

Contents

Preface	vii
1. <i>Analytic Geometry of Euclidean Spaces</i>	1
1.1 Vectors	1
1.2 Length and Dot Product of Vectors in $\mathbb{R}^n$	15
1.3 Lines and Planes	28
2. <i>Systems of Linear Equations, Matrices</i>	41
2.1 Gaussian Elimination	41
2.2 The Theory of Gaussian Elimination	53
2.3 Homogeneous and Inhomogeneous Systems, Gauss-Jordan Elimination	57
2.4 The Algebra of Matrices	67
2.5 The Inverse and the Transpose of a Matrix	86
3. <i>Vector Spaces and Subspaces</i>	99
3.1 General Vector Spaces	99
3.2 Subspaces	105
3.3 Span and Independence of Vectors	109
3.4 Bases	117
3.5 Dimension, Orthogonal Complements	131
3.6 Change of Basis	148
4. <i>Linear Transformations</i>	163
4.1 Representation of Linear Transformations by Matrices	163
4.2 Properties of Linear Transformations	174
4.3 Applications of Linear Transformations in Computer Graphics	188
5. <i>Orthogonal Projections and Bases</i>	199
5.1 Orthogonal Projections and Least-Squares Approximations ..	199
5.2 Orthogonal Bases	210

6. <i>Determinants</i>	221
6.1 Determinants: Definition and Basic Properties	221
6.2 Further Properties of Determinants	235
6.3 The Cross Product of Vectors in $\mathbb{R}^3$	245
7. <i>Eigenvalues and Eigenvectors</i>	253
7.1 Eigenvalues and Eigenvectors, Basic Properties	253
7.2 Diagonalization of Matrices	263
7.3 Principal Axes	273
7.4 Complex Matrices	279
8. <i>Numerical Methods</i>	291
8.1 <i>LU</i> Factorization	291
8.2 Scaled Partial Pivoting	300
8.3 The Computation of Eigenvalues and Eigenvectors	305
A. <i>Appendices</i>	315
A.1 Implication and Equivalence	315
A.2 Complex Numbers	318
Further Reading	325
Index	327