

Index

The pages on which definitions occur are given in **bold** type.

A

abelian group, viii, 93.192,206
 absolute bound, 41–42
 absolute point, **42**, 46
 adjacency matrix, **36–37**
 affine design, **16**, 69, 70, 79–80
 affine permutation group, 129, 141
 affine plane, **14**, 15, 93
 affine resolvable design, 16
 affine space, **17**, 139
 algebra, Bose–Mesner, **201**, 204
 algebra, centralizer, 38, 201
 algebra, group, 172
 algebraic geometry, 35, 127
 alphabet, 117
 alternating bilinear form, **76**, 95, 101, 107, 143
 alternating group, 36, 82, 89
 arc, **17**, 130, 156, 160
 Arf invariant, 77
 Assmus–Mattson Theorem, 165–167, 178, 188
 association scheme, **197**, *passim*
 association scheme, cyclotomic, 212
 association scheme in the sense of Del-sarte, 199, 211–212
 association scheme, P-polynomial, **203**, 203–205

association scheme, Q-polynomial, **204**, 204–205
 automorphism, **3**, 133, 164, 176, 188
 automorphism group, 3, 22, 67, 133, 141, 152, 164, 178–180
 Axiom of Choice, 83

B

Baer subplane, **9**, 22, 27, 83–84, 99–100
 balanced incomplete-block design, 4
 ball, **118**
 BCH code, **127–129**, 167, 188
 BIBD, 4
 binary Golay code, 22, 130, **131–135**, 151, 155, 165, 193
 biplane, 46, 67, 156–157
 block graph, **70**
 block design, 4
 blocks, repeated, 1–2, 14
 Boolean function, 139, 141
 Bose’s Theorem, 92
 Bose–Mesner algebra, **200–201**, 204
 bound, Johnson, 182
 bound, linear programming, 169, 207
 bound, sphere-packing, 118, 182, 207
 bound, square root, 164
 Bruck–Ryser–Chowla Theorem, 7, 9, 73

C

cardinals, infinite, 83
category theory, 83
centralizer algebra, 38, 201
Chang graphs, **60–61**, 64–65, 66, 74, 103
character, viii, 122, 172, 206
check polynomial, 126
class of set, 96
classical GQ, 95–96
Clebsch graph, **35**, 43, 63, 67, 106, 109, 112, 192
cocktail party graph, **35**, 43, 52, 63, 71
code, BCH, **127–129**, 167, 188
code, binary Golay, 22, 130, **131–135**, 151, 155, 165, 193
code, cyclic, **125**, 142
code, distance invariant, **168**, 171, 186
code, doubly even, **131**
code, equidistant, 150, 162
code, equivalent, 119
code, Euclidean geometry, 149
code, extended, 120
code, extended QR, 164
code, GQR, **172**
code, Hamming, 120, 126–127, 133, 140, 153, 162, 167, 183, 187, 193
code, in association scheme, **207**
code, Kerdock, 142–145, 187, 211
code, linear, **118**, *passim*
code, maximum distance separable, 123, 129
code, MDS, 123, 129
code, narrow sense BCH, **128**
code, nearly perfect, 181, **182**, 184–185, 188
code, non-linear, 119, 123, 131, 137, 142–145, 150, 151, 183–188, 192–194, 211
code, Nordstrom–Robinson, 137, 144

code, perfect, **118**, 120, 131, 135, 137–138, 173, 181, 208, 210
code, Preparata, 185, 188, 192–194, 211
code, primitive BCH, **128**, 167
code, projective, 189
code, projective geometry, 149
code, quadratic residue, **162**, *passim*
code, quasi-perfect, 183
code, Reed–Muller, 139, *passim*, 153, 168, 188
code, Reed–Solomon, 129–130
code, residual, 123
code, RM, 139, *passim*, 153, 168, 188
code, RS, 129–130
code, self-dual, 120, 133, 135, 153, 167, 173–174, 176
code, self-orthogonal, 120, 130, 131, 153, 164
code, symmetry, **176**, *passim*
code, systematic, 119
code, ternary Golay, 22, **135–136**, 153, 167, 173, 176
code, two-weight, 181, 189–192
code, uniformly packed, 181, **183**, *passim*
coherent configuration, 199
complement of design, **13**, 70, 166, 184–185
complement of graph, **29**, 32, 33, 35, 72
complete graph, 29
complete multipartite graph, **34–35**
complete transversal design, 93–94
completely regular two-graph, 65–66
conference graph, 110
conference matrix, 40, **175**
conic, 18–19, 26, 134
conjugate dual, 136
contraction of code, 167
Conway group, 58, 67
covering radius, 183

cross ratio, 106–107
 cyclic code, **125**, 142
 cyclotomic association scheme, 212

