

TABLE OF CONTENTS

CHAPTER	PAGE
I. SYSTEMS OF LINEAR EQUATIONS	
1. Graphs	3
2. Equivalence of systems	6
3. Elementary operations	8
4. Systems of homogeneous equations	8
5. Systems of non-homogeneous equations	11
II. VECTOR SPACES	
6. Vectors in ordinary space	15
7. Vectors in general	17
8. Rank of a linear system	21
9. The concept of matrix	23
10. Rectangular arrays	29
11. Elementary matrices	31
12. A normal form	35
13. Non-singular matrices	38
14. Column vectors	40
15. Systems of equations	43
16. On the rank of a product	44
III. DETERMINANTS	
17. Complex numbers	47
18. Matrices as hypercomplex numbers	49
19. Determinants	54
20. The adjoint	56
21. Properties of determinants	61
22. Minors and cofactors	63
23. Rank	64
IV. MATRIC POLYNOMIALS	
24. Ring with unit element	67
25. Polynomial domains	68
26. Degree of a polynomial	71
27. Matrices with polynomial elements	74

CHAPTER	PAGE
28. The characteristic function.	75
29. The minimum function.	77
30. The rank of a polynomial in a matrix	79
31. Matrix having a given minimum function	81
32. The norm.	82
 V. UNION AND INTERSECTION	
33. Complementary spaces	86
34. Linear homogeneous systems	88
35. Union and intersection	90
36. Divisors and multiples	95
37. Divisors and multiples of matrix polynomials	99
38. Relation of the union to the greatest common right divisor	100
39. The sum of vector spaces	102
40. Annihilators of vectors	106
 VI. THE RATIONAL CANONICAL FORM	
41. Similar matrices.	112
42. The direct sum	114
43. Invariant spaces.	116
44. The non-derogatory case	122
45. A canonical form	125
46. The derogatory case	128
47. Continuation of the derogatory case	131
48. The rational canonical form	133
 VII. ELEMENTARY DIVISORS	
49. Equivalence of matrices	137
50. Invariant factors	139
51. A canonical form	141
52. Elementary divisors.	144
53. Elementary divisors of a direct sum	147
54. Similar matrices.	148
55. The Weyr characteristic	150
56. Collineations.	155
 VIII. ORTHOGONAL TRANSFORMATIONS	
57. Orthogonal matrices	160
58. Orthogonal bases	162

CONTENTS

xi

CHAPTER	PAGE
59. Symmetric matrices	166
60. The orthogonal canonical form	169
61. Principal axis transformation	171
IX. ENDOMORPHISMS	
62. Groups with operators	175
63. Vector fields	179
64. Matrices	183
65. Change of basis	186
BIBLIOGRAPHY	189
INDEX	191
PROBLEMS	193