

CONTENTS

Introduction	1
------------------------	---

CHAPTER ONE

Elementary Properties of the Laplace Transform

1. Introduction	10
2. Convergence	11
3. Translation Properties	11
4. The Unraveling of Convolutions.	13
5. Inversion of the Laplace Transform	14
6. Instability of the Inverse of the Laplace Transform	17
7. Tauberian Results	19
Bibliography and Comments	20

CHAPTER TWO

Numerical Inversion of the Laplace Transform

1. Introduction	22
2. Numerical Quadrature	22
3. The Legendre Polynomials	24
4. Recurrence Properties of the Legendre Polynomials	26
5. Reality of Zeroes	28
6. Shifted Legendre Polynomials	29
7. Connection with Numerical Quadrature	29
8. Numerical Inversion of the Laplace Transform	32

9.	Instability of Inverse of the Laplace Transform	33
10.	Explicit Approximate Inversion Formula	35
11.	Numerical Aspects	36
12.	Interlacing of the $x_{i,N}$	37
13.	Change of Time Scale	37
14.	Error Analysis	40
15.	Extrapolation Methods	41
16.	Inversion of the Mellin Transform	41
17.	Explicit Matrix Inversion	42
18.	Elimination of Partial Derivatives	44
19.	Inversion Techniques of Other Types	45
	Bibliography and Comments	47

CHAPTER THREE

Linear Functional Equations

1.	Introduction	49
2.	The Scalar Renewal Equation	51
3.	Some Examples	52
4.	Systems of Renewal Equations	58
5.	An Example	58
6.	Differential-Difference Equations	60
7.	A Poor Example	61
8.	Asymptotic Behavior and L^2 -Divergence	62
9.	The Equation $\lambda = e^{-\lambda}$	64
10.	Rigorous Proof of Asymptotic Behavior	65
11.	Numerical Utility of Asymptotic Behavior	67
12.	A Simple Remedy	69
13.	Mismatched Equations	69
14.	Laplace Transform Solution	73
15.	The One-Dimensional Heat Equation	75
16.	The Transform Equation	77
17.	Some Numerical Results	78
18.	A Chemotherapy Model	82
19.	Explicit Solution for $U(y,s)$	83
20.	Numerical Results	84
21.	Inverse Problems	86
22.	Estimation of System Constants and Unobservable States	87
23.	Numerical Example	89

24. A More General Identification Process	89
25. The Abel Integral Equation	90
Bibliography and Comments	93

CHAPTER FOUR

Nonlinear Equations

1. Introduction	97
2. A Time-Dependent Neutron Transport Process	98
3. Computational Results.	100
4. Radiative Transfer: Time-Independent Case	100
5. Time-Dependent Radiative Transfer	107
6. Some Numerical Results	109
7. A Dynamic Programming Process	109
8. Numerical Treatment	113
9. A Numerical Example	114
10. Nonlinear Differential Equations	115
11. Numerical Results	122
12. Alternate Approach.	123
13. A Differential-Difference Equation	125
14. Numerical Results	125
15. A Heat Equation	127
16. Numerical Results	127
17. Perturbation Techniques	128
18. Convergence Aspects	129
19. Discussion	130
20. Linear Equations with Variable Coefficients	131
21. Quasilinearization	132
Bibliography and Comments	133

CHAPTER FIVE

Dynamic Programming and III-Conditioned Systems

1. Introduction	135
2. A Least Squares Approach	137
3. An Extrinsic Condition.	138
4. Dynamic Programming Approach—I	139
5. Dynamic Programming Approach—II	140
6. Determination of the Minimizing Values	141

7. Discussion	142
8. Successive Approximations	143
9. Obtaining an Initial Approximation	144
10. Analytic Continuation and Extrapolation	146
11. Example	147
12. Application of Successive Approximation Plus Smoothing	150
13. Results of Extrapolation	152
14. A Self-Consistent Method	153
15. Dynamic Programming Approach	155
16. The Details	155
17. Example	159
18. Sequential Computation	160
19. An Example	166
Bibliography and Comments	173
 Appendix 1. FORTRAN IV Programs	175
1. The Heat Equations	175
2. The Routing Problem	183
3. Adaptive Computation.	187
 Appendix 2. Roots of the Shifted Legendre Polynomials and Corresponding Weights	205
 Appendix 3. Coefficients of the Polynomials $P_N^*(x)/(x - x_i)$ in Order of Smallest to Largest Root x_i and Lowest to Highest Power	210
 Appendix 4. Derivatives of Shifted Legendre Polynomials Evaluated at the Roots, in Order of Smallest to Largest Root	226
 Appendix 5. The Elements of the Inverse Matrix with Division by Weights	229
 Appendix 6. Negatives of Logarithms of Roots of Shifted Legendre Polynomials	245
 Index	247

