

CONTENTS

<i>Dedication</i>	v
<i>Preface</i>	xiii
<i>Acknowledgments</i>	xv
Chapter 1: Vectors and Parametric Curves	1
1.1 Points and Vectors on the Plane	2
1.2 Scalar Product on the Plane	17
1.3 Linear Independence	26
1.4 Geometric Transformations in Two Dimensions	31
1.5 Determinants in Two Dimensions	41
1.6 Parametric Curves on the Plane	49
1.7 Vectors in Space	64
1.8 Cross Product	77
1.9 Matrices in Three Dimensions	86
1.10 Determinants in Three Dimensions	93
1.11 Some Solid Geometry	99
1.12 Cavalieri and the Pappus-Guldin Rules	103
1.13 Dihedral Angles and Platonic Solids	108
1.14 Spherical Trigonometry	113

1.15 Canonical Surfaces	119
1.16 Parametric Curves in Space	132
1.17 Multidimensional Vectors	137

Chapter 2: Differentiation **147**

2.1 Some Topology	148
2.2 Multivariable Functions	153
2.3 Limits and Continuity	159
2.4 Definition of the Derivative	173
2.5 The Jacobi Matrix	177
2.6 Gradients and Directional Derivatives	191
2.7 Levi-Civita and Einstein	200
2.8 Extrema	204
2.9 Lagrange Multipliers	211

Chapter 3: Integration **217**

3.1 Differential Forms	218
3.2 Zero-Manifolds	223
3.3 One-Manifolds	225
3.4 Closed and Exact Forms	232
3.5 Two-Manifolds	239
3.6 Change of Variables in Double Integrals	252
3.7 Change to Polar Coordinates	261
3.8 Three-Manifolds	267
3.9 Change of Variables in Triple Integrals	274
3.10 Surface Integrals	279
3.11 Green's, Stokes', and Gauss' Theorems	283

Appendix A: Maple **295**

A.1 Getting Started and Windows of Maple	296
A.2 Arithmetic	298
A.3 Symbolic Computation	299
A.4 Assignments	299
A.5 Working with Output	299
A.6 Solving Equations	300
A.7 Plots with Maple	300
A.8 Limits and Derivatives	301
A.9 Integration	302
A.10 Matrix	302

Appendix B: MATLAB **303**

B.1 Getting Started and Windows of MATLAB	304
B.1.1 Using MATLAB in Calculations	305
B.2 Plotting	312
B.2.1 Two-dimensional Plotting	312
B.2.2 Three-Dimensional Plotting	321
B.3 Programming in MATLAB	327
B.3.1 For Loops	329
B.3.2 While Loops	330
B.3.3 If, Else, and Elseif	330
B.3.4 Switch	332
B.4 Symbolic Computation	333
B.4.1 Simplifying Symbolic Expressions	334
B.4.2 Differentiating Symbolic Expressions	336
B.4.3 Integrating Symbolic Expressions	337
B.4.4 Limits Symbolic Expressions	338

B.4.5 Taylor Series Symbolic Expressions	338
B.4.6 Sums Symbolic Expressions	339
B.4.7 Solving Equations as Symbolic Expressions	339
Appendix C: Answers to Odd-Numbered Exercises	341
Chapter 1	341
1.1 Points and Vectors on the Plane	341
1.2 Scalar Product on the Plane	343
1.3 Linear Independence	344
1.4 Geometric Transformations in Two Dimensions	346
1.5 Determinants in Two Dimensions	348
1.6 Parametric Curves on the Plane	349
1.7 Vectors in Space	350
1.8 Cross Product	351
1.9 Matrices in Three Dimensions	353
1.10 Determinants in Three Dimensions	356
1.11 Some Solid Geometry	356
1.12 Cavalieri and the Pappus-Guldin Rules	356
1.13 Dihedral Angles and Platonic Solids	358
1.14 Spherical Trigonometry	358
1.15 Canonical Surfaces	358
1.16 Parametric Curves in Space	360
1.17 Multidimensional Vectors	361
Chapter 2	362
2.1 Some Topology	362
2.2 Multivariable Functions	363
2.3 Limits and Continuity	371
2.4 Definition of the Derivative	373
2.5 The Jacobi Matrix	374
2.6 Gradients and Directional Derivatives	376
2.7 Levi-Civita and Einstein	379
2.8 Extrema	380
2.9 Lagrange Multipliers	381

Chapter 3	383
3.1 Differential Forms	383
3.2 Zero-Manifolds	384
3.3 One-Manifolds	384
3.4 Closed and Exact Forms	385
3.5 Two-Manifolds	386
3.6 Change of Variables in Two Dimensions	388
3.7 Change to Polar Coordinates	388
3.8 Three-Manifolds	390
3.9 Change of Variables in Three Dimensions	390
3.10 Surface Integrals	392
3.11 Green's, Stokes', and Gauss' Theorems	392
Appendix D: Formulas	395
D.1 Trigonometric Identities	395
D.2 Hyperbolic Functions	397
D.3 Table of Derivatives	398
D.4 Table of Integrals	400
D.5 Summations (Series)	402
D.5.1 Finite Element of Terms	402
D.5.2 Infinite Element of Terms	402
D.6 Logarithmic Identities	403
D.7 Exponential Identities	404
D.8 Approximations for Small Quantities	404
D.9 Vectors	404
D.9.1 Vector Derivatives	404
D.9.2 Vector Identity	406
D.9.3 Fundamental Theorems	407
Bibliography	409
Index	413

