Contents

Preface		۷
----------------	--	---

S۱	/m	bo	ls	used	— IX

1	Preliminaries — 1
1.1	Binary operations — 1
1.2	Congruence and residue classes —— 1
1.3	Group — 4
1.4	Homomorphism —— 7
1.5	Rings and fields —— 10
1.5	Kings and neius — 10
2	Vector spaces —— 13
2.1	Definition and examples —— 13
2.2	Vector subspaces — 17
2.3	Linear dependence and linear independence —— 21
2.4	Basis and dimension of a vector space —— 23
2.5	Sum and direct sum of subspaces —— 35
2.6	Quotient space —— 40
	•
3	Matrices and spaces of matrices —— 43
3.1	Matrix definition and matrix operations —— 43
3.2	Some special matrices and their properties —— 49
3.3	Vector spaces formed by the collection of matrices —— 57
4	Linear transformations — 64
4.1	Definition and examples of linear transformations — 64
4.2	Rank and nullity of a linear transformation —— 69
4.3	Vector spaces of linear transformations —— 82
4.4	Transpose of a linear transformation —— 90
5	Matrices and linear transformations —— 93
5.1	The matrix representation of a linear transformation —— 93
5.2	Effect of change of bases on matrix representation — 101
5.3	Rank of a matrix — 106
5.4	Elementary matrix operations —— 112
5.5	System of linear equations — 131
5.6	Miscellaneous — 147
6	Inner product spaces —— 153
6.1	Inner products and norms —— 153

6.2	Orthogonality and the Gram–Schmidt process —— 161
6.3	The adjoint of a linear operator —— 173
7	Determinant, eigenvalues and diagonalization of matrices — 185
7.1	Determinant of a matrix — 185
7.2	Eigenvalues and eigenvectors (of linear transformations and matrices) —— 204
7.3	Diagonalization —— 216
7.4	Eigenvalues and eigenvectors of some special matrices —— 227
7.5	Cayley–Hamilton theorem and the minimal polynomial —— 235
8	Bilinear and quadratic forms —— 241
8.1	Bilinear forms —— 241
8.2	Symmetric bilinear forms and quadratic forms —— 251
Index -	— 263