
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	29.
Induced Homomorphisms	34.
1.2. Van Kampen's Theorem	40
Free Products of Groups 41. The van Kampen Theorem	43.
Applications to Cell Complexes	50.
1.3. Covering Spaces	56
Lifting Properties 60. The Classification of Covering Spaces	63.
Deck Transformations and Group Actions	70.
Additional Topics	
1.A. Graphs and Free Groups	83.
1.B. $K(G,1)$ Spaces and Graphs of Groups	87.

Chapter 2. Homology	97
2.1. Simplicial and Singular Homology	102
Δ -Complexes 102. Simplicial Homology 104. Singular Homology 108.	
Homotopy Invariance 110. Exact Sequences and Excision 113.	
The Equivalence of Simplicial and Singular Homology 128.	
2.2. Computations and Applications	134
Degree 134. Cellular Homology 137. Mayer-Vietoris Sequences 149.	
Homology with Coefficients 153.	
2.3. The Formal Viewpoint	160
Axioms for Homology 160. Categories and Functors 162.	
Additional Topics	
2.A. Homology and Fundamental Group 166.	
2.B. Classical Applications 169.	
2.C. Simplicial Approximation 177.	
Chapter 3. Cohomology	185
3.1. Cohomology Groups	190
The Universal Coefficient Theorem 190. Cohomology of Spaces 197.	
3.2. Cup Product	206
The Cohomology Ring 212. A Künneth Formula 214.	
Spaces with Polynomial Cohomology 220.	
3.3. Poincaré Duality	230
Orientations and Homology 233. The Duality Theorem 239.	
Connection with Cup Product 249. Other Forms of Duality 252.	
Additional Topics	
3.A. Universal Coefficients for Homology 261.	
3.B. The General Künneth Formula 268.	
3.C. H-Spaces and Hopf Algebras 281.	
3.D. The Cohomology of $SO(n)$ 292.	
3.E. Bockstein Homomorphisms 303.	
3.F. Limits and Ext 311.	
3.G. Transfer Homomorphisms 321.	
3.H. Local Coefficients 327.	

Chapter 4. Homotopy Theory	337
4.1. Homotopy Groups	339
Definitions and Basic Constructions 340. Whitehead's Theorem 346. Cellular Approximation 348. CW Approximation 352.	
4.2. Elementary Methods of Calculation	360
Excision for Homotopy Groups 360. The Hurewicz Theorem 366. Fiber Bundles 375. Stable Homotopy Groups 384.	
4.3. Connections with Cohomology	393
The Homotopy Construction of Cohomology 393. Fibrations 405. Postnikov Towers 410. Obstruction Theory 415.	
Additional Topics	
4.A. Basepoints and Homotopy 421.	
4.B. The Hopf Invariant 427.	
4.C. Minimal Cell Structures 429.	
4.D. Cohomology of Fiber Bundles 431.	
4.E. The Brown Representability Theorem 448.	
4.F. Spectra and Homology Theories 452.	
4.G. Gluing Constructions 456.	
4.H. Eckmann-Hilton Duality 460.	
4.I. Stable Splittings of Spaces 466.	
4.J. The Loopspace of a Suspension 470.	
4.K. The Dold-Thom Theorem 475.	
4.L. Steenrod Squares and Powers 487.	
Appendix	519
Topology of Cell Complexes 519. The Compact-Open Topology 529.	
Bibliography	533
Index	539