

Contents

Preface	vii
Notation	xi
1 Preliminaries	1
1.1 Semi-Euclidean spaces	1
1.2 Semi-Riemannian manifolds	9
1.3 Warped product manifolds	22
1.4 Lightlike manifolds	30
2 Lightlike hypersurfaces	41
2.1 Basic general results	42
2.2 Screen conformal hypersurfaces	51
2.3 Unique existence of screen distributions	57
2.4 Induced scalar curvature	65
2.5 Lightlike Einstein hypersurfaces	75
2.6 Semi-symmetric hypersurfaces	85
3 Applications of lightlike hypersurfaces	97
3.1 Global null splitting theorem	97
3.2 Killing horizons	107
3.3 Dynamical horizons	115
3.4 Conformal Killing horizons	124
3.5 Differential operators on hypersurfaces	132
3.6 Osserman lightlike hypersurfaces	142
4 Half-lightlike submanifolds	157
4.1 Basic general results	157
4.2 Unique existence of screen distributions	165
4.3 Totally umbilical submanifolds	169
4.4 Screen conformal submanifolds	179

5	Lightlike submanifolds	191
5.1	The induced geometric objects	191
5.2	Unique screen distributions	201
5.3	Totally umbilical submanifolds	214
5.4	Minimal lightlike submanifolds	220
5.5	Warped product lightlike submanifolds	225
6	Submanifolds of indefinite Kähler manifolds	231
6.1	Introduction	231
6.2	Invariant lightlike submanifolds	242
6.3	Screen real submanifolds	250
6.4	Screen CR-lightlike submanifolds	255
6.5	Generalized CR-lightlike submanifolds	268
6.6	Totally real lightlike submanifolds	280
6.7	Slant lightlike submanifolds	284
6.8	Screen slant lightlike submanifolds	293
7	Submanifolds of indefinite Sasakian manifolds	305
7.1	Introduction	305
7.2	Lightlike hypersurfaces	313
7.3	Invariant submanifolds	318
7.4	Contact CR-lightlike submanifolds	321
7.5	Contact SCR-lightlike submanifolds	326
7.6	Generalized contact CR-lightlike submanifolds	334
8	Submanifolds of indefinite quaternion Kähler manifolds	347
8.1	Introduction	347
8.2	Lightlike hypersurfaces	360
8.3	Screen real submanifolds	366
8.4	QR-lightlike submanifolds	372
8.5	Screen QR-lightlike submanifolds	384
8.6	Screen CR-lightlike submanifolds	391
9	Applications of lightlike geometry	397
9.1	Null 2-surfaces of spacetimes	397
9.2	Harmonic maps and morphisms	407
9.3	Harmonic maps from lightlike manifolds	417
9.4	CR-lightlike geometry in relativity	434
9.5	Lightlike contact geometry in physics	438
	Bibliography	443
	Index	469