

Bibliography

- [A] V. I. Arnol'd, *Huygens & Barrow, Newton & Hooke*, Birkhäuser, Basel, 1990.
- [B] E. Artin, *Geometric Algebra*, Interscience, New York, 1957.
- [C] K. S. Brown, *Buildings*, Springer, New York, 1989.
- [D] R. H. Bruck, *A Survey of Binary Systems*, Springer, Berlin, 1958.
- [E] F. Buekenhout (ed.), *Handbook of Incidence Geometry*, Elsevier, Amsterdam, 1995.
- [F] P. J. Cameron and J. H. van Lint, *Designs, Graphs, Codes and their Links*, London Math. Soc. Student Texts **22**, Cambridge Univ. Press, Cambridge, 1991.
- [G] R. W. Carter, *Simple Groups of Lie Type*, Wiley, London, 1972.
- [H] C. Chevalley, *The Algebraic Theory of Spinors and Clifford Algebras* (Collected Works Vol. 2), Springer, Berlin, 1997.
- [I] P. M. Cohn, *Algebra*, Volume 1, Wiley, London, 1974.
- [J] J. H. Conway, R. T. Curtis, S. P. Norton, R. A. Parker, and R. A. Wilson, *An ATLAS of Finite Groups*, Oxford University Press, Oxford, 1985.
- [K] L. E. Dickson, *Linear Groups, with an Exposition of the Galois Field theory*, Teubner, Leipzig, 1901 (reprint Dover Publ., New York, 1958).
- [L] J. Dieudonné, *La Géométrie des Groupes Classiques*, Springer, Berlin, 1955.

- [M] P. B. Kleidman and M. W. Liebeck, *The Subgroup Structure of the Finite Classical Groups*, London Math. Soc. Lecture Notes **129**, Cambridge Univ. Press, Cambridge, 1990.
- [N] H. Lüneburg, *Transitive Erweiterungen endlicher Permutationsgruppen*, Lecture Notes in Math. **84**, Springer, Berlin, 1969.
- [O] G. Pickert, *Projektive Ebenen*, Springer-Verlag, Berlin, 1955.
- [P] M. A. Ronan, *Lectures on Buildings*, Academic Press, Boston, 1989.
- [Q] SOCRATES lecture notes, available from
<http://dwispc8.vub.ac.be/Potenza/lectnotes.html>
 and
<http://cage.rug.ac.be/~fdc/intensivcourse2/final.html>
- [R] D. E. Taylor, *The Geometry of the Classical Groups*, Heldermann Verlag, Berlin, 1992.
- [S] J. Tits, *Buildings of Spherical Type and Finite BN-Pairs*, Lecture Notes in Math. **386**, Springer, Berlin, 1974.
- [T] O. Veblen and J. W. Young (1916), *Projective Geometry* (2 vols.), Ginn & Co., Boston, 1916.

- [1] A. Barlotti, Sul gruppo delle proiettività di una retta in se nei piani liberi e nei piani aperti, *Rendic. Sem. Math. Padova* **34** (1964), 135–139.
- [2] D. R. Breach and A. P. Street, Partitioning sets of quadruples into designs, II, *J. Comb. Math. Comb. Comput.* **3** (1988), 41–48.
- [3] M. Brown, (Hyper)ovals and ovoids in projective spaces, available from
http://cage.rug.ac.be/~fdc/intensivcourse2/brown_2.pdf
- [4] R. H. Bruck and H. J. Ryser, The nonexistence of certain finite projective planes, *Canad. J. Math.* **1** (1949), 88–93.
- [5] F. Buekenhout, Plans projectifs à ovoïdes pascaliens, *Arch. Math.* **17** (1966), 89–93.

