MATH-506

Topology IV.b - cohomology rings

Cursus	Sem.	Type
Ing.-math	MA1, MA3	Opt.
Mathématicien	MA1, MA3	Opt.

Language of teaching	English
Credits	5
Session	Winter
Semester	Fall
Exam	Written
Workload	150h
Weeks	14
Hours	**4 weekly**
Lecture	2 weekly
Exercises	2 weekly
Number of positions	

Remark

Pas donné en 2024-25

Summary

Singular cohomology is defined by dualizing the singular chain complex for spaces. We will study its basic properties, see how it acquires a multiplicative structure and becomes a graded commutative algebra. We study an algebraic version, namely group cohomology, and compare both approaches.

Content

1. Singular cohomology
2. Universal coefficient Theorem
3. Cup product
4. Künneth formula
5. Group homology and cohomology
6. Computations of group (co)homology in low degrees
7. Cup product and Yoneda product
8. Classifying spaces
9. Comparison of singular cohomology and group cohomology

Keywords

Cohomology, cup product, extensions, Yoneda product, classifying space

Learning Prerequisites

Required courses

Topology, Algebraic Topology, Group Theory, Rings and Fields

Recommended courses

Rings and modules

Important concepts to start the course

Homology, homological algebