

Table of Contents

Preface	V
Leitfaden	XI
Fields of Application	XIII

Part I. Examples and Applications

Chapter A: Examples and Applications in Topological Categories ..	3
1 Homotopy Theory of Spaces Under a Space	3
2 Homotopy Theory of Diagrams of Spaces	18
3 Homotopy Theory of Transformation Groups	31
4 Homotopy Theory Controlled at Infinity	40
Chapter B: Examples and Applications in Algebraic Homotopy Theories	51
1 Homotopy Theory of Chain Algebras	51
2 Homotopy Theory of Connected Simplicial Objects in Algebraic Theories	61
Chapter C: Applications and Examples in Delicate Homotopy Theories of Simplicial Objects	71
1 Homotopy Theory of Free Simplicial Objects in Theories of Coactions	71
2 Examples of Theories of Coactions Satisfying the Delicate Blakers-Massey Property	87
3 Polynomial Theories of Cogroups	89
4 Algebras over an Operad	95
Chapter D: Resolutions in Model Categories	99
1 Quillen Model Categories	99
2 Spiral Model Categories	101
3 Spiral Homotopy Theory	110
4 Spiral Homotopy Groups	115

5	Examples of Spiral Model Categories	118
6	Homology and Cohomology in Spiral Homotopy Theory	120
7	Spiral Resolutions and Spiral Realizations	124

Part II. Combinatorial Homology and Homotopy

Chapter I: Theories of Coactions and Homology	129
1 Theories of Cogroups and Theories of Coactions	129
2 Examples	134
3 The Category of Twisted Maps	139
4 The Category of Coefficients	145
5 Enveloping Functors and the Categories of Premodules and Modules	149
6 Chain Complexes and Homology	156
7 Augmented Theories of Coactions	161
Chapter II: Twisted Chain Complexes and Twisted Homology	169
1 Twisted Chain Complexes	170
2 The Module Γ_1	174
3 The Obstruction for the Twisted Realization of a Chain Map	177
4 Twisted Homotopies	182
5 Twisted Homotopy Equivalences	187
6 The Augmentation Functor	192
7 Appendix: Homology of Coefficient Objects	193
8 Appendix: Twisted Homology of Coefficient Objects	197
Chapter III: Basic Concepts of Homotopy Theory	203
1 Cofibration Categories	203
2 Homotopy Groups	207
3 Principal Cofibrations	209
4 The Cylinder of Pairs	214
5 Homotopy Cogroups and Homotopy Coactions	215
6 The Theories susp (*) and cone (*)	217
7 Appendix: Categories with a Cylinder Functor	221
8 Appendix: Natural Cylinder Categories and Homotopy Theory of Diagrams	223
9 Appendix: Homotopy Theory of Chain Complexes	225
Chapter IV: Complexes in Cofibration Categories	229
1 Filtered Objects	229
2 Complexes Associated to Theories of Coactions	231
3 The Whitehead Theorem	234
4 Cellular Approximation	240
5 The Blakers-Massey Property	245

Chapter V: Homology of Complexes	249
1 Homological Cofibration Categories	249
2 The Chains of a Complex	254
3 The Homology of a Complex	257
4 The Obstruction Cocycle	260
5 The Hurewicz Homomorphism and Whitehead's Exact Sequence ...	262
Chapter V: Homology of Complexes	267
1 Twisted Homotopy Systems of Order n	267
2 Obstructions for the Realizability of Chain Maps	271
3 The Homotopy Lifting Property of the Chain Functor	276
4 Counting Realization of Chain Maps	277
5 Linear Extensions and Towers of Categories	279
6 The Homological Tower of Categories	283
7 The Homological Whitehead Theorem	286
8 The Model Lifting Property of the Twisted Chain Functor	287
9 Obstructions for the Realizability of Twisted Chain Complexes ...	291
10 The Hurewicz Theorem	294
11 Appendix: Eilenberg-Mac Lane Complexes and (\mathbf{C}, \mathbf{T}) -Homology of Coefficient Objects	296
Chapter VII: Finiteness Obstructions	301
1 The Reduced Projective Class Group	301
2 The Finiteness Obstruction Theorem	303
3 Finiteness Obstructions for Twisted Chain Complexes	304
4 Proof of the Finiteness Obstruction Theorem	312
Chapter VIII: Non-Reduced Complexes and Whitehead Torsion ...	315
1 Classes of Discrete Objects	315
2 Cells in a Cofibration Category	317
3 Non-Reduced Complexes	319
4 The Ball Pair Axiom	323
5 Cellular I -Categories	327
6 Elementary Expansions	328
7 Formal Deformations and Simple Homotopy Equivalences	330
8 The Whitehead Group and Whitehead Torsion	334
9 Simplified Form of Elements in the Whitehead Group	339
10 The Torsion Group K_1	342
11 The Algebraic Whitehead Group	344
12 The Isomorphism Between the Geometric and Algebraic Whitehead Group	345
Index	355
List of Notations	361