

# Table of Contents

---

<b>Preface</b> .....	7
<b>Chapter 1 – Matrices</b>	
1.1 Matrices and Matrix Operations .....	9
1.2 Some Properties of Matrix Operations .....	17
1.3 Partitioned Matrices .....	26
1.4 Some Special Matrices .....	28
1.5 The State – Space Concept .....	33
<b>Chapter 2 – Vector Spaces</b>	
2.1 Vectors .....	43
2.2 Linear Dependence and Bases .....	51
2.3 Coordinates and the Transition Matrix .....	59
<b>Chapter 3 – Linear Transformations</b>	
3.1 Homomorphisms .....	69
3.2 Isomorphism and Vector Spaces .....	74
3.3 Linear Transformations and Matrices .....	77
3.4 Orthogonal Transformations .....	86
3.5 General Change of Bases for a Linear Transformation .....	89
<b>Chapter 4 – The Rank and the Determinant of a Matrix</b>	
4.1 The Kernel and the Image Space of a Linear Transformation .....	97
4.2 The Rank of a Matrix .....	103
4.3 The Determinant of a Matrix .....	113
4.4 Operations with Determinants .....	118
4.5 Cramer’s Rule .....	120
<b>Chapter 5 – Linear Equations</b>	
5.1 Systems of Homogeneous Equations .....	131
5.2 Systems of Non-Homogeneous Equations .....	136

**Chapter 6 – Eigenvectors and Eigenvalues**

6.1 The Characteristic Equation . . . . .	144
6.2 The Eigenvalues of the transposed matrix. . . . .	149
6.3 When all the Eigenvalues of $A$ are distinct . . . . .	152
6.4 A reduction to a Diagonal Form. . . . .	155
6.5 Multiple Eigenvalues . . . . .	160
6.6 The Cayley-Hamilton Theorem . . . . .	165

**Chapter 7 – Canonical Forms and Matrix Functions**

7.1 Polynomials . . . . .	177
7.2 Eigenvalues of Rational Functions of a Matrix . . . . .	179
7.3 The Minimum Polynomial of a Matrix . . . . .	185
7.4 Direct Sums and Invariant Subspaces. . . . .	187
7.5 A Decomposition of a Vector Space . . . . .	197
7.6 Cyclic Bases and the Rational Canonical Form . . . . .	205
7.7 The Jordan Canonical Forms . . . . .	217
7.8 Matrix Functions. . . . .	224

**Chapter 8 – Inverting a Matrix**

8.1 Elementary Operations and Elementrry Matrices . . . . .	238
8.2 The Inverse of a Vandermonde Matrix. . . . .	245
8.3 Faddeeva's Method . . . . .	250
8.4 Inverting a Matrix with Complex Elements. . . . .	255

<b>Solutions to Problems . . . . .</b>	<b>263</b>
--	------------

<b>References and Bibliography . . . . .</b>	<b>291</b>
--	------------

<b>Index . . . . .</b>	<b>293</b>
------------------------	------------