

ALGEBRAIC TOPOLOGY-HOMOLOGY THEORY

Lecturer: Konstantin Athanassopoulos

I. Homology

1. Homotopy of maps
2. Homotopy type
3. Categories, functors and algebraic invariants
4. The singular homology groups of a topological space
5. Chain complexes and exact sequences
6. The axioms of Eilenberg-Steenrod for a homology theory and some consequences
7. The singular homology
8. The homotopy invariance of the singular homology
9. Small simplices and excision
10. The Mayer-Vietoris long exact sequence and applications of singular homology
11. The theorem of Hurewicz

II. Homology with coefficients

1. The tensor product
2. The torsion product
3. The Universal Coefficient Theorem
4. Singular homology with coefficients

III. Cohomology

1. Groups of homomorphisms
2. The functors Hom and Ext
3. Cohomology of chain complexes
4. Singular cohomology

IV. Products

1. The cross product, the Eilenberg-Zilber theorem and the Künneth formula
2. The cross product in cohomology
3. The cup product and applications

V. Topological manifolds and duality

1. Orientation for topological manifolds
2. The singular homology groups of a topological n -manifold in degrees $\geq n$
3. The cap product
4. Algebraic limits
5. The Poincaré-Lefschetz duality
6. Applications

Bibliography

1. G. Bredon, Topology and Geometry, Springer, 1993.
2. T. tom Dieck, Topologie, 2. Auflage, Walter de Gruyter, 2000.
3. A. Dold, Lectures on Algebraic Topology, Springer, 1972.
4. M.J. Greenberg-J.R. Harper, Algebraic Topology; A first course, Benjamin, 1981.
5. A. Hatcher, Algebraic Topology, Cambridge University Press, 2002.
6. E. Spanier, Algebraic Topology, McGraw-Hill, 1966.
7. R. Stöcker und H. Zieschang, Algebraische Topologie, Teubner, 1994.
8. R.M. Switzer, Algebraic Topology-Homotopy and Homology, Springer, 1975.

Evaluation of the students

The students will be evaluated from:

- (a) obligatory exercises which they will be asked to solve throughout the semester,
- (b) public presentations of supplementary subjects, and
- (c) a final written examination.

The course will be taught on Tuesday and Thursday from 11:00 to 13:00 in room B 208.