

Contents

Preface	vii
1 The geometry of world-vectors and spin-vectors	1
1.1 Minkowski vector space	1
1.2 Null directions and spin transformations	8
1.3 Some properties of Lorentz transformations	24
1.4 Null flags and spin-vectors	32
1.5 Spinorial objects and spin structure	41
1.6 The geometry of spinor operations	56
2 Abstract indices and spinor algebra	68
2.1 Motivation for abstract-index approach	68
2.2 The abstract-index formalism for tensor algebra	76
2.3 Bases	91
2.4 The total reflexivity of \mathfrak{E} on a manifold	98
2.5 Spinor algebra	103
3 Spinors and world-tensors	116
3.1 World-tensors as spinors	116
3.2 Null flags and complex null vectors	125
3.3 Symmetry operations	132
3.4 Tensor representation of spinor operations	147
3.5 Simple propositions about tensors and spinors at a point	159
3.6 Lorentz transformations	167
4 Differentiation and curvature	179
4.1 Manifolds	179
4.2 Covariant derivative	190
4.3 Connection-independent derivatives	201
4.4 Differentiation of spinors	210
4.5 Differentiation of spinor components	223
4.6 The curvature spinors	231
4.7 Spinor formulation of the Einstein–Cartan–Sciama–Kibble theory	237

4.8	The Weyl tensor and the Bel–Robinson tensor	240
4.9	Spinor form of commutators	242
4.10	Spinor form of the Bianchi identity	245
4.11	Curvature spinors and spin-coefficients	246
4.12	Compactified spin-coefficient formalism	250
4.13	Cartan’s method	262
4.14	Applications to 2-surfaces	267
4.15	Spin-weighted spherical harmonics	285
5	Fields in space–time	312
5.1	The electromagnetic field and its derivative operator	312
5.2	Einstein–Maxwell equations in spinor form	325
5.3	The Rainich conditions	328
5.4	Vector bundles	332
5.5	Yang–Mills fields	342
5.6	Conformal rescalings	352
5.7	Massless fields	362
5.8	Consistency conditions	366
5.9	Conformal invariance of various field quantities	371
5.10	Exact sets of fields	373
5.11	Initial data on a light cone	385
5.12	Explicit field integrals	393
	Appendix: diagrammatic notation	424
	References	435
	Subject and author index	445
	Index of symbols	457