UNIVERSITI TEKNOLOGI MARA

A COMPREHENSIVE STUDY OF NEWTON'S METHOD, HALLEY'S METHOD, SUPER-HALLEY'S METHOD AND MODIFIED SUPER-HALLEY'S METHOD FOR SOLVING NONLINEAR EQUATIONS

HADFINA JAHIZAH BINTI HARUN

BSc

July 2026

TABLE OF CONTENTS

		Page
CONFIRMATION BY PANEL EXAMINERS		**i**
AUTHOR'S DECLARATION		**ii**
DECLARATION BY THE CANDIDATE		**iii**
ABSTRACT		**iv**
ACKNOWLEDGEMENT		**v**
TABLE OF CONTENTS		**vi**
LIST OF TABLES		**ix**
LIST OF FIGURES		**xi**
LIST OF SYMBOLS		**xii**
LIST OF ABBREVIATIONS		**xiii**
LIST OF NOMENCLATURE		**xiv**
CHAPTER 1 INTRODUCTION		**1**
1.1	Research Background	1
1.2	Problem Statement	2
1.3	Research Objectives	3
1.4	Significance of Study	4
1.5	Scope of the Project	4
1.6	Project Benefits	5
1.7	Definition of Term and Concept	5
1.8	Project Outline	6
CHAPTER 2 LITERATURE REVIEW		**7**
2.1	Introduction	7
2.2	Nonlinear equation	7
2.3	Iterative Method	8
2.4	Newton's Method	8
2.5	Halley's Method	9
2.6	Super-Halley's Method	10

2.7 Modified Super-Halley's Method 11
2.8 Conclusion 12

CHAPTER 3 RESEARCH METHODOLOGY 13
3.1 Introduction 13
3.2 Research Step 13
3.3 Algorithm 17
3.4 Conclusion 19

CHAPTER 4 IMPLEMENTATION 20
4.1 Introduction 20
4.2 Sample of Function 20
4.3 Implementation 25
4.3.1 Implementation of Newton's Method 25
4.3.2 Implementation of Halley's Method 26
4.3.3 Implementation of Super-Halley's Method 28
4.3.4 Implementation of Modified Super-Halley's Method 30
4.4 Conclusion 31

CHAPTER 5 RESULT AND DISCUSSION 32
5.1 Introduction 32
5.2 Result and Discussion 32
5.3 Performance Profile 47
5.4 Conclusion 49

CHAPTER 6 CONCLUSION AND RECOMMENDATION 51
6.1 Introduction 51
6.2 Conclusion and Discussion 51
6.3 Recommendations 52

ACKNOWLEDGEMENT

In the name of Allah, Most Gracious and Most Merciful. All thanks to His guidance, blessing and mercy I could finish this project successfully.

First and foremost, I would like to express my sincere gratitude to my supervisor, Madam Ruhana binti Jaafar, for her continuous support and assistance during my thesis writing. Without her guidance and help, my research would not have been completed successfully. Her knowledge, feedback and dedication have been instrumental in helping me complete this project successfully.

I would also like to extend my appreciation to my beloved family, my father Harun bin Awang, my mother Janita Taksiah binti Jinan Taib and my brother Ahmad Hafidz Jahiz bin Harun, for their continuous support during this thesis writing.

Finally, I would like to thank my friends, A'isyah, Ariesa, Aina, Izlyana and Umaira, for their unwavering support and encouragement during this project. Their unshakable faith in my abilities and support has been a continual source of inspiration.

Thank you everyone who directly and indirectly helping me completing this project. Your support and encouragement are sincerely appreciated.

ABSTRACT

This project analyses the efficiency of Newton's method, Halley's method, Super-Halley's method and Modified Super-Halley's method for solving nonlinear equations. The objective of this study is to identify the most effective method to solve nonlinear equations. These methods were tested using 10 nonlinear test functions consisting of combination of polynomial, trigonometric, logarithmic and exponential functions. The algorithm was tested under different initial guesses and measured using two tolerance levels. These nonlinear functions were executed using MAPLE 2016 software to determine their performance based on number of iterations and CPU time. SigmaPlot was then used to generate performance profiles to compare and analyse the graphs based on number of iterations and CPU time. This project observed that Super-Halley's method is the best performing method in terms of number of iterations. Super-Halley's method successfully solved all of the test functions with the fewest calculation steps. However, Newton's method is the fastest in terms of CPU time. Newton's method successfully solved all the test functions with the least computational cost. This project highlights that using higher-order method such as Modified Super-Halley's method does not guarantee the most efficient performance because higher-order method is highly sensitive to initial guesses and computationally expensive.