- [6] F. Buekenhout, Une caractérisation des espaces affines basée sur la notion de droite, *Math. Z.* **111** (1969), 367–371.
- [7] F. Buekenhout, Diagrams for geometries and groups, *J. Combinatorial Theory (A)* **27** (1979), 121–151.
- [8] F. Buekenhout and E. E. Shult (1974), On the foundations of polar geometry, *Geometriae Dedicata* **3** (1974), 155–170.
- [9] P. J. Cameron, Dual polar spaces, *Geometriae dedicata* **12** (1982), 75–85.
- [10] P. J. Cameron, *Classical Groups*, available from http://www.maths.qmw.ac.uk/~pjc/class_gps/
- [11] P. J. Cameron and J. I. Hall, Some groups generated by transvection subgroups, *J. Algebra* **140** (1991), 184–209.
- [12] P. J. Cameron and W. M. Kantor, 2-transitive and antiflag transitive collineation groups of finite projective spaces, *J. Algebra* **60** (1979), 384–422.
- [13] P. J. Cameron and C. E. Praeger, Partitioning into Steiner systems, in *Combinatorics '88*, Mediterranean Press, Roma, 1991.
- [14] W. Cherowitzo, Hyperoval page, available from <http://www-math.cudenver.edu/~wcherowi/research/hyperoval/hypero.html>
- [15] P. M. Cohn, The embedding of firs in skew fields, *Proc. London Math. Soc.* (3) **23** (1971), 193–213.
- [16] J. Doyen and X. Hubaut, Finite regular locally projective spaces, *Math. Z.* **119** (1971), 83–88.
- [17] W. Feit and G. Higman, On the non-existence of certain generalised polygons, *J. Algebra* **1** (1964), 434–446.
- [18] M. Hall Jr., Automorphisms of Steiner triple systems, *IBM J. Res. Develop.* **4** (1960), 460–471.

- [19] M. Hall Jr., Group theory and block designs, pp. 115-144 in *Proc. Internat. Conf. theory of Groups* (ed. L. G. Kovács and B. H. Neumann), Gordon & Breach, New York, 1967.
- [20] G. Higman, B. H. Neumann and H. Neumann, Embedding theorems for groups, *J. London Math. Soc.* (1) **26** (1949), 247–254.
- [21] C. W. H. Lam, S. Swiercz and L. Thiel, The nonexistence of finite projective planes of order 10, *Canad. J. Math.* **41** (1989), 1117–1123.
- [22] J. E. McLaughlin, Some groups generated by transvections, *Arch. Math. (Basel)* **18** (1967), 362–368.
- [23] J. E. McLaughlin, Some subgroups of $SL_n(F_2)$, *Illinois J. Math.* **13** (1969), 108–115.
- [24] R. Scharlau, Buildings, pp. 477–645 in *Handbook of Incidence Geometry* (F. Buekenhout, ed.), Elsevier, Amsterdam, 1995.
- [25] A. Schleiermacher, Bemerkungen zum Fundamentalsatz der projectivern Geometrie, *Math. Z.* **99** (1967), 299–304.
- [26] B. Segre, Sulle ovali nei piani lineari finiti, *Atti Accad. Naz. Lincei Rendic.* **17** (1954), 141–142.
- [27] J. J. Seidel, On two-graphs, and Shult’s characterization of symplectic and orthogonal geometries over $GF(2)$, *T.H. report 73-WSK-02*, Techn. Univ., Eindhoven, 1973.
- [28] E. E. Shult, Characterizations of certain classes of graphs, *J. Combinatorial Theory (B)* **13** (1972), 142–167.
- [29] E. E. Shult, Characterizations of the Lie incidence geometries, pp. 157–186 in *Surveys in Combinatorics* (ed. E. K. Lloyd), London Math. Soc. Lecture Notes **82**, Cambridge Univ. Press, Cambridge, 1983.
- [30] E. E. Shult and A. Yanushka, Near n -gons and line systems, *Geometriae Dedicata*, **9** (1980), 1–72.
- [31] A. P. Sprague, Pasch’s axiom and projective spaces, *Discrete Math.* **33** (1981), 79–87.

