CONTENTS

Preface

Chapter I. Introduction

I.1. I.2. I.3. I.4. I.5.	Introductory example Basic Difference Operators Lax's Theorem The Fourier Method References	1 7 12 15 20
	Chapter II. Parabolic Equations	
11.1.	Introduction to Parabolic Equations	21
11.2.	Finite Difference Methods for a Single Parabolic	
	Equation in One Space Dimension	24
11.3.	Finite Difference Methods for a Single Parabolic	
	Equation in Several Space Dimensions	35
11.4.	Fractional Step Methods	44
11.5.	Alternating Direction Implicit Methods	59
11.6.	Effect of Lower Order Terms	68
11.7.	Systems of Parabolic Equations	73
11.8.	Weak Stability	81
11.9.	Multilevel Methods	84
II.10.	Boundary Conditions Involving Derivatives	88
ĨĨ.11.	Parabolic Equations with Variable Coefficients	94
ÎI.12.		110
II.13.		116
11.14.	Irregular Boundaries	130
11.15.		134
II.16.		141
TT*10*	Verelences	141

Chapter III. Hyperbolic Equations

Introduction to Hyperbolic Equations	143
The Courant-Friedrichs-Lewy Condition	151
The Algebraic Characterization of Accuracy	162
	168
The Lax-Wendroff Method	173
Dispersion and Dissipation	176
Implicit Methods	
Systems of Hyperbolic Equations in One Space	
Dimension	190
Systems of Hyperbolic Equations in Several Space	
Dimensions	196
Multilevel Methods	206
Hyperbolic Equations with Variable Coefficients	217
Random Choice Methods	
Asymptotic Error Expansion	241
How Accurate Should a Finite Difference Method Be?	244
Numerical Examples	252
References	266
	The Courant-Friedrichs-Lewy Condition The Algebraic Characterization of Accuracy Finite Difference Methods with Positive Coefficients The Lax-Wendroff Method Dispersion and Dissipation Implicit Methods Systems of Hyperbolic Equations in One Space Dimension Systems of Hyperbolic Equations in Several Space Dimensions Multilevel Methods Hyperbolic Equations with Variable Coefficients

vii

Chapter IV. Hyperbolic Conservation Laws

IV.1. IV.2. IV.3. IV.4. IV.5. IV.6. IV.7.	Introduction to Hyperbolic Conservation Laws Conservative Finite Difference Methods Monotone Difference Methods The Godunov and Random Choice Methods Corrective and High Resolution Methods Numerical Examples References Chapter V. Stability in the Presence of Boundaries	284 298 321 333 355
V.1. V.2. V.3. V.4.	Introduction Ryabenki-Godunov Theory Stability of Initial Boundary-Value Problems for Hyperbolic Equations References	375 385
A. B. C. D.	Appendices The Kreiss Matrix Theorem and Its Consequences Kreiss' Stability Theorems for Dissipative Methods The Lax-Nirenberg Theorem and a Special Case Hyperbolic Equations with Discontinuous Initial Data	403 417
	Index	445