

Contents

Introduction, 1

- 0.1. Definitions. Classification of problems, 1
- 0.2. Necessity of numerical methods for solving differential equations, 2
- 0.3. Discrete variable methods, 3
- Notes, 5

PART I. ONE-STEP METHODS FOR INITIAL VALUE PROBLEMS

7

***Chapter 1. Euler's method for a single equation of the first order*, 9**

- 1.1. Introduction, 9
- 1.2. The existence of a solution of the initial value problem, 15
- 1.3. The discretization error of Euler's method, 26
- 1.4. The round-off error in Euler's method, 35
- 1.5. Random variables, 41
- 1.6. Probabilistic theory of round-off errors, 50
- 1.7. Problems for solution, 59
- Notes, 63

***Chapter 2. General one-step methods for a single equation of the first order*, 64**

- 2.1. Special one-step methods, 65
- 2.2. The discretization error of the general one-step method, 70
- 2.3. The round-off error in the general one-step method, 87
- 2.4. Problems for solution, 100
- Notes, 106

Chapter 3. General one-step methods for systems of equations of the first order, 108

- 3.1. Theoretical introduction, 108
- 3.2. Special one-step methods for systems, 117
- 3.3. The discretization error of one-step methods, 123
- 3.4. The round-off error in the integration of systems by one-step methods, 137
- 3.5. Problems for solution, 158
- Notes, 163

Chapter 4. One-step methods for systems of equations of higher order, 164

- 4.1. Introduction, 164
- 4.2. Numerical methods for system of equations of higher order, 167
- 4.3. Discretization error, 173
- 4.4. Propagation of round-off error, 178
- 4.5. Problems for solution, 181
- Notes, 184

PART II. MULTISTEP METHODS FOR INITIAL VALUE PROBLEMS

185

Chapter 5. Multistep methods for equations of the first order, 187

- 5.1. Special multistep methods, 187
- 5.2. General discussion of linear multistep methods, 209
- 5.3. The discretization error of linear multistep methods, 235
- 5.4. Round-off error in the integration by multistep methods, 262
- 5.5. Problems and supplementary remarks, 281
- Notes, 287

210 Difference
Eqns.

Chapter 6. Multistep methods for special equations of the second order, 289

- 6.1. Local study of linear multistep methods, 290
- 6.2. The discretization error, 312
- 6.3. Propagation of round-off error, 318
- 6.4. Summed form of the difference equations, 327
- 6.5. Problems and supplementary remarks, 339
- Notes, 342

PART III. BOUNDARY VALUE PROBLEMS**345*****Chapter 7. Direct methods for a class of nonlinear boundary value problems of the second order, 347***

- 7.1. Method of solution, 347
 - 7.2. Existence of a solution of the difference scheme, 358
 - 7.3. The discretization error in boundary problems of class M , 374
 - 7.4. Influence of round-off error, 377
 - 7.5. Problems and supplementary remarks, 384
- Notes, 388

Bibliography, 389

Index, 401