

Contents

List of abbreviations	xii
1 Introduction to basics	1
1.1 Block designs	1
1.2 Resolvability	11
1.3 Latin squares	15
1.4 Pairwise balanced designs	23
1.5 Systems of distinct representatives	26
1.6 Finite fields	30
1.7 Exercises 1	34
2 Difference methods	39
2.1 Difference sets	39
2.2 Difference systems	43
2.3 Difference systems for tournaments	47
2.4 Pure and mixed differences	51
2.5 Multipliers of difference sets	56
2.6 Exercises 2	58
3 Symmetric designs	62
3.1 The extreme cases	62
3.2 Hadamard designs and matrices	64
3.3 Constructing Hadamard matrices	68
3.4 Finite projective planes	76
3.5 The Bruck–Chowla–Ryser theorem	77
3.6 Exercises 3	79
4 Orthogonal Latin squares	83
4.1 Early results	83
4.2 Orthogonal arrays	87
4.3 Using pairwise balanced designs	91
4.4 The collapse of the Euler conjecture	93
4.5 Transversal designs	97

4.6	Transversal designs and orthogonal arrays	100
4.7	Group divisible designs	102
4.8	Exercises 4	104
5	Self-orthogonal Latin squares	108
5.1	SOLS and mixed doubles tournaments	108
5.2	New SOLS from old	111
5.3	The Brayton–Coppersmith–Hoffman theorem	113
5.4	Resolvable SAMDRR	116
5.5	Some examples	121
5.6	Exercises 5	123
6	Steiner systems	125
6.1	Existence of Steiner triple systems	125
6.2	Cyclic Steiner triple systems	129
6.3	Introduction to t -designs	136
6.4	Steiner systems	140
6.5	Exercises 6	142
7	Kirkman triple systems	148
7.1	Early history	148
7.2	The theorem of Ray-Chaudhuri, Wilson, and Lu Jiaxi	153
7.3	Sylvester’s problem	156
7.4	Exercises 7	157
8	League schedules	160
8.1	Round robin tournaments	160
8.2	Venues	161
8.3	Carry-over effects	164
8.4	Bipartite tournaments	165
8.5	Exercises 8	169
9	Room squares and bridge tournaments	172
9.1	Room squares	172
9.2	The use of starters	176
9.3	Triplication and quintuplication	181
9.4	Balanced Room squares for bridge tournaments	184
9.5	Exercises 9	192

10	Balanced tournament designs	195
	10.1 Factored balanced tournament designs	195
	10.2 Partitioned balanced tournament designs	202
	10.3 Howell designs	204
	10.4 Exercises 10	206
11	Whist tournaments	209
	11.1 The use of differences	209
	11.2 Using pairwise balanced designs	212
	11.3 Product theorems	215
	11.4 Using SAMDRR	217
	11.5 Whist tournaments for $4n + 1$ players	218
	11.6 Directedwhist and triplewhist tournaments	221
	11.7 Exercises 11	225
	Bibliography	227
	Index of (v, k, λ)BIBDs explicitly constructed	233
	Index	235