

# CONTENTS

<b>Preface</b>	xi
<b>1. Graphs</b>	1
<i>Terminology of graphs and digraphs, Eulerian circuits, Hamiltonian circuits</i>	
<b>2. Trees</b>	11
<i>Cayley's theorem, spanning trees and the greedy algorithm</i>	
<b>3. Colorings of graphs and Ramsey's theorem</b>	20
<i>Brooks' theorem, Ramsey's theorem and Ramsey numbers, the Erdős-Szekeres theorem</i>	
<b>4. Turán's theorem and extremal graphs</b>	29
<i>Turán's theorem and extremal graph theory</i>	
<b>5. Systems of distinct representatives</b>	35
<i>Bipartite graphs, P. Hall's condition, SDRs, König's theorem, Birkhoff's theorem</i>	
<b>6. Dilworth's theorem and extremal set theory</b>	42
<i>Partially ordered sets, Dilworth's theorem, Sperner's theorem, symmetric chains, the Erdős-Ko-Rado theorem</i>	
<b>7. Flows in networks</b>	49
<i>The Ford-Fulkerson theorem, the integrality theorem, a generalization of Birkhoff's theorem</i>	
<b>8. De Bruijn sequences</b>	56
<i>The number of De Bruijn sequences</i>	

<b>9. The addressing problem for graphs</b>	62
<i>Quadratic forms, Winkler's theorem</i>	
<b>10. The principle of inclusion and exclusion; inversion formulae</b>	70
<i>Inclusion-exclusion, derangements, Euler indicator, Möbius function, Möbius inversion, Burnside's lemma, problème des ménages</i>	
<b>11. Permanents</b>	79
<i>Bounds on permanents, Schrijver's proof of the Minc conjecture, Fekete's lemma, permanents of doubly stochastic matrices</i>	
<b>12. The Van der Waerden conjecture</b>	91
<i>The early results of Marcus and Newman, London's theorem, Egoritsjev's proof</i>	
<b>13. Elementary counting; Stirling numbers</b>	100
<i>Stirling numbers of the first and second kind, Bell numbers, generating functions</i>	
<b>14. Recursions and generating functions</b>	109
<i>Elementary recurrences, Catalan numbers, counting of trees, Joyal theory, Lagrange inversion</i>	
<b>15. Partitions</b>	132
<i>The function <math>p_k(n)</math>, the partition function, Ferrers diagrams, Euler's identity, asymptotics, the Jacobi triple product identity, Young tableaux and the hook formula</i>	
<b>16. (0,1)-Matrices</b>	148
<i>Matrices with given line sums, counting (0,1)-matrices</i>	
<b>17. Latin squares</b>	157
<i>Orthogonal arrays, conjugates and isomorphism, partial and incomplete Latin squares, counting Latin squares, the Evans conjecture</i>	
<b>18. Hadamard matrices, Reed-Muller codes</b>	172
<i>Hadamard matrices and conference matrices, recursive constructions, Paley matrices, Williamson's method, excess of a Hadamard matrix, first order Reed-Muller codes</i>	

<b>19. Designs</b>	187
<i>The Erdős-De Bruijn theorem, Steiner systems, balanced incomplete block designs, Hadamard designs, counting, (higher) incidence matrices, the Wilson-Petrenjuk theorem, symmetric designs, projective planes, derived and residual designs, the Bruck-Ryser-Chowla theorem, constructions of Steiner triple systems, write-once memories</i>	
<b>20. Codes and designs</b>	214
<i>Terminology of coding theory, the Hamming bound, the Singleton bound, weight enumerators and MacWilliams' theorem, the Assmus-Mattson theorem, symmetry codes, the Golay codes, codes from projective planes</i>	
<b>21. Strongly regular graphs and partial geometries</b>	231
<i>The Bose-Mesner algebra, eigenvalues, the integrality condition, quasisymmetric designs, the Krein condition, the absolute bound, uniqueness theorems, partial geometries, examples</i>	
<b>22. Orthogonal Latin squares</b>	250
<i>Pairwise orthogonal Latin squares and nets, Euler's conjecture, the Bose-Parker-Shrikhande theorem, asymptotic existence, orthogonal arrays and transversal designs, difference methods, orthogonal subsquares</i>	
<b>23. Projective and combinatorial geometries</b>	269
<i>Projective and affine geometries, duality, Pasch's axiom, Desargues' theorem, combinatorial geometries, geometric lattices, Greene's theorem</i>	
<b>24. Gaussian numbers and <math>q</math>-analogues</b>	291
<i>Chains in the lattice of subspaces, <math>q</math>-analogue of Sperner's theorem, interpretation of the coefficients of the Gaussian polynomials, spreads</i>	

<b>25. Lattices and Möbius inversion</b>	298
<i>The incidence algebra of a poset, the Möbius function, chromatic polynomial of a graph, Weisner's theorem, complementing permutations of geometric lattices, connected labeled graphs</i>	
<b>26. Combinatorial designs and projective geometries</b>	313
<i>Arcs and subplanes in projective planes, blocking sets, quadratic and Hermitian forms, unitals, generalized quadrangles, Möbius planes</i>	
<b>27. Difference sets and automorphisms</b>	329
<i>Automorphisms of symmetric designs, Paley-Todd and Stanton-Sprott difference sets, Singer's theorem</i>	
<b>28. Difference sets and the group ring</b>	342
<i>The Multiplier Theorem and extensions, homomorphisms and further necessary conditions</i>	
<b>29. Codes and symmetric designs</b>	355
<i>The sequence of codes of a symmetric design, Wilbrink's theorem</i>	
<b>30. Association schemes</b>	364
<i>Examples, the eigenmatrices and orthogonality relations, formal duality, the distribution vector of a subset, Delsarte's inequalities, polynomial schemes, perfect codes and tight designs</i>	
<b>31. Algebraic graph theory: eigenvalue techniques</b>	390
<i>Tournaments and the Graham-Pollak theorem, the spectrum of a graph, Hoffman's theorem, Shannon capacity, applications of interlacing and Perron-Frobenius</i>	
<b>32. Graphs: planarity and duality</b>	403
<i>Deletion and contraction, the chromatic polynomial, Euler's formula, Whitney duality, matroids</i>	
<b>33. Graphs: colorings and embeddings</b>	427
<i>The Five Color Theorem, embeddings and colorings on arbitrary surfaces, the Heawood conjecture, the Edmonds embedding technique</i>	
<b>34. Electrical networks and squared squares</b>	449
<i>The matrix-tree theorem, the network of a squared rectangle, Kirchhoff's theorem</i>	

<b>35. Pólya theory of counting</b>	461
<i>The cycle index of a permutation group, counting orbits, weights, necklaces, the symmetric group, Stirling numbers</i>	
<b>36. Baranyai's theorem</b>	475
<i>One-factorizations of complete graphs and complete designs</i>	
<b>Appendix 1. Hints and comments on problems</b>	481
<i>Hints, suggestions, and comments on the problems in each chapter</i>	
<b>Appendix 2. Formal power series</b>	506
<i>Formal power series ring, formal derivatives, inverse functions, residues, the Lagrange-Bürmann formula</i>	
<b>Name Index</b>	512
<b>Subject Index</b>	518