

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 Delsarte, 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

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

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
 syntherme, 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**