

## Contents

---

	<b>Introduction</b>	<i>page</i> 1
<b>1</b>	<b>Foundations</b>	8
	1.1 Smooth manifolds	9
	1.2 Smooth maps, tangent vectors, submanifolds	16
	1.3 Fibre bundles	23
	1.4 Integration of smooth vector fields	26
	1.5 Manifolds with boundary	29
	1.6 Notes on Chapter 1	34
<b>2</b>	<b>Geometrical tools</b>	36
	2.1 Riemannian metrics	37
	2.2 Geodesics	39
	2.3 Tubular neighbourhoods	45
	2.4 Diffeotopy extension theorems	49
	2.5 Tubular neighbourhood theorem	53
	2.6 Corners and straightening	59
	2.7 Cutting and glueing	63
	2.8 Notes on Chapter 2	67
<b>3</b>	<b>Differentiable group actions</b>	68
	3.1 Lie groups	68
	3.2 Smooth actions	72
	3.3 Proper actions and slices	74
	3.4 Properties of proper actions	78
	3.5 Orbit types	81
	3.6 Actions with few orbit types	87
	3.7 Examples of smooth proper group actions	90
	3.8 Notes on Chapter 3	92

<b>4</b>	<b>General position and transversality</b>	94
4.1	Nul sets	95
4.2	Whitney's embedding theorem	96
4.3	Existence of non-degenerate functions	98
4.4	Jet spaces and function spaces	100
4.5	The transversality theorem	105
4.6	Multitransversality	111
4.7	Generic singularities of maps	114
4.8	Normal forms	122
4.9	Notes on Chapter 4	125
<b>5</b>	<b>Theory of handle decompositions</b>	129
5.1	Existence	129
5.2	Normalisation	137
5.3	Homology of handles and manifolds	139
5.4	Modifying decompositions	143
5.5	Geometric connectivity and the h-cobordism theorem	149
5.6	Applications of h-cobordism	153
5.7	Complements	159
5.8	Notes on Chapter 5	165
<b>6</b>	<b>Immersions and embeddings</b>	167
6.1	Fibration theorems	167
6.2	Geometry of immersions	169
6.3	The Whitney trick	176
6.4	Embeddings and immersions in the metastable range	184
6.5	Notes on Chapter 6	193
<b>7</b>	<b>Surgery</b>	195
7.1	The surgery procedure: a single surgery	196
7.2	Surgery below the middle dimension	199
7.3	Bilinear and quadratic forms	202
7.4	Poincaré complexes and pairs	207
7.5	The even dimensional case	212
7.6	The odd dimensional case	216
7.7	Homotopy theory of Poincaré complexes	220
7.8	Homotopy types of smooth manifolds	225
7.9	Notes on Chapter 7	234
<b>8</b>	<b>Cobordism</b>	237
8.1	The Thom construction	239
8.2	Cobordism groups and rings	243

	<i>Contents</i>	vii
8.3	Techniques of bordism theory	248
8.4	Bordism as a homology theory	252
8.5	Equivariant cobordism	259
8.6	Classifying spaces, $\Omega_*^O, \Omega_*^U$	262
8.7	Calculation of $\Omega_*^{SO}$ and $\Omega_*^{SU}$	269
8.8	Groups of knots and homotopy spheres	281
8.9	Notes on Chapter 8	292
<b>Appendix A</b>	<b>Topology</b>	296
A.1	Definitions	296
A.2	Topology of metric spaces	298
A.3	Proper group actions	303
A.4	Mapping spaces	306
<b>Appendix B</b>	<b>Homotopy theory</b>	314
B.1	Definitions and basic properties	314
B.2	Groups and homogeneous spaces	319
B.3	Homotopy calculations	323
B.4	Further techniques	327
	<i>References</i>	331
	<i>Index of notations</i>	340
	<i>Index</i>	345