

contents

1	Computational Error	1
	Significant numbers	3
	Range numbers	3
	Approximation-error numbers	6
	An error-limited problem	8
2	Taylor Series and Divided Differences	11
	Taylor's series	15
	Divided-difference polynomials	19
3	Interpolation	30
	Simultaneous-equation approach	31
	Lagrangian interpolation	32
	Equal-interval interpolation	37
4	The Solution of Equations	54
	Newton's method	54
	Difference methods	58
	The method of successive approximations	61
	Half-interval method	67
	Multiple roots	71
	Solving polynomial equations	72
	Complex roots of polynomials	78
5	Numerical Integration	81
	Gaussian quadrature	86
	Numerical differentiation	96
6	Systems of Equations	101
	Properties of systems	103
	Matrix operations	105
	Elimination or reduction	109

	An improvement for the elimination method	118
	Determinants	119
	Matrix inversion	130
	Elementary row operations	133
	Factoring	135
	Pivot-element selection	138
	An interchange algorithm	139
	Special treatment for tridiagonal coefficient matrices	144
	Iterative methods	146
	Relaxation	149
	Simultaneous nonlinear equations	153
7	Approximation	163
	Least-squares polynomial approximation	163
	Near-singular sets of equations	172
	Chebyshev economization	174
	A unifying approach	181
	Discrete Fourier series	188
8	Linear Eigenvalue Problems	198
	The general eigenvalue problem	201
	Solving by iteration	201
	Convergence	202
	Smallest eigenvalue	206
	Intermediate eigenvalues	206
	Solution with polynomial operators	208
	Trial and error solutions	211
9	The Numerical Solution of Ordinary Differential Equations	216
	Numerical solutions	218
	Open integration formulas	219
	Euler's method	221
	Predictor-corrector methods	222
	Taylor's series	224
	Iteration	225
	The method of undetermined parameters	226
	Runge-Kutta methods	228
	Third-order Runge-Kutta derivation	229
	Two fourth-order formulas	231
	Simultaneous ordinary differential equations	232
	Example programs	235
	Error and stability	240

10	Partial Differential Equations	246
	Classification of partial differential equations	249
	Difference equations	251
	Computational molecules	253
	Boundary conditions	257
	Irregular boundaries	260
	Eigenvalue problems for continuous systems	265
	A parabolic partial differential equation	268
	Stability	273
	The implicit form	276
	The Crank-Nicolson method	279
	Parabolic partial differential equations in two spatial coordinates	279
	Boundary conditions for parabolic equations	281
	An added note on eigenvalue problems	282
	A computer program	283
	Bibliography	295
	Appendix A A table of flow-chart conventions used in the text	299
	Appendix B Roots and coefficients for Gauss-Legendre Quadrature	301
	Index	303