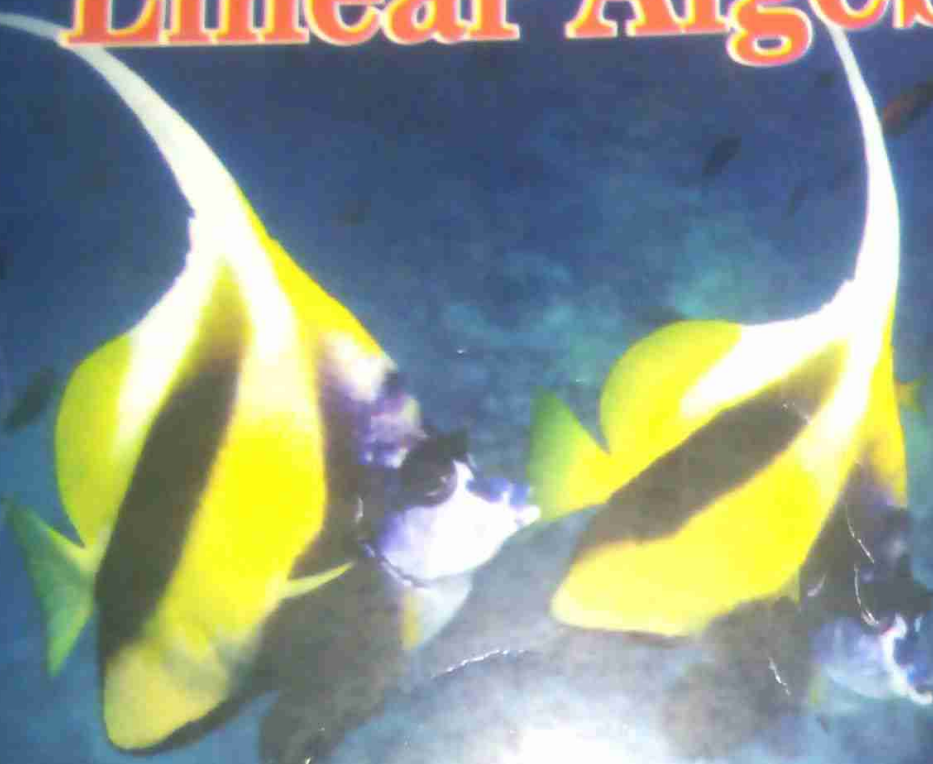


Elementary Linear Algebra



11th Edition

CONTENTS

CHAPTER 1 Systems of Linear Equations and Matrices 1

- 1.1 Introduction to Systems of Linear Equations 2
- 1.2 Gaussian Elimination 11
- 1.3 Matrices and Matrix Operations 25
- 1.4 Inverses, Algebraic Properties of Matrices 39
- 1.5 Elementary Matrices and a Method for Finding A^{-1} 52
- 1.6 More on Linear Systems and Invertible Matrices 61
- 1.7 Diagonal, Triangular, and Symmetric Matrices 67
- 1.8 Matrix Transformations 76
- 1.9 Applications of Linear Systems 84
 - Network Analysis (Traffic Flow) 84
 - Electrical Circuits 86
 - Balancing Chemical Equations 88
 - Polynomial Interpolation 91
- 1.10 Application: Leontief Input-Output Models 96

CHAPTER 2 Determinants 105

- 2.1 Determinants by Cofactor Expansion 105
- 2.2 Evaluating Determinants by Row Reduction 113
- 2.3 Properties of Determinants; Cramer's Rule 118

CHAPTER 3 Euclidean Vector Spaces 131

- 3.1 Vectors in 2-Space, 3-Space, and n -Space 131
- 3.2 Norm, Dot Product, and Distance in R^n 142
- 3.3 Orthogonality 155
- 3.4 The Geometry of Linear Systems 164
- 3.5 Cross Product 172

CHAPTER 4 General Vector Spaces 183

- 4.1 Real Vector Spaces 183
- 4.2 Subspaces 191
- 4.3 Linear Independence 202
- 4.4 Coordinates and Basis 212
- 4.5 Dimension 221
- 4.6 Change of Basis 229
- 4.7 Row Space, Column Space, and Null Space 237
- 4.8 Rank, Nullity, and the Fundamental Matrix Spaces 248
- 4.9 Basic Matrix Transformations in R^2 and R^3 259
- 4.10 Properties of Matrix Transformations 270
- 4.11 Application: Geometry of Matrix Operators on R^2 280

CHAPTER 5 Eigenvalues and Eigenvectors 391

- 5.1 Eigenvalues and Eigenvectors 391
- 5.2 Diagonalization 392
- 5.3 Complex Vector Spaces 413
- 5.4 Application: Differential Equations 426
- 5.5 Application: Dynamical Systems and Markov Chains 432

CHAPTER 6 Inner Product Spaces 346

- 6.1 Inner Products 346
- 6.2 Angle and Orthogonality in Inner Product Spaces 356
- 6.3 Gram-Schmidt Process; QR -Decomposition 364
- 6.4 Best Approximation; Least Squares 378
- 6.5 Application: Mathematical Modeling Using Least Squares 387
- 6.6 Application: Function Approximation; Fourier Series 394

CHAPTER 7 Diagonalization and Quadratic Forms 401

- 7.1 Orthogonal Matrices 401
- 7.2 Orthogonal Diagonalization 409
- 7.3 Quadratic Forms 417
- 7.4 Optimization Using Quadratic Forms 429
- 7.5 Hermitian, Unitary, and Normal Matrices 437

CHAPTER 8 General Linear Transformations 447

- 8.1 General Linear Transformations 447
- 8.2 Compositions and Inverse Transformations 458
- 8.3 Isomorphism 466
- 8.4 Matrices for General Linear Transformations 472
- 8.5 Similarity 481

CHAPTER 9 Numerical Methods 491

- 9.1 LU -Decompositions 491
- 9.2 The Power Method 501
- 9.3 Comparison of Procedures for Solving Linear Systems 509
- 9.4 Singular Value Decomposition 514
- 9.5 Application: Data Compression Using Singular Value Decomposition 52

CHAPTER 10 Applications of Linear Algebra 527

- 10.1 Constructing Curves and Surfaces Through Specified Points 528
- 10.2 The Earliest Applications of Linear Algebra 533
- 10.3 Cubic Spline Interpolation 540

10.4 Markov Chains	551
10.5 Graph Theory	561
10.6 Games of Strategy	570
10.7 Leontief Economic Models	575
10.8 Forest Management	586
10.9 Computer Graphics	595
10.10 Equilibrium Temperature Distributions	603
10.11 Computed Tomography	613
10.12 Fractals	624
10.13 Chaos	639
10.14 Cryptography	652
10.15 Genetics	663
10.16 Age-Specific Population Growth	673
10.17 Harvesting of Animal Populations	683
10.18 A Least Squares Model for Human Hearing	691
10.19 Warps and Morphs	697
10.20 Internet Search Engines	706

APPENDIX A Working with Proofs A1

APPENDIX B Complex Numbers A5

Answers to Exercises A13

Index II