D

deficiency of net, **93**
 degree of design, 210
 degree of net, **93**
 Dembowski–Wagner Theorem, 8, 75
 derangement, 28
 derived design, **11**
 Desargues' Theorem, 8
 Desarguesian plane, 7, 158
 design, affine, **16**, 69, 70, 79–80
 design, affine resolvable, 16
 design, balanced incomplete-block, 4
 design, complementary, **13**, 70, 166, 184–185
 design, complete transversal, 93–94
 design, derived, **11**
 design, extendable, **11**, 26
 design, Hadamard, **10**, 11–12, 17, 24, 25, 72–73, 76
 design, in association scheme, **207**
 design, pair, 30
 design, pairwise balanced, 4
 design, Paley, **10**
 design, projective, 5, 17
 design, quasi-residual, **14**, 17, 73–74
 design, quasi-symmetric, **69**, *passim*, 107–108, 211
 design, quasi-3, **75**, 75–77
 design, residual, **13**, 17
 design, resolvable, **16**
 design, spherical, 111
 design, square, **5**, 5–13, 17, 42, 69
 design, symmetric, 5, 69
 design, *t*-, **1**, *passim*
 design, tight, **20**, 20–21, 71, 211
 designed distance, 127–128

diameter, 45
 dimension, 118
 distance distribution, **168**, 169
 distance, dual, **170**, 210
 distance enumerator, **168**
 distance, external, **170**, 210
 distance, Hamming, **117**
 distance invariant code, **168**, 171, 186
 distance, minimum, 118–119, 139, 170, 186, 210
 distance regular graph, **199**
 distribution vector, **206**
 dodecad, 88
 doubly even code, **131**
 doubly transitive group, 8, **36**, 180
 duad, 81
 dual design, 5, 93
 dual distance, **170**, 210
 dual (5, 6, 12)s, 87
 dual 6-sets, **83**, 85, 86
 duality of association schemes, 205–206
 duality of design, **6**
 duality of Reed–Muller codes, 140

E

eigenmatrices, first and second, **202**
 eigenvalue of graph, 37, 51–54, 70
 eigenvalue of two-graph, 61
 egglike inversive plane, **15**
 EGQ, 98
 elliptic quadric, 15, 191
 embeddable net, **93**
 equidistant code, 150, 162
 equivalence, monomial, 119, 124, 137
 equivalence of codes, 119
 equivalence of Hadamard matrices, 9
 error-correcting codes, 117, *passim*
 Euclidean geometry code, 149
 extendable design, **11**, 26
 extended code, 120

extended generalized quadrangle, 98
 extended QR code, 164
 extension of design, **11**, 12, 26
 extension of graph, 59
 external distance, **170**, 210
 extremal Smith graph, 113

F

factor, 81–83
 factorization, 16, 81–83
 field, finite, viii, 117, 138
 Fisher's inequality, 5, 7, 12, 16, 70, 71
 flat, 8, 140–141
 Friendship Theorem, 45
 fundamental parameters, 170, 210

G

generalized line graph, **52–53**, 55–56
 generalized quadrangle, **94**, *passim*
 generalized quadrangle, classical, 95–96
 generator matrix, **119**
 generator polynomial, 125
 generously transitive group, 198
 geometric graph, **92**, 101, 112, 114
 geometry, affine, **17**, 139
 geometry, algebraic, 35, 127
 geometry, Moore, 105
 geometry, partial, 15, **91**, *passim*, 148, 192
 geometry, projective, **7–8**, 75, 124, 189–191, 194–195
 Gewirtz graph, **35–36**, 43, 106–109, 156
 girth, 45
 Golay codes, *see* binary or ternary
 GQ, **94**, *passim*
 GQR code, **172**
 Gram matrix, **41**
 graph, **29**
 graph, block, **70**