- [32] J. A. Thas, P. J. Cameron and A. Blokhuis, On a generalization of a theorem of B. Segre, *Geometriae Dedicata* **43** (1992), 299–305.
- [33] J. Tits, Sur la trialité et certains groupes qui s'en déduisent, *Publ. Math. I.H.E.S.* **2** (1959), 14–60.
- [34] J. Tits, Ovoïdes et groupes de Suzuki, *Arch. Math.* **13** (1962), 187–198.
- [35] J. Tits, Nonexistence de certains polygones généralisés, I, *Invent. Math.* **36** (1976), 275–284.
- [36] J. Tits, Nonexistence de certains polygones généralisés, II, *Invent. Math.* **51** (1979), 267–269.
- [37] J. A. Todd, As it might have been, *Bull. London Math. Soc.* **2** (1970), 1–4.
- [38] O. Veblen and J. H. M. Wedderburn, Non-Desarguesian and non-Pascalian geometries, *Trans. Amer. Math. Soc.* **8** (1907), 379–388.
- [39] R. Weiss, The nonexistence of certain Moufang polygones, *Invent. Math.* **51** (1979), 261–266.

Index

- abstract polar space, 105
- addition, 1, 10, 32
- affine plane, 21, 40
- affine space, 3, 6
- algebraic curve, 52
- algebraic variety, 52
- alternating bilinear form, 77
- alternating groups, 131
- alternative division rings, 114
- anisotropic, 84
- anti-automorphism, 2
- atom, 39
- atomic lattice, 39
- automorphism, 17
- axis, 61

- Baer subplane, 141
- bilinear form, 76
- binary Golay code, 36
- bispread, 47, 127
- bits, 34
- block, 16
- Buekenhout geometry, 65
- buildings, 131
- bundle theorem, 58

- Cayley numbers, 114
- central collineation, 23
- central collineations, 133
- centre, 61
- chamber, 70
- chamber-connected, 70
- characteristic, 1
- Chevalley group, 133
- circle, 68
- classical groups, 114, 131
- classical point-quad pair, 154
- classical polar space, 88
- Clifford algebra, 156
- code, 34
- coding theory, 34
- collineation, 8
- commutative field, 1, 147
- complete bipartite graph, 97
- complete graph, 68
- configuration theorem, 23
- conic, 52, 127
- connected geometry, 66
- coordinatisation, 9
- corank, 66
- coset geometry, 70
- cospread, 47
- cotype, 66
- cross ratio, 59
- cross-ratio, 8

- degenerate conic, 55
- derivation, 46
- Desargues' Theorem, 4, 22, 38
- Desargues' theorem, 133
- Desarguesian planes, 24
- Desarguesian spread, 46

- design, 16
- determinant, 149
- diagram, 67
- digon, 67
- dimension, 3
- division ring, 1
- dodecad, 140, 144
- doubly-even self-dual code, 130
- dual polar space, 107, 133
- dual space, 3
- duality, 75
- duality principle, 6

- egglike inversive plane, 58
- elation, 23, 61
- elliptic quadrics, 57
- equianharmonic, 60
- error-correcting codes, 34
- exterior algebra, 149
- exterior points, 53
- exterior power, 148
- exterior set, 103
- exterior square, 148

- Feit–Higman theorem, 132
- field, 1
- finite field, 1, 14
- finite simple groups, 131
- firm, 66
- fixed field, 81
- flag, 66
- flag geometry, 132
- flat, 3
- flat C_3 -geometry, 102
- free plane, 20
- Friendship Theorem, 22
- Fundamental Theorem of Projective
Geometry, 8, 114

- Galois’ Theorem, 2
- gamma space, 150
- Gaussian coefficient, 15
- general linear group, 8
- generalised polygons, 131
- generalised projective plane, 68
- generalised projective space, 39
- generalised quadrangle, 90, 97
- geometry, 65
- germ, 85, 90, 92
- ghost node, 142
- Golay code, 137, 144
- GQ, 98
- graph
 - complete bipartite, 97
- grid, 91, 98
- group, 8
- groups of Lie type, 131

- Hadamard matrix, 144
- half-spinor geometry, 160
- half-spinor spaces, 160
- Hamming codes, 35
- Hamming distance, 34
- harmonic, 60
- Hermitian form, 77
- Hessian configuration, 141
- homology, 23, 63
- hyperbolic line, 84
- hyperbolic quadric, 91, 103
- hyperoval, 57, 101, 141
- hyperplane, 3, 33, 90
- hyperplane at infinity, 3, 7

- ideal hyperplane, 7
- incidence relation, 65
- interior points, 53
- inversive plane, 58

