

TOPICS FOR MATHEMATICS 205B, WINTER 2012

H = Hatcher, **M** = Munkres

I. Further properties of covering spaces

0. Introduction (**M**, §§51–55, 56; **H**, Ch. 0, Ch. 1 Introduction, §1.1)
1. Lifting criterion (**M**, §79; **H**, §§1.1, 1.3)
2. Covering space transformations (**M**, §§79, 81; **H**, §1.3)
3. Universal coverings and applications (**M**, §§80, 82; **H**, §1.3)
- ∞. Counterexamples in covering space theory (**M**, §82; **H**, §§1.2, 1.3)

II. Computing fundamental groups

1. Orbit spaces (**H**, §1.3)
2. Amalgamation constructions for groups (**M**, §§67–69; **H**, §1.2)
3. The Seifert-van Kampen Theorem (**M**, §70; **H**, §1.2)
4. Examples (**M**, §§59, 71, 72; **H**, §1.2)
- ∞. Realizing groups as fundamental groups (**H**, §1.B)

III. Graph complexes

1. Basic definitions (**M**, §83; **H**, §1.A, Ch. 2 Introduction)
2. Maximal trees (**M**, §84; **H**, §1.A)
3. Computing fundamental groups (**M**, §84; **H**, §1.A)
4. Finite coverings and Euler characteristics (**M**, §§83, 85; **H**, §1.A)
- ∞. Infinite graphs (**M**, §§83–85; **H**, §1.B)

IV. Prelude to homology theory

1. Algebraic chains for graphs (**H**, §1.A)
2. Triangulations and simplicial complexes (**H**, §2.1)
3. Chain complexes and exact sequences (**H**, §§2.1–2.2)
- ∞. Homological algebra and simplicial approximation (**H**, §§3.1, 3.A, 3.B, 3.F)

V. Simplicial chain complexes

1. Simplicial chains and homology (**H**, §§1.A, 2.1)
2. Examples and special cases (**H**, §§2.1, 2.2)
3. Relative groups and exactness properties (**H**, §2.1)
4. Bootstrap computational techniques (**H**, §2.2)
- ∞. Invariance of homology (**H**, §2.1)

VI. Axiomatic singular homology

0. Motivation (**H**, Ch. 2 Introduction)
1. Primitive data and basic axioms (**H**, §§2.1, 2.3)
2. Exactness, homotopy invariance and support properties (**H**, §2.3)
3. Normalization properties (**H**, §§2.3, 2.A)
4. Excision and Mayer-Vietoris sequences (**H**, §2.3)
5. Reduced homology (**H**, §§2.1, 2.3)
- ∞. Existence and uniqueness theorems (**H**, §2.3, 3.F)

VII. Some elementary applications

1. Consequences of the axioms (**H**, §§2.1–2.3, 2.B)
2. Nonretraction and fixed point theorems (**H**, §2.B; **M**, §55)
3. Separation and invariance theorems (**H**, §2.B; **M**, §63)
4. Nonplanar graphs (**M**, §64)
5. Rationalizations of abelian groups (**H**, §2.2)
6. Cell decompositions and Euler's Formula (**H**, Ch. 0, §2.2, Appendix)
- ∞. Degree theory, Fundamental Theorem of Algebra (**H**, §§1.1, 2.2)