

Contents

	Preface	v
Chapter 1	Vectors	1
1.1	Elementary vector geometry of 3-space	1
1.2	Linear dependence and independence	7
1.3	The dot product	11
1.4	The vector (or cross) product	17
1.5	Triple products of vectors	24
1.6	The line and plane	27
1.7	Vector spaces	31
1.8	Vector spaces with inner products	36
Chapter 2	Vector Functions	41
2.1	Vector functions	41
2.2	Limits of vector functions	43
2.3	Derivatives of vector functions	46
2.4	Curves, directed curves, and arclength	52
2.5	Elementary kinematics	61
2.6	Introductory differential geometry	66
2.7	Curvature of arc	70
2.8	The Frenet-Serret formulas	74
Chapter 3	Differential Calculus of R^n	77
3.1	R^n - R^m functions	77
3.2	Limits and continuity for R^n - R^m functions	78
3.3	Surfaces	89
3.4	Partial derivatives	98
3.5	Higher-order partial derivatives	105
3.6	M.V.T. for partial derivatives	110
3.7	The gradient	114
3.8	Differentiability	116
3.9	The general chain rule for derivatives	127
3.10	Gradient fields	134
3.11	The direction derivative	139
3.12	Implicit differentiation	146
3.13	Taylor's theorem for R^n - R functions	154
3.14	Extrema for R^n - R functions	157

Chapter 4	Multiple Integrals	168
4.1	Area and volume	168
4.2	The double integral	171
4.3	Iterated integration	176
4.4	Double integrals in polar coordinates	183
4.5	The triple integral	189
4.6	Mass and moments	195
4.7	Cylindrical and spherical coordinates	204
4.8	The area of an explicit surface	210
Chapter 5	Infinite Series	217
5.1	Sequential limits	217
5.2	Convergence and divergence of series	226
5.3	Comparison tests for positive-termed series	234
5.4	Alternating series	240
5.5	Absolute and conditional convergence	243
5.6	The ratio and root tests	245
5.7	Power series	248
5.8	Differentiation and integration of power series	259
5.9	The binomial series	267
Chapter 6	Line Integrals	271
6.1	Line integrals with respect to arclength	271
6.2	Line integrals of vector functions	276
6.3	Green's theorem	283
6.4	Exactness and path-independence	288
Chapter 7	Advanced Concepts in Infinite Series	294
7.1	Rearrangement of series	294
7.2	Multiplication of series	298
7.3	The substitution theorem for power series	303
7.4	Inversion of power series	306
7.5	Pointwise and uniform convergence of function sequences	308
7.6	Termwise integration and differentiation	318
7.7	Series of functions	324
7.8	Complex series and elementary complex functions	329
Chapter 8	Improper Integrals and Integrals with Parameter	341
8.1	The definition of improper integral	341
8.2	Convergence tests for improper integrals	350
8.3	Proper integrals with parameter	355
8.4	Improper integrals with parameter	359
Chapter 9	Introductory Differential Equations	367
9.1	Differential equations	367
9.2	Families of curves and associated differential equations	370

9.3	Initial-value problems and existence-uniqueness theorems	373
9.4	Separable equations	375
9.5	Homogeneous equations	379
9.6	First-order linear equations	384
9.7	Exact equations	387
9.8	Orthogonal trajectories	393
9.9	Applications to elementary problems in motion	395
9.10	Picard's method of successive approximations	396
9.11	Proof of the existence-uniqueness theorem	398
Chapter 10	Linear Differential Equations	404
10.1	Existence and uniqueness	404
10.2	Second-order equations	408
10.3	Linear dependence and independence	415
10.4	Differential operators with constant coefficients	424
10.5	Non-homogeneous equations: undetermined coefficients	431
10.6	Variation of parameters	437
10.7	Reduction of order by known solutions	441
10.8	The Euler equation	444
10.9	Applications to vibrational systems	448
10.10	Applications to electrical circuits	455
10.11	Systems of differential equations	458
Chapter 11	The Laplace Transform	466
11.1	The definition of Laplace transform	466
11.2	Table of transforms	469
11.3	Algebraic properties	473
11.4	Inverse transforms	476
11.5	Transforms of derivatives	479
11.6	Solving differential equations by transforms	481
11.7	Systems of equations solved by Laplace transforms	483
11.8	Derivatives of Laplace transforms	484
11.9	Convolution theorem	486
Chapter 12	Series Solutions	493
12.1	Power series solutions	493
12.2	Power series solutions: successive differentiations	499
12.3	Solutions about a regular singular point	501
12.4	Bessel's equation	504
Chapter 13	Fourier Series	510
13.1	Trigonometric Fourier series	510
13.2	Convergence of Fourier series	518

13.3	Half-range Fourier series	523
13.4	Differentiation and integration of Fourier series	527
13.5	Fourier series with respect to orthogonal sets	531
13.6	Application to the vibrating string problem	533
	Appendix A	541
	Selected Answers	543
	Index	553