;
case 6: System.out.print("Enter octal number: "); String octal =
scanner.next(); System.out.println(octal + " in decimal is " +
```

```
octalToDecimal(octal)); break;

  case 7: System.out.print("Enter binary number: "); binary = scanner.next();
System.out.println(binary + " in octal is " + binaryToOctal(binary)); break;
case 8: System.out.print("Enter octal number: "); octal =scanner.next();
System.out.println(octal + " in binary is " + octalToBinary(octal)); break;
default: System.out.println("Invalid choice.");
}
   break;case 0:
System.out.println("Exiting the program.");scanner.close();
   return;default:
System.out.println("Invalid choice.");
}
System.out.println();
}
}
}
```

CHAPTER 4

RESULTS AND DISCUSSION

Scientific calculator with scientific and basic modes

Output

```
java -cp /tmp/OUbZTrQlIf/ScientificCalculator
1. Trigonometric Calculations
2. Logarithmic and Exponential Calculations
3. Conversion Calculations
0. Exit
Enter your choice: 1
1. Sine
2. Cosine
3. Tangent
4. Sine Inverse
5. Cosine Inverse
6. Tangent Inverse
Enter your choice: 2
Enter the value: 6
Cos(6.0) = 0.9945218953682733

1. Trigonometric Calculations
2. Logarithmic and Exponential Calculations
3. Conversion Calculations
0. Exit
Enter your choice: 2
1. Natural Logarithm
2. Logarithm Base 10
3. Exponential
Enter your choice: 2
Enter the value: 24
Log10(24.0) = 1.380211241711606
```

Description

The Output From A Scientific Calculator Program Implemented In Java. It Shows A Terminal-Based Interface Where The User Is Prompted To Choose Between Various Calculation Modes: **Trigonometric Calculations**, **Logarithmic And Exponential Calculations**, And **Conversion Calculations**. The User Selects **Trigonometric Calculations** And Then Chooses **Cosine**. After Entering The Value **6**, The Calculator Returns The Result Of **Cos(6.0)** As **0.9945218953682733**. The User Then Switches To **Logarithmic And Exponential Calculations**, Selects **Logarithm Base 10**, And Enters **24**, With The Result Displayed As **Log10(24.0) = 1.3802112417171606**.

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