

Contents

LIST OF CONTRIBUTORS	v
PREFACE	vii

A Finite Difference Scheme for Generalized Neumann Problems

K. O. Friedrichs and H. B. Keller

1. Introduction	1
2. The Difference Method and Convergence for the Neumann Problem	2
3. The Finite Difference Equations	7
4. Interpretation of the Finite Difference Equations	10
5. Systems with Variable Coefficients	13
References	19

Remarks on the Order of Convergence in the Discrete Dirichlet Problem

Bert Hubbard

1. Introduction	21
2. Definitions	22
3. The Dirichlet Problem	24
4. Estimates for Derivatives (Richardson's Method)	28
5. Problems with Singularities (Exterior Problems)	31
References	34

Fluid Dynamical Calculations

Eugene Isaacson

1. Introduction	35
2. Motion of Cold Fronts	35
3. Flood Waves in Rivers	42
4. Summary and Acknowledgments	48
References	48

Difference Approximations for Hyperbolic Differential Equations

Heinz-Otto Kreiss

1. Cauchy Problem	51
2. Initial-Boundary Value Problem	54
References	57

Discrete Methods for Nonlinear Two-Point Boundary Value Problems

Milton Lees

1. Introduction	59
2. A Discrete Boundary Value Problem	63
3. Newton's Method	67
4. The Difference Correction	69
References	72

Remarks on the Numerical Computation of Solutions of $\Delta u = f(P, u)$

Seymour V. Parter

1. Introduction	73
2. Analytic Preliminaries	73
3. Finite-Difference Equations	76
4. Convergence Theorems	79
References	82

Error Bounds Based on A Priori Inequalities

Lawrence E. Payne

1. Introduction	83
2. A Priori Bounds	83
References	92

On Admissibility in Representations of Functions of Several Variables as Finite Sums of Functions of One Variable

David A. Sprecher

1. Introduction and Summary	95
2. On Separation of Points	98
3. A Partition of Functions	103
4. The Problem of Admissibility	105
References	108

Stability of Nonlinear Discretization Algorithms*Hans J. Stetter*

Text	111
References	123

On Maximum-Norm Stable Difference Operators*Vidar Thomée*

Text	125
References	151

A Posteriori Error Bounds in Iterative Matrix Inversion*H. F. Weinberger*

1. Introduction	153
2. The Symmetric Case	156
3. Some Numerical Results	159
4. An Improved Approximation	161
5. Remarks on Nonsymmetric Matrices	163
References	163

Finite Difference Methods for Solving Systems of Partial Differential Equations*I. Flügge-Lotz*

Text	165
----------------	-----

Some Numerical Results in Intermediate Problems for Eigenvalues*A. Weinstein*

Text	167
References	189

Stability of Linear and Nonlinear Difference Schemes*Peter D. Lax*

Text	193
References	195

The Solutions of Multidimensional Generalized Transport Equations and Their Calculation by Difference Methods

Avron Douglis

Introduction	197
1. Statement of Problem; Notation; Minimal Assumptions	197
2. Reduction of Problem to an Integral Equation	202
3. Some Appropriate Function Spaces	208
4. Continuous Dependence, Uniqueness, and Existence	210
5. A Priori Lipschitz Conditions for Weak Solutions; Lipschitz Condition with Respect to t	216
6. An A Priori Lipschitz Condition for u with Respect to the $x_s, s = 1, \dots, d$	221
7. Determination and Behavior of t^* and x^*	224
8. Proofs of Auxiliary Estimates	229
9. Positivity and Monotonic Dependence	237
10. Truncation	239
11. Difference Scheme Notation; Some Remarks	242
12. Statement of Difference Equations	246
13. Outline of Convergence Proof	249
14. A Bound for the Solution of the Difference Equations and an Estimate for Its t Difference Quotients	250
15. Boundary Behavior	252
16. Lipschitz Conditions in Truncated Problems	253
References	256

Application of Integral Operators to Singular Differential Equations and to Computations of Compressible Fluid Flows

Stefan Bergman

1. Introduction	257
2. The Integral Operator Generating Solutions of Eq. (1.1)	259
3. The Equation for the Stream Function ψ of Compressible Fluid in the Pseudo-logarithmic Plane	268
4. A Set $\psi_{\nu}, \nu = 1, 2, \dots$, of Particular Solutions of Eq. (3.3) Obtained Using the Generating Function (3.13)	276
5. Remarks on Application of Integral Operators for Numerical Purposes	280
References	283

Numerical Solution of the Telegraph and Related Equations

Garrett Birkhoff and Robert E. Lynch

A. Introduction	
1. Telegraph Equation	289
2. Infinitesimal Amplification Factors	291
3. Relevant Difference Schemes	293
B. Thermal Transients in Reactor Channels	
4. Physical Problem	295
5. Simplified Model	296
6. Conduction Equation	297
7. Convection Equation	298
C. Regenerator Problems	
8. The Mathematical Model	301
9. Asymptotic Discussion	303
10. Moments	304
11. Characteristic Triangular Meshes	308
D. Generalizations	
12. Hyperbolic Systems of Positive Type	309
13. Asymptotic Behavior	312
References	314

Approximation and Estimates for Eigenvalues

Gaetano Fichera

1. Eigenvalue Problems, the Rayleigh-Ritz Method	318
2. The Weinstein-Aronszajn Method	323
3. Construction of the Intermediate Operators	328
4. Orthogonal Invariants of Positive Compact Operators	332
5. Upper Approximation of the Eigenvalues of a PCO; Representation of Orthogonal Invariants	338
Bibliography	351

Approximate Continuation of Harmonic and Parabolic Functions

Jim Douglas, Jr.

1. Introduction	353
2. Harmonic Continuation in a Disk	353
3. Harmonic Continuation in a Half-Plane	360
4. Continuation of Solutions of the Heat Equation	361
References	363

Hermite Interpolation-Type Ritz Methods for Two-Point Boundary Value Problems

Richard S. Varga

1. Introduction	365
2. The Spaces $H_N^{(m)}$ and H	365
3. Accuracy	367
4. Determination of the Best Approximation in $H_N^{(m)}$	369
5. Connection with Other Methods	370
6. A Posteriori Error Bounds and Spines	372
References	373

