

Contents

PREFACE	xiii
A SUGGESTED TIME SCHEDULE FOR LECTURES	xvii
An Introductory Comment	3
CHAPTER 1. INTRODUCTION TO ERROR ANALYSIS	5
1.1 Input Errors	8
1.2 Errors in Addition and Subtraction	16
1.3 Floating-Point Multiplication and Division	28
1.4 Truncation Errors	33
1.5 Chains of Calculations	48
1.6 Some Programming Hints	49
CHAPTER 2. THE SOLUTION OF AN EQUATION	52
2.1 Starters	53
2.2 The Method of Simple Iteration	63
2.3 The Newton-Raphson Method (Part I)	70
2.4 The Newton-Raphson Method (Part II)	83
CHAPTER 3. SYSTEMS OF LINEAR EQUATIONS	87
3.1 The Gauss-Jordan Method	93
3.2 Seidel Iteration	107
3.3 Matrix Inversion	110
3.4 Determinants	127
3.5 Eigenvalue Problems	137
CHAPTER 4. NON-LINEAR SYSTEMS	155
4.1 Starters	155
4.2 Theory for the Many-Dimensional Newton-Raphson Formula	168
4.3 The Newton-Raphson Algorithm for Many Equations	175
CHAPTER 5. CLASSICAL INTERPOLATION THEORY	182
5.1 The Interpolating Polynomial	184
5.2 Factorial Functions	194
5.3 The Forward Difference Operator	199
5.4 Repeated Differences	209

CHAPTER 6.	SUMMATION BY FORMULA	221
6.1	Sums of Differences	222
6.2	Other Series	227
6.3	Summation by Parts	234
6.4	Homogeneous Linear Difference Equations	239
6.5	Non-homogeneous Linear Difference Equations	252
CHAPTER 7.	THE TAYLOR SERIES	257
7.1	The Taylor Series (Part I)	258
7.2	The Taylor Series (Part II)	264
CHAPTER 8.	SERIES OF POWERS AND FRACTIONS	280
8.1	Series of Powers	280
8.2	Series of Fractions	287
CHAPTER 9.	THE FOURIER SERIES	300
9.1	The Infinite Fourier Series	300
9.2	Harmonic Analysis	323
CHAPTER 10.	THE CHEBYSHEV CRITERION	348
10.1	The “Best” Polynomial Approximation	349
10.2	The Chebyshev Series by Integration	358
10.3	The Chebyshev Series for a Polynomial	374
CHAPTER 11.	THE CHEBYSHEV SUMMATION	382
11.1	The Finite Series	382
11.2	The Hastings Method	407
11.3	The Method of Rational Fractions	418
CHAPTER 12.	INTEGRATION BY COMPUTER	431
12.1	Preliminary Steps for Computer Integration	436
12.2	Newton-Cotes Formulas, Closed Type	438
12.3	Simpson’s Rule and the Richardson Extrapolation	447
12.4	The Trapezoidal Rule and the Romberg Extrapolation Procedure	460
12.5	Integration by Chebyshev Summation	473
CHAPTER 13.	FIRST-ORDER ORDINARY DIFFERENTIAL EQUATIONS	486
13.1	Graphical Approximations for First-Order Differential Equations	491
13.2	The Runge-Kutta Algorithm (First Order)	494
13.3	Predictor-Corrector Methods: First Order	513

CHAPTER 14. SECOND-ORDER ORDINARY DIFFERENTIAL EQUATIONS	528
14.1 Series Methods for Second-Order Differential Equations	528
14.2 Higher-Order Differential Equations: The Runge-Kutta Algorithm	552
14.3 Predictor-Corrector Method: Second Order	564
14.4 Second-Order Differential Equations Lacking the y' Term	574
14.5 The Boundary-Value Problem	580
APPENDIX—TABLES	586
SELECTED BIBLIOGRAPHY	600
ANSWERS TO NUMERICAL PROBLEMS	601
INDEX	614