- isomorphism, 8
- join, 39
- Kirkman's schoolgirl problem, 119
- Klein quadric, 118
- lattice, 39
- left vector space, 2
- Lie algebra, 133
- line, 3, 89, 150
- line at infinity, 21
- linear code, 137
- linear codes, 35
- linear diagram, 69
- linear groups, 131
- linear space, 36, 40, 68
- linear transformations, 8
- Mathieu group, 139, 140, 143
- matrix, 3, 18
- meet, 39
- Miquel's theorem, 58
- modular lattice, 39
- Moufang condition, 114, 133
- Moulton plane, 20
- multiplication, 1, 10
- multiply transitive group, 11
- near polygon, 153
- Neumaier's geometry, 101
- non-degenerate, 76
- non-singular, 83
- nucleus, 55
- octad, 140
- octonions, 114
- opposite field, 2
- opposite regulus, 46
- order, 19, 22, 58
- orders, 98
- orthogonal groups, 114
- orthogonal space, 88
- overall parity check, 137
- ovoid, 57, 58, 125, 131, 135, 154
- ovoidal point-quad pair, 154
- Pappian planes, 25
- Pappus' Theorem, 24, 55
- parallel, 7
- parallel postulate, 21
- parallelism, 41
- parameters, 69
- partial linear space, 67
- Pascal's Theorem, 55
- Pascalian hexagon, 55
- passant, 57
- perfect, 83
- perfect codes, 35
- perfect field, 123
- perspectivity, 27
- plane, 3, 89
- Playfair's Axiom, 21, 41
- point, 3, 16, 89
- point at infinity, 21
- point-shadow, 69
- polar rank, 85, 88
- polar space, 88
- polarisation, 82
- polarity, 77
- orders, 69
- prime field, 1
- probability, 17
- projective plane, 4, 19, 40, 68
- projective space, 3
- projectivity, 27
- pseudoquadratic form, 82, 113
- pure products, 151

- pure spinors, 159
- quad, 153
- quadratic form, 82
- quaternions, 2
- radical, 80, 110
- rank, 3, 66, 89
- reduced echelon form, 18
- Ree group, 135
- Reed–Muller code, 139
- reflexive, 77
- regular spread, 46, 127
- regulus, 46, 127
- residually connected geometry, 66
- residue, 66
- right vector space, 2
- ruled quadric, 91
- Schläfli configuration, 100
- secant, 57
- Segre’s Theorem, 52
- semilinear transformations, 8
- semilinear, 76
- sesquilinear, 76
- shadow, 69
- sharply t -transitive, 28
- singular subspace, 105
- skew field, 1
- solid, 41
- solids, 128
- spinor space, 158
- spinors, 158
- sporadic groups, 131
- spread, 45, 125, 127, 131
- Steiner quadruple system, 43
- Steiner triple system, 43
- subspace, 33, 36, 90, 105
- subspace geometry, 150
- sum of linear spaces, 38
- support, 35, 140
- Suzuki–Tits ovoids, 58
- symmetric algebra, 149
- symmetric bilinear form, 77
- symmetric power, 149
- symmetric square, 149
- symplectic groups, 114
- symplectic space, 88
- symplectic spread, 128
- t.i. subspace, 88
- t.s. subspace, 88
- tangent, 57
- tangent plane, 57
- tensor algebra, 148
- tensor product, 147
- tetrad, 142
- theory of perspective, 7
- thick, 37, 66
- thin, 66
- totally isotropic subspace, 88
- totally singular subspace, 88
- trace, 81
- trace-valued, 113
- trace-valued Hermitian form, 81
- transitivity of parallelism, 41
- translation plane, 45
- transvection, 61
- transversality condition, 66
- triality, 129, 133
- triality quadric, 133
- triangle property, 110
- trio, 140
- type map, 65
- types, 65
- unital, 141

unitary groups, 114
unitary space, 88

varieties, 65

variety, 16

Veblen's Axiom, 4, 37, 42

Veblen's axiom, 32, 40

Wedderburn's Theorem, 1, 25

weight, 35

Witt index, 85

Witt system, 140