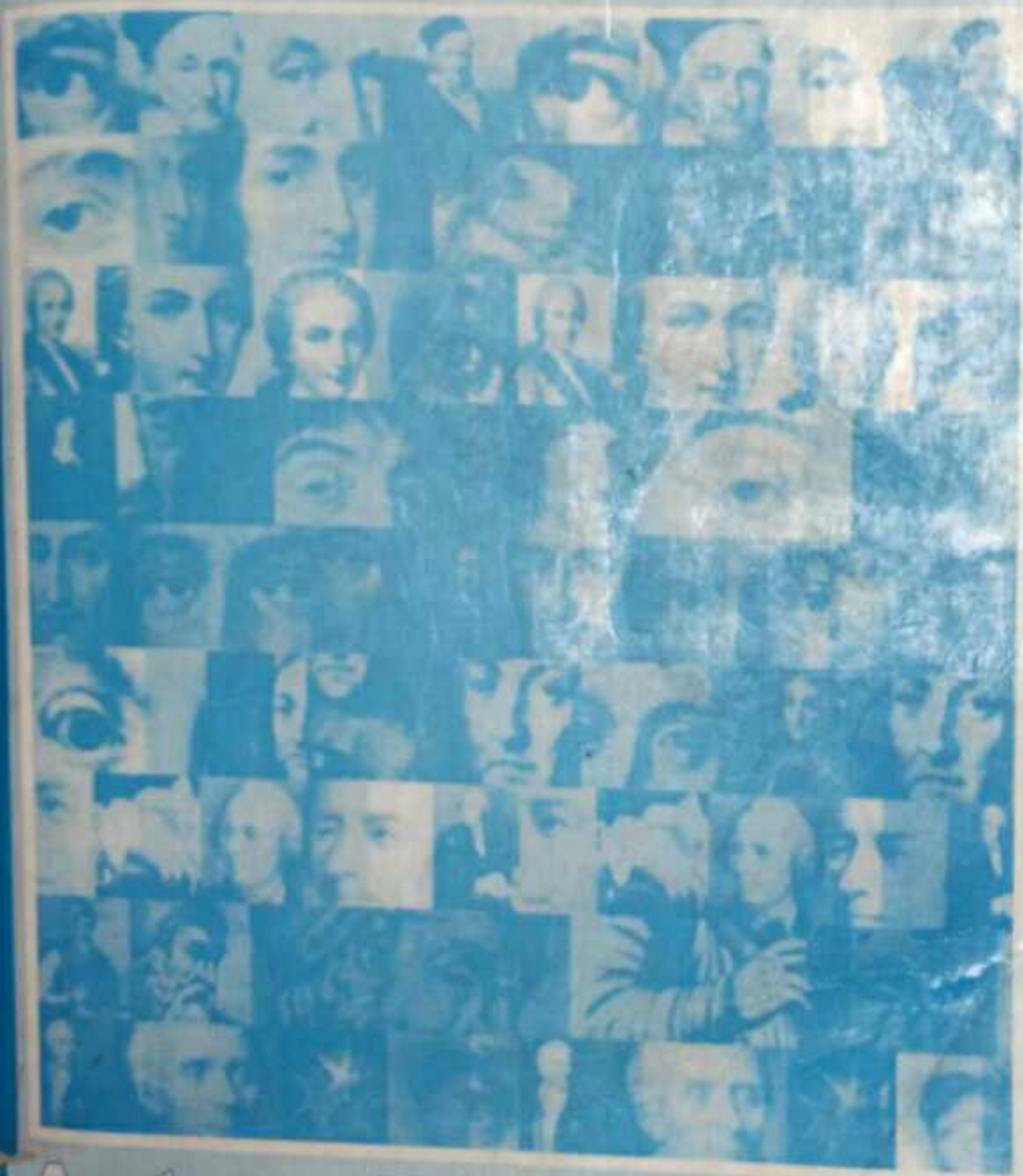


Seventh Edition

Calculus



Anton • Bivens • Davis

CD • Inside

CONTENTS



INTRODUCTION. CALCULUS: A NEW HORIZON FROM ANCIENT ROOTS 1



CHAPTER 1. FUNCTIONS 7

- 1.1 Functions and the Analysis of Graphical Information 8
- 1.2 Properties of Functions 16
- 1.3 Graphing Functions on Calculators and Computers;
Computer Algebra Systems 27
- 1.4 New Functions from Old 38
- 1.5 Lines 51
- 1.6 Families of Functions 63
- 1.7 Mathematical Models 79
- 1.8 Parametric Equations 88
- Horizon Module: Iteration and Dynamical Systems 102



