

1. Counting and Binomial Coefficients	1
1.1 Basic Principles	1
1.2 Factorials	2
1.3 Selections	3
1.4 Binomial Coefficients and Pascal's Triangle	6
1.5 Selections with Repetitions	10
1.6 A Useful Matrix Inversion	13
2. Recurrence	19
2.1 Some Examples	19
2.2 The Auxiliary Equation Method	23
2.3 Generating Functions	26
2.4 Derangements	28
2.5 Sorting Algorithms	32
2.6 Catalan Numbers	34
3. Introduction to Graphs	43
3.1 The Concept of a Graph	43
3.2 Paths in Graphs	46
3.3 Trees	47
3.4 Spanning Trees	50
3.5 Bipartite Graphs	52
3.6 Planarity	54
3.7 Polyhedra	60
4. Travelling Round a Graph	69
4.1 Hamiltonian Graphs	69
4.2 Planarity and Hamiltonian Graphs	71
4.3 The Travelling Salesman Problem	74

4.4	Gray Codes	76
4.5	Eulerian Graphs	78
4.6	Eulerian Digraphs	81
5.	Partitions and Colourings	89
5.1	Partitions of a Set	89
5.2	Stirling Numbers	91
5.3	Counting Functions	94
5.4	Vertex Colourings of Graphs	96
5.5	Edge Colourings of Graphs	99
6.	The Inclusion–Exclusion Principle	107
6.1	The Principle	107
6.2	Counting Surjections	112
6.3	Counting Labelled Trees	113
6.4	Scrabble	114
6.5	The Ménage Problem	115
7.	Latin Squares and Hall’s Theorem	121
7.1	Latin Squares and Orthogonality	121
7.2	Magic Squares	125
7.3	Systems of Distinct Representatives	127
7.4	From Latin Squares to Affine Planes	131
8.	Schedules and 1-Factorisations	137
8.1	The Circle Method	137
8.2	Bipartite Tournaments and 1-Factorisations of $K_{n,n}$	142
8.3	Tournaments from Orthogonal Latin Squares	145
9.	Introduction to Designs	149
9.1	Balanced Incomplete Block Designs	149
9.2	Resolvable Designs	156
9.3	Finite Projective Planes	159
9.4	Hadamard Matrices and Designs	161
9.5	Difference Methods	165
9.6	Hadamard Matrices and Codes	167
	Appendix	179
	Solutions	183
	Further Reading	195
	Bibliography	197
	Index	199