## **Contents**

	Pref	ace	X
1.	Introduction		
	1.1	"Historical" Background	]
	1.2	Numerical Methods	]
	1.3	Optimization Techniques	4
	1.4	Computer Philosophy Used in the Text	4
	1.5	Error Analysis	6
		Problems	1
2.	Solution of Linear Equations		
	2.1	Introduction	15
	2.2	Cramer's Rule	16
	2.3	The Matrix Solution	17
	2.4	Gauss Elimination	19
	2.5	Crout Reduction	29
	2.6	Suggested Reading in Related Topics	36
		Problems	38
3.	Solutions for a Nonlinear Equation		
	3.1	Introduction	43
	3.2	Iterative Procedures	44
	3.3	Newton's Method	45
	3.4	Quadratic Interpolation and Muller's Method	50
	3.5	Bairstow's Method	57
	3.6	Suggested Reading in Related Topics	64
		Problems	67
4.	Interpolation		
	4.1	Introduction	71
	4.2	A Unique Solution	72

7111	Contents

	4.3	The Normalized Variable	73
	4.4	Some Useful Operators, $\Delta$ and $E$	74
	4.5	Difference Tables	77
	4.6	The Newton-Gregory Polynomial	78
	4.7	The Lagrange Polynomial	82
	4.8	Inverse Interpolation	85
	4.9	Introduction to Least-Squares Data Fitting	86
	4.10	Spline Functions	89
	4.11	Fourier Series Applied to Interpolation	91
	4.12	Suggested Reading in Related Topics	97
		Problems	100
5.	Diffe	erentiation	
	5.1	Introduction	103
	5.2	Method of Interpolating Polynomials	103
	5.3	Method of Undetermined Coefficients	104
	5.4	Application of Interpolating Programs	107
		Problems	111
			113
6.	Integration		115
	6.1	Introduction	115
	6.2	Trapezoidal Rule	116
	6.3	Simpson's Rules	121
	6.4	Examples	125
	6.5	Romberg Prediction	127
	6.6	Method of Undetermined Coefficients	129
	6.7	Predictor and Corrector Equations	131
	6.8	Gaussian Quadrature	134
	6.9	Suggested Reading in Related Topics	137
		Problems	139
7.	Soluti	ion of Differential Equations	143
	7.1	Introduction	143
	7.2	Classification of Differential Equations	143
	7.3	Euler Method	144
	7.4	Stability Analysis	147
	7.5	Modified Euler Method	151
	7.6	Runge-Kutta Method	153

Cont	lent <b>s</b>		ix		
	7.7	Adams Method and Automatic Error Control	156		
	7.8	Solution of Higher-Order Differential Equations	163		
	7.9	Boundary-Value Problems	169		
	7.10	Suggested Reading in Related Topics	172		
		Problems	174		
8.	Introduction to Optimization Theory				
	8.1	Preliminary Remarks	177		
	8.2	Formulation of Optimization Problems	179		
	8.3	Overview of Various Optimization Techniques	181		
	8.4	The Simplex Optimization Technique	183		
	8.5	Applications of Simplex	190		
	8.6	Test Functions	195		
		Problems	202		
9.	Grad	ient Techniques	205		
	9.1	Introduction	205		
	9.2	Quadratic Interpolation for a Specific Direction	206		
	9.3	The Gradient	208		
	9.4	The Steepest-Descent Optimization Technique	211		
	9.5	Applications of Steepest Descent	220		
	9.6	The Fletcher-Powell Optimization Technique	226		
		Problems	233		
10.	The	Least- <i>p</i> th Optimization Technique	237		
	10.1	Introduction	237		
	10.2	The Least-Squares Algorithm	238		
	10.3	The Least-pth Algorithm	242		
	10.4	A Least-pth Program	244		
	10.5	Application to Least-Squares Data Fitting	252		
	10.6	Chebyshev Approximations	256		
		Problems	263		

11. Constrained Optimization Problems

11.2 Active Constraints versus Inactive Constraints

11.1 Introduction

11.3 Transformations

265

265

266

269

Inde	x					291
References Answers to Selected Problems						287
						285
mqu	Problems					282
11.5 nigu		Comments	about	Optimization	Tech-	280
11.4	Penalty Fund	ctions			<b>7</b> 5. 1	276