CHAPTER 2. LIMITS AND CONTINUITY 107

- 2.1 Limits (An Intuitive Approach) 108
- 2.2 Computing Limits 122
- 2.3 Computing Limits: End Behavior 131
- 2.4 Limits (Discussed More Rigorously) 138
- 2.5 Continuity 147
- 2.6 Limits and Continuity of Trigonometric Functions 159



CHAPTER 3. THE DERIVATIVE 169

- 3.1 Slopes and Rates of Change 170
- 3.2 The Derivative 177
- 3.3 Techniques of Differentiation 191
- 3.4 Derivatives of Trigonometric Functions 200
- 3.5 The Chain Rule 204
- 3.6 Implicit Differentiation 211
- 3.7 Related Rates 219
- 3.8 Local Linear Approximation; Differentials 226
- Horizon Module: Robotics 236



CHAPTER 4. THE DERIVATIVE IN GRAPHING AND APPLICATIONS 241

- 4.1 Analysis of Functions I: Increase, Decrease, and Concavity 242
- 4.2 Analysis of Functions II: Relative Extrema; First and Second Derivative Tests 250
- 4.3 Analysis of Functions III: Applying Technology and the Tools of Calculus 257
- 4.4 Rectilinear Motion (Motion Along a Line) 270
- 4.5 Absolute Maxima and Minima 280
- 4.6 Applied Maximum and Minimum Problems 288
- 4.7 Newton's Method 302
- 4.8 Rolle's Theorem; Mean-Value Theorem 307



CHAPTER 5. INTEGRATION 317

- 5.1 An Overview of the Area Problem 318
- 5.2 The Indefinite Integral; Integral Curves and Direction Fields 323
- 5.3 Integration by Substitution 333
- 5.4 Sigma Notation; Area as a Limit 338
- 5.5 The Definite Integral 351
- 5.6 The Fundamental Theorem of Calculus 360
- 5.7 Rectilinear Motion Revisited; Average Value 371
- 5.8 Evaluating Definite Integrals by Substitution 384
- Horizon Module: Blammo the Human Cannonball 393



CHAPTER 6. APPLICATIONS OF THE DEFINITE INTEGRAL IN GEOMETRY, SCIENCE, AND ENGINEERING 397

- 6.1 Area Between Two Curves 398
- 6.2 Volumes by Slicing; Disks and Washers 404
- 6.3 Volumes by Cylindrical Shells 412
- 6.4 Length of a Plane Curve 416
- 6.5 Area of a Surface of Revolution 421
- 6.6 Work 425
- 6.7 Fluid Pressure and Force 433



CHAPTER 7. EXPONENTIAL, LOGARITHMIC, AND INVERSE TRIGONOMETRIC FUNCTIONS 441

- 7.1 Inverse Functions 442
- 7.2 Exponential and Logarithmic Functions 452
- 7.3 Derivatives and Integrals Involving Logarithmic and Exponential Functions 462
- 7.4 Graphs and Applications Involving Logarithmic and Exponential Functions 470
- 7.5 Logarithmic Functions from the Integral Point of View 478
- 7.6 Derivatives and Integrals Involving Inverse Trigonometric Functions 490
- 7.7 L'Hôpital's Rule; Indeterminate Forms 500
- 7.8 Hyperbolic Functions and Hanging Cables 509



CHAPTER 8. PRINCIPLES OF INTEGRAL EVALUATION 523

- 8.1 An Overview of Integration Methods 524
- 8.2 Integration by Parts 526
- 8.3 Trigonometric Integrals 534
- 8.4 Trigonometric Substitutions 542
- 8.5 Integrating Rational Functions by Partial Fractions 548
- 8.6 Using Tables of Integrals and Computer Algebra Systems 555
- 8.7 Numerical Integration; Simpson's Rule 565
- 8.8 Improper Integrals 579
- Horizon Module: Railroad Design 590



CHAPTER 9. MATHEMATICAL MODELING WITH DIFFERENTIAL EQUATIONS 595

- 9.1 First-Order Differential Equations and Applications 596
- 9.2 Direction Fields; Euler's Method 608
- 9.3 Modeling with First-Order Differential Equations 615
- 9.4 Second-Order Linear Homogeneous Differential Equations; The Vibrating Spring 625



