
Table of Contents

Preface	ix
Standard Notations	xii.
Chapter 0. Some Underlying Geometric Notions	1
Homotopy and Homotopy Type 1. Cell Complexes	5.
Operations on Spaces 8. Two Criteria for Homotopy Equivalence	10.
The Homotopy Extension Property	14.
Chapter 1. The Fundamental Group	21
1.1. Basic Constructions	25
Paths and Homotopy 25. The Fundamental Group of the Circle	28.
Induced Homomorphisms	33.
1.2. Van Kampen's Theorem	38
Free Products of Groups 39. The van Kampen Theorem	41.
Applications to Cell Complexes	48.
1.3. Covering Spaces	54
Lifting Properties 58. The Classification of Covering Spaces	61.
Deck Transformations and Group Actions	68.
Additional Topics	
1.A. Graphs and Free Groups	81.
1.B. $K(G,1)$ Spaces and Graphs of Groups	85.

Chapter 2. Homology	95
2.1. Simplicial and Singular Homology	100
Δ -Complexes 100. Simplicial Homology 102. Singular Homology 106.	
Homotopy Invariance 108. Exact Sequences and Excision 111.	
The Equivalence of Simplicial and Singular Homology 126.	
2.2. Computations and Applications	132
Degree 132. Cellular Homology 135. Mayer-Vietoris Sequences 147.	
Homology with Coefficients 151.	
2.3. The Formal Viewpoint	158
Axioms for Homology 158. Categories and Functors 160.	
Additional Topics	
2.A. Homology and Fundamental Group 164.	
2.B. Classical Applications 167.	
2.C. Simplicial Approximation 175.	
Chapter 3. Cohomology	183
3.1. Cohomology Groups	188
The Universal Coefficient Theorem 188. Cohomology of Spaces 195.	
3.2. Cup Product	204
The Cohomology Ring 209. A Künneth Formula 216.	
Spaces with Polynomial Cohomology 222.	
3.3. Poincaré Duality	228
Orientations and Homology 231. The Duality Theorem 237.	
Connection with Cup Product 247. Other Forms of Duality 250.	
Additional Topics	
3.A. Universal Coefficients for Homology 259.	
3.B. The General Künneth Formula 266.	
3.C. H-Spaces and Hopf Algebras 279.	
3.D. The Cohomology of $SO(n)$ 290.	
3.E. Bockstein Homomorphisms 301.	
3.F. Limits and Ext 309.	
3.G. Transfer Homomorphisms 319.	
3.H. Local Coefficients 325.	

Chapter 4. Homotopy Theory	335
4.1. Homotopy Groups	337
Definitions and Basic Constructions 338. Whitehead's Theorem 344.	
Cellular Approximation 346. CW Approximation 350.	
4.2. Elementary Methods of Calculation	358
Excision for Homotopy Groups 358. The Hurewicz Theorem 364.	
Fiber Bundles 373. Stable Homotopy Groups 382.	
4.3. Connections with Cohomology	391
The Homotopy Construction of Cohomology 391. Fibrations 403.	
Postnikov Towers 408. Obstruction Theory 413.	
Additional Topics	
4.A. Basepoints and Homotopy 419.	
4.B. The Hopf Invariant 425.	
4.C. Minimal Cell Structures 427.	
4.D. Cohomology of Fiber Bundles 429.	
4.E. The Brown Representability Theorem 446.	
4.F. Spectra and Homology Theories 450.	
4.G. Gluing Constructions 454.	
4.H. Eckmann-Hilton Duality 458.	
4.I. Stable Splittings of Spaces 464.	
4.J. The Loopspace of a Suspension 468.	
4.K. The Dold-Thom Theorem 473.	
4.L. Steenrod Squares and Powers 485.	
Appendix	517
Topology of Cell Complexes 517. The Compact-Open Topology 527.	
Bibliography	531
Index	537