graph, Chang, **60–61**, 64–65, 66, 74, 103
 graph, Clebsch, **35**, 43, 63, 67, 106, 109, 112, 192
 graph, cocktail party, **35**, 43, 52, 63, 71
 graph, complete, 29
 graph, complete multipartite, **34–35**
 graph, conference, 110
 graph, distance regular, **199**
 graph, extremal Smith, 113
 graph, generalized line, **52–53**, 55–56
 graph, geometric, **92**, 101, 112, 114
 graph, Gewirtz, **35–36**, 43, 106–109, 156
 graph, Hamming, **199**
 graph, Higman–Sims, **107**, 109, 112, 113–114
 graph, Hoffman–Singleton, 46, **85–86**, 90, 103, 109
 graph, Johnson, **199**
 graph, ladder, **34**, 39, 71, 73
 graph, Latin square, 40, 93, **110**, 190
 graph, line, **51**, 69, 92
 graph, McLaughlin, 67, 112
 graph, Moore, 45–46, 81, 84–85, 88–89, 105, 109
 graph, negative Latin square, 110, 114
 graph, null, 29
 graph, odd, 200, 213
 graph, Paley, **35**, 39, 40
 graph, Petersen, **33–34**, 40, 55, 63, 66, 85, 103, 109, 114, 200
 graph, point, 92
 graph, pseudo-geometric, **92**, 101, 112, 114
 graph, pseudo Latin square, 110–114
 graph, rank 3, **36**, 39, 115
 graph, regular, **30**
 graph, Schläfli, **32**, 35, 47, 63, 112
 graph, Shrikhande, **60**, 63, 66, 67

graph, Smith, 111–113
 graph, square lattice, **33–35**, 63, 67, 71, 92, 110
 graph, strongly regular, **32**, *passim*, 136, 138, 189–192, 194–195, 198
 graph, triangular, **33**, 35, 53–55, 63, 87, 93
 graph, (v, k, λ) , **43**
 group, abelian, viii, 93, 192, 206
 group, affine, 129, 141
 group algebra, 172
 group, alternating, 36, 82, 89
 group, automorphism, 3, 22, 67, 133, 141, 152, 164, 178–180
 group, Conway, 58, 67
 group, doubly transitive, 8, **36**, 180
 group, generously transitive, 198
 group, imprimitive, 82
 group, intransitive, 82
 group, linear fractional, 16, 23, 88, 164, 179
 group, Mathieu, 22, 165, 179
 group, symmetric, 82–83

H

H-matrix, **9**
 Hadamard design, **10**, 11–12, 17, 24, 25, 72–73, 76
 Hadamard matrix, **9**, 17, 24, 25–26, 150, 183–184, 188
 Hadamard product, **42**, 204
 Hall-Connor Theorem, 14, 73
 Hamming code, 120, 126–127, 133, 140, 153, 162, 167, 183, 187, 193
 Hamming distance, **117**
 Hamming graph, **199**
 Hamming scheme, **198**
 Hasse-Minkowski theory, 7
 Hermitian form, 95, 99
 Hessian configuration, 127

hexacode, 134
 higher regularity conditions, 112
 Higman's two-graph, 65–67
 Higman-Sims graph, **107**, 109, 112, 113–114
 Hill cap, **191–192**
 Hoffman-Singleton graph, 46, **85–86**, 90, 103, 109
 hyperbolic quadric, 191
 hypergraph, 58
 hyperplane, 8, 124, 152, 191, 194–195

I

icosahedron, 133
 idempotent, 42, 161, 173, 204
 imprimitive group, 82
 incidence matrix, 4, 5, 43
 index of form, 95
 infinite cardinals, 83
 integrality condition, 37–38, 106, 201
 intersection matrix, **201**
 intersection triangle, **21**, 26, 86–87
 intransitive group, 82
 invariant factor, viii, 157–158
 inversive plane, **15**, 173
 inversive plane, egglike, **15**
 isomorphism, 3

J

Johnson bound, 182
 Johnson graph, **199**
 Johnson scheme, **198**

K

Kerdock code, 142–145, 187, 211
 Kerdock set, **144**, 145–149
 Kirkman's schoolgirl problem, 16
 knot, 18
 Krawtchouk polynomial, 169, 203, 212