CHAPTER 10. INFINITE SERIES 637

- 10.1 Maclaurin and Taylor Polynomial Approximations 638
- 10.2 Sequences 647
- 10.3 Monotone Sequences 658
- 10.4 Infinite Series 664
- 10.5 Convergence Tests 672
- 10.6 The Comparison, Ratio, and Root Tests 679
- 10.7 Alternating Series; Conditional Convergence 685
- 10.8 Maclaurin and Taylor Series; Power Series 693
- 10.9 Convergence of Taylor Series; Computational Methods 701
- 10.10 Differentiating and Integrating Power Series; Modeling with Taylor Series 710



CHAPTER 11. ANALYTIC GEOMETRY IN CALCULUS 723

- 11.1 Polar Coordinates 724
- 11.2 Tangent Lines and Arc Length for Parametric and Polar Curves 736
- 11.3 Area in Polar Coordinates 744
- 11.4 Conic Sections in Calculus 749
- 11.5 Rotation of Axes; Second-Degree Equations 766
- 11.6 Conic Sections in Polar Coordinates 772
- Horizon Module: Comet Collision 785



CHAPTER 12. THREE-DIMENSIONAL SPACE; VECTORS 789

- 12.1 Rectangular Coordinates in 3-Space; Spheres; Cylindrical Surfaces 790
- 12.2 Vectors 795
- 12.3 Dot Product; Projections 806
- 12.4 Cross Product 815
- 12.5 Parametric Equations of Lines 825
- 12.6 Planes in 3-Space 831
- 12.7 Quadric Surfaces 838
- 12.8 Cylindrical and Spherical Coordinates 849



CHAPTER 13. VECTOR-VALUED FUNCTIONS 859

- 13.1 Introduction to Vector-Valued Functions 860
- 13.2 Calculus of Vector-Valued Functions 866
- 13.3 Change of Parameter; Arc Length 875
- 13.4 Unit Tangent, Normal, and Binormal Vectors 885
- 13.5 Curvature 890
- 13.6 Motion Along a Curve 898
- 13.7 Kepler's Laws of Planetary Motion 911



CHAPTER 14. PARTIAL DERIVATIVES 921

- 14.1 Functions of Two or More Variables 922
- 14.2 Limits and Continuity 932
- 14.3 Partial Derivatives 941
- 14.4 Differentiability, Local Linearity, and Differentials 953
- 14.5 The Chain Rule 963
- 14.6 Directional Derivatives and Gradients 974
- 14.7 Tangent Planes and Normal Vectors 985
- 14.8 Maxima and Minima of Functions of Two Variables 991
- 14.9 Lagrange Multipliers 1003



CHAPTER 15. MULTIPLE INTEGRALS 1013

- 15.1 Double Integrals 1014
- 15.2 Double Integrals over Nonrectangular Regions 1021
- 15.3 Double Integrals in Polar Coordinates 1029
- 15.4 Parametric Surfaces; Surface Area 1036
- 15.5 Triple Integrals 1048
- 15.6 Centroid, Center of Gravity, Theorem of Pappus 1056
- 15.7 Triple Integrals in Cylindrical and Spherical Coordinates 1065
- 15.8 Change of Variables in Multiple Integrals; Jacobians 1075



CHAPTER 16. TOPICS IN VECTOR CALCULUS 1091

| | | |
|------|--|------|
| 16.1 | Vector Fields | 1092 |
| 16.2 | Line Integrals | 1100 |
| 16.3 | Independence of Path; Conservative Vector Fields | 1114 |
| 16.4 | Green's Theorem | 1124 |
| 16.5 | Surface Integrals | 1130 |
| 16.6 | Applications of Surface Integrals; Flux | 1137 |
| 16.7 | The Divergence Theorem | 1145 |
| 16.8 | Stokes' Theorem | 1154 |
| ■ | Horizon Module: Hurricane Modeling | 1162 |

APPENDIX A. REAL NUMBERS, INTERVALS, AND INEQUALITIES A1

APPENDIX B. ABSOLUTE VALUE A11

APPENDIX C. COORDINATE PLANES AND LINES A16

APPENDIX D. DISTANCE, CIRCLES, AND QUADRATIC EQUATIONS A28

APPENDIX E. TRIGONOMETRY REVIEW A37

APPENDIX F. SOLVING POLYNOMIAL EQUATIONS A50

APPENDIX G. SELECTED PROOFS A57

ANSWERS A63

PHOTO CREDITS C1

INDEX I-1