

Contents

Preface	v
The Greek Alphabet	vii
CHAPTER 1. ORDINARY DIFFERENTIAL EQUATIONS	1
1.1 Introduction	1
1.2 Geometrical Interpretation of Solutions of Ordinary Differential Equations	3
1.3 First-order Equations	7
1.4 Linear Ordinary Differential Equations with Constant Coefficients. D Operator Notation	17
1.5 Solution of Homogeneous Linear Equations with Constant Coefficients	18
1.6 Theory of Damped Free Vibrations	23
1.7 Inhomogeneous Second-order Equations with Constant Coefficients	28
1.8 Theory of Forced Vibrations	37
1.9 Simultaneous Linear Differential Equations with Constant Coefficients	40
1.10 Euler's Equation	43
Problems	45
Bibliography	48
CHAPTER 2. FOURIER SERIES	49
2.1 Introduction	49
2.2 Derivation of the Fourier Series	50
2.3 Convergence of Fourier Series	60
2.4 Fourier Sine and Cosine Series	67
2.5 Integration and Differentiation of Fourier Series	75
2.6 Application of Fourier Series	80
Problems	84
CHAPTER 3. LAPLACE TRANSFORMS	88
3.1 Introduction	88
3.2 Transforms of Derivatives	93

3.3	Step Function and Delta Function	96
3.4	Properties of the Laplace Transform	102
3.5	Linear Ordinary Differential Equations	106
3.6	Difference and Integral Equations	111
3.7	Some Physical Problems	117
	Problems	124
	Bibliography	126
CHAPTER 4. PARTIAL DIFFERENTIATION, WITH APPLICATIONS		127
4.1	Basic Results	127
4.2	The Chain Rule and Taylor's Theorem	135
4.3	Total Derivatives	146
4.4	Stationary Points	150
4.5	Further Applications	159
	Problems	163
	Bibliography	165
CHAPTER 5. MULTIPLE INTEGRALS		166
5.1	Multiple Integrals and Ordinary Integrals	166
5.2	Evaluation of Double Integrals	169
5.3	Triple Integrals	184
5.4	Line Integrals	189
5.5	Surface Integrals	194
	Problems	196
	Bibliography	197
CHAPTER 6. VECTOR ANALYSIS		198
6.1	Introduction	198
6.2	Vector Functions of One Variable	200
6.3	Scalar and Vector Fields	206
6.4	The Divergence Theorem	215
6.5	Stokes's Theorem	223
6.6	The Formulation of Partial Differential Equations	230
6.7	Orthogonal Curvilinear Coordinates	234
	Problems	241
	Bibliography	244
CHAPTER 7. PARTIAL DIFFERENTIAL EQUATIONS		245
7.1	Introduction	245
7.2	The One-dimensional Wave Equation	250
7.3	The Method of Separation of Variables	266
7.4	The Wave Equation	267

7.5	The Heat Conduction and Diffusion Equation	274
7.6	Laplace's Equation	279
7.7	Laplace's Equation in Cylindrical and Spherical Polar Coordinates	291
7.8	Inhomogeneous Equations	296
7.9	General Second-order Equations	299
	Problems	301
	Bibliography	304
CHAPTER 8. LINEAR ALGEBRA – THEORY		305
8.1	Systems of Linear Algebraic Equations. Matrix Notation	305
8.2	Elementary Operations of Matrix Algebra	312
8.3	Determinants	320
8.4	The Inverse of a Matrix	325
8.5	Orthogonal Matrices	331
8.6	Partitioned Matrices	333
8.7	Inhomogeneous Systems of Linear Equations	337
8.8	Homogeneous Systems of Linear Equations	343
8.9	Eigenvalues and Eigenvectors	347
	Problems	356
	Bibliography	359
CHAPTER 9. INTRODUCTION TO NUMERICAL ANALYSIS		361
9.1	Numerical Approximation	361
9.2	Evaluation of Formulae	364
9.3	Flow Diagrams or Charts	366
9.4	Solution of Single Algebraic and Transcendental Equations	368
	Problems	379
	Bibliography	380
CHAPTER 10. LINEAR ALGEBRA – NUMERICAL METHODS		381
10.1	Introduction	381
10.2	Direct Methods for the Solution of Linear Equations	382
10.3	Iterative Methods for the Solution of Linear Equations	391
10.4	Numerical Methods of Matrix Inversion	395
10.5	Eigenvalues and Eigenvectors	400
	Problems	405
	Bibliography	407
CHAPTER 11. FINITE DIFFERENCES		408
11.1	Introduction	408
11.2	Finite Differences and Difference Tables	409

11.3 Interpolation	417
11.4 Numerical Integration	424
11.5 Numerical Differentiation	430
Problems	432
Bibliography	433
 CHAPTER 12. ELEMENTARY STATISTICS – PROBABILITY THEORY	 434
12.1 Introduction	434
12.2 Probability and Equi-likely Events	435
12.3 Probability and Relative Frequency	439
12.4 Probability and Set Theory	448
12.5 The Random Variable	459
12.6 Basic Variates	472
12.7 Bivariate and Multivariate Probability Distributions	484
12.8 Simulation and Monte Carlo Methods	490
Problems	492
Bibliography	496
 Appendix	
Table A1: Laplace Transforms	497
Table A2: The Standardized Normal Variate	499
 Answers to Exercises and Problems	 500
 Index	 527

CONTENTS OF VOLUME 2

Chapter 1. Linear Programming
Chapter 2. Non-linear and Dynamic Programming
Chapter 3. Further Statistics – Estimation and Inference
Chapter 4. Complex Variables
Chapter 5. Integral Transforms
Chapter 6. Ordinary Differential Equations
Chapter 7. Numerical Solution of Differential Equations
Chapter 8. Variational Methods