

Contents

Preface	v
1 Designs	1
1.1 Introduction	1
1.2 Basic definitions	1
1.3 Related structures	13
1.4 Ranks of incidence matrices	17
1.5 Arcs and ovals	19
1.6 Block's theorem	20
2 Codes	25
2.1 Introduction	25
2.2 Linear codes	31
2.3 Parity-check matrices	35
2.4 Codes from designs	41
2.5 Hamming codes	55
2.6 Cyclic codes	60
2.7 Transforms	66
2.8 Cyclic codes through roots	71
2.9 MDS codes	74
2.10 Quadratic-residue codes	76
2.11 Weight enumerators	81
3 The geometry of vector spaces	89
3.1 Introduction	89
3.2 Projective geometry	90
3.3 Affine geometry	96
3.4 Designs from geometries	99
3.5 The cross ratio	101
3.6 Desargues' theorem	103
3.7 Quadrics and hermitian varieties	104

4 Symmetric Designs	117
4.1 Introduction	117
4.2 The parameters	118
4.3 Automorphisms	122
4.4 Difference sets	123
4.5 Group algebras	129
4.6 The codes and the multiplier theorem	132
5 The standard geometric codes	139
5.1 Introduction	139
5.2 The Reed-Muller codes	140
5.3 Geometries and Reed-Muller codes	145
5.4 Generalized Reed-Muller codes	152
5.5 Dimensions and minimum weights	160
5.6 The geometric codes	167
5.7 The subfield subcodes	177
5.8 Summation formulas for the p -rank	193
6 Codes from planes	199
6.1 Introduction	199
6.2 Projective to affine and back	201
6.3 The codes	203
6.4 The minimum-weight vectors	209
6.5 Central collineations	214
6.6 Other geometric codewords	218
6.7 Hermitian unitals	225
6.8 Translation planes	228
6.9 Tame planes and a rigidity theorem	235
6.10 Derivations	238
6.11 Ovals and derivation sets	243
6.12 Other derivation sets	245
7 Hadamard designs	249
7.1 Introduction	249
7.2 Hadamard designs	251
7.3 Equivalent matrices	255
7.4 The codes	258
7.5 Kronecker product constructions	263
7.6 Size 16 and special n -tuples	266
7.7 Geometric constructions	269
7.8 The Paley construction	271
7.9 Bent functions	275

7.10 Regular Hadamard matrices	278
7.11 Hadamard matrices of size 24	284
7.12 Hadamard matrices from Steiner systems	288
8 Steiner systems	295
8.1 Introduction	295
8.2 Steiner triple and quadruple systems	296
8.3 Units	298
8.4 Oval designs	304
8.5 Some Steiner 3-designs	309
8.6 Witt designs and Golay codes	312
 Bibliography	317
(Glossary)	337
(Index of Names)	339
(Index of Terms)	344