Krein condition, 42, 45, 63, 105, 110–112, 204
Kronecker product, **25**, 42, 79

L

ladder graph, **34**, 39, 71, 73
Latin square, **14**, 93
Latin square graph, 40, 93, **110**, 190
Latin squares, mutually orthogonal, 15
Latin squares, orthogonal, **14**, 93
line, 8, 17, 91, 155
line, in design, **8–9**
line graph, **51**, 69, 92
line graph of design, 69
line graph of partial geometry, **92**
line system, **49**
line system, star-closed, **49**
linear code, **118**, *passim*
linear fractional group, 16, 23, 88, 164, 179
linear programming bound, 169, 207
lines, parallel, 14
linked partial geometries, 97
linked square designs, 78, **148**

M

MacWilliams relations, 121–122, 155, 160, 166–167
MacWilliams transform, 168–169
majority logic decoding, 142
Mathieu groups, 22, 165, 179
matrix, adjacency, **36–37**
matrix, conference, 40, **175**
matrix, generator, **119**
matrix, Gram, **41**
matrix, Hadamard, 9, 17, 24, 25–26, 150, 183–184, 188
matrix, incidence, 4, 5, 43
matrix, intersection, **201**
matrix, monomial, 119, 179

matrix, Paley, **10**, 132, 135, 175–176
matrix, parity check, **120**
matrix, reduced adjacency, 201
matrix, Sylvester, **10**, 17, 27, 150
matrix, Vandermonde, 20, 128
maximum distance separable code, 123, 129
McLaughlin graph, 67, 112
MDS code, 123, 129
minimum distance, 118–119, 139, 170, 186, 210
minimum weight, 119, 129
Minkowski inner product, 157
Miracle Octad Generator, 24
Möbius plane, **15**, 173
monomial equivalence, 119, 124, 137
monomial matrix, 119, 179
Moore geometry, 105
Moore graph, 45–46, 81, 84–85, 88–89, 105, 109
morphism, 83
mutually orthogonal Latin squares, 15

N

narrow sense BCH code, **128**
nearly perfect code, 181, **182**, 184–185, 188
negative Latin square graph, 110, 114
net, 14, **93**
net, embeddable, **93**
non-linear code, 119, 123, 131, 137, 142–145, 150, 151, 183–188, 192–194, 211
nonsingular form, 144
Nordstrom–Robinson code, 137, 144
normalized H-matrix, **10**
nucleus, 18, 26, 134
null graph, 29

O

- objects, 83
- odd graph, 200, 213
- order of net, **93**
- orthogonal array, 170, 209
- orthogonal GQ, 95
- orthogonal Latin squares, **14**, 93
- orthogonal spread, 145–146
- oval, **17**, 17–19, 22, 83–84, 97, 134, 155–157, 159
- overall parity check, 120
- ovoid, **15–16**, 191
- ovoid, Suzuki–Tits, 16, 191

P

- P-polynomial association scheme, **203**, 203–205
- pair design, 30
- pairwise balanced design, 4
- Paley design, **10**
- Paley graph, **35**, 39, 40
- Paley H-matrix, 10
- Paley matrix, **10**, 132, 135, 175–176
- Pappus' Theorem, 8
- parallel lines, 14
- parallelism, 16
- parity check matrix, **120**
- partial geometry, 15, **91**, *passim*, 148, 192
- passant, 17
- pentagon, 34, 35, 46, 62, 106, 109, 111, 113, 115
- perfect code, **118**, 120, 131, 135, 137–138, 173, 181, 208, 210
- Perron-Frobenius Theorem, 40
- Petersen graph, **33**, 34, 40, 55, 63, 66, 85, 103, 109, 114, 200
- plane, 8, 17
- plane, affine, **14**, 15, 93
- plane, Desarguesian, 7, 158

- plane, inversive, **15**, 173
- plane, Möbius, **15**, 173
- plane, projective, **7**, 81, 83–84, 89–90, 122, 126, 132, 137, 152–158
- Playfair's Axiom, 14
- point, 1, 8, 17, 91
- point graph of partial geometry, **92**
- polarity, **6**, 42–43, 46, 47, 195
- polarization, 43
- polynomial, check, 126
- polynomial, generator, 125
- polynomial, Krawtchouk, 169, 203, 212
- Preparata code, 185, 188, 192–194, 211
- primitive BCH code, **128**, 167
- primitive element, 126
- Principle of Inclusion and Exclusion, viii, 13, 21, **24–25**, 27, 112, 115
- projective code, 189
- projective design, 5, 17
- projective geometry, **7–8**, 75, 124, 189–191, 194–195
- projective geometry code, 149
- projective plane, **7**, 81, 83–84, 89–90, 122, 126, 132, 137, 153–158
- projective space, **7–8**
- pseudo-geometric graph, **92**, 101, 112, 114
- pseudo Latin square graph, 110–114

