

Contents

Editor's Preface	ix
Preface	xi
Preliminaries	xiii

CHAPTER 1. *Multistep Methods*

1.1 Strategies to Derive Algorithms	1
1.2 Elements of the Theory of Backward Differences	2
1.3 The General Algorithm of the Multistep Methods	4
1.4 The Open Methods Euler, Adams-Bashforth, Nyström	6
1.5 The Closed Methods Adams-Moulton, Milne-Simpson, and Milne	8
1.6 Error Analysis: Local Truncation Error and Consistency.	10
1.7 Error Analysis: Error Propagation and Stability	18
1.8 Practical Issues Concerning Multistep Algorithms.	36
1.9 Predictor-Corrector Procedure for Closed Multistep Algorithms	40
1.10 User-oriented Investigation of the Accumulated Error for Multistep Methods	46
1.11 Multistep Methods for Second-Order Differential Equations of Special Form	63
1.12 The de Vogelaere Method	79
1.13 Methods to Solve Linear Second-Order Differential Equations	103
References	112

CHAPTER 2. *One-Step Methods*

2.1 Generalities	115
2.2 The Runge-Kutta Method; Various Versions	126

2.3	Step-Size Adjustment for Genuine One-Step Methods	135
2.4	Other Genuine One-Step Methods	145
2.5	Chebyshev Series Method	150
2.6	Special One-Step Methods	158
	References	167
CHAPTER 3. <i>Piecewise Perturbation Methods</i>		
3.1	Difficulties with the Classical Methods	170
3.2	A Constant Perturbation Method for Linear Non-homogeneous Second-order Equations	177
3.3	General Piecewise Perturbation Approach	182
3.4	Constant Perturbation Methods	195
3.5	Line Perturbation Methods	219
3.6	Piecewise Perturbation Methods for Systems of Differential Equations	233
3.7	Perturbation Solution of Differential Equations with Singular Coefficients	245
3.8	A Way to Improve the Accuracy of Classical Algorithms.	254
	References	260
CHAPTER 4. <i>Boundary Value Problems</i>		
4.1	Generalities	263
4.2	Shooting Methods.	265
4.3	Direct Methods	273
4.4	Eigenvalue Problems	283
4.5	The Schrödinger Equation	289
	References	295
CHAPTER 5. <i>Practical Applications</i>		
5.1	Formulation of the Test Problem	297
5.2	Organization of the Program.	299
5.3	The Program	301
5.4	Discussion of the Results	324
	<i>Subject Index</i>	335