Q

- Q-polynomial association scheme, **204**, 204–205
- Q-transform, **207**
- quadratic form, 44, 45, **76**, 143
- quadratic residue, 162
- quadratic residue code, **162**, *passim*
- quadric, 145–148, 191, 195
- quadric, elliptic, 15, 191
- quadric, hyperbolic, 191
- quasi-perfect code, 183

234

quasi-residual design, **14**, 17, 73–74
 quasi-symmetric design, **69**, *passim*,
 107–108, 211
 quasi-3 design, **75**, 75–77

R

rank 3 graph, **36**, 39, 115
 rationality condition, 37–38
 reduced adjacency matrix, 201
 Reed–Muller code, 139, *passim*, 153,
 168, 188
 Reed–Solomon code, 129–130
 regular graph, **30**
 regular two-graph, **58**, 61–62
 regularity conditions, higher, 112
 repeated blocks, 1–2, 14
 residual code, 123
 residual design, **13**, 17
 resolution, 16
 resolvable design, **16**
 RM code, 139, *passim*, 153, 168, 188
 root system, 49
 RS code, 129–130

S

Schläfli graph, **32**, 35, 47, 63, 112
 Schur ring, 206
 SDR, 64
 secant, 17, 96
 Segre's Theorem, 19
 self-dual code, 120, 133, 135, 153, 167,
 174–174, 176
 self-orthogonal code, 120, 130, 131,
 153, 164
 set of class s , 96
 Shrikhande graph, **60**, 63, 66, 67
 singular space, 145
 Smith graph, 111–113
 Smith normal form, viii, 157–158
 space, affine, **17**

Index

space, projective, **7–8**
 sphere packing bound, 118, 182, 207
 spherical design, 111
 spread, 145–146
 spread, orthogonal, 145–146
 spread, symplectic, 146
 square design, **5**, 5–13, 17, 42, 69
 square lattice graph, **33–35**, 63, 67, 71,
 92, 110
 square root bound, 164
 standard form, 119
 star, **49**
 star-closed line system, **49**
 Steiner system, **1**, 2, 81, 86–88, 124,
 126–127, 132, 137–138, 178
 strength of design, 210
 strongly regular graph, **32**, *passim*, 136,
 138, 189–192, 194–195, 198
 structure, 1, 2, 27
 subconstituents, **110**, 110–115
 subgroup, Sylow, 36, 86
 subplane, **9**, 27
 Suzuki–Tits ovoid, 16, 191
 switching, 40, **59**
 Sylow subgroup, 36, 86
 Sylvester H-matrix, **10**, 17, 27
 Sylvester matrix, 10, 17, 27, 150
 symmetric design, 5, 69
 symmetric difference and reflection, 64
 symmetric difference property, 77, 138,
 152
 symmetry code, **176**, *passim*
 symplectic GQ, 95
 symplectic spread, 146
 syntheme, 81
 system of linked square designs, 78,
148
 systematic code, 119

T

- t*-design, **1**, *passim*
- tangent, **17**
- tensor product, **25**, **42**
- ternary Golay code, **22**, **135–136**, **153**,
167, **173**, **176**
- tight design, **20**, **20–21**, **71**, **211**
- topology, **58**
- totally isotropic, **145**
- totally singular, **145**
- triangle property, **44**, **46–47**
- triangular graph, **33**, **35**, **53–55**, **63**, **87**,
93
- two-graph, **58**, *passim*
- two-graph, completely regular, **65–66**
- two-graph, Higman's, **65–67**
- two-graph, regular, **58**, **61–62**
- two-weight code, **181**, **189–192**

U

- uniformly packed code, **181**, **183**, *pas-*
sim
- unital, **23**, **99**, **127**, **190**

unitary GQ, **95**

V

- (v, k, λ) graph, **43**
- valency, **30**
- Vandermonde matrix, **20**, **128**
- variance trick, **6**, **18**
- volume, **9**

W

- weight, **118**
- weight enumerator, **121**, **155**
- windmill, **31–32**, **45**, **51**
- word, **117**
- word length, **117**
- wreath product, **119**

X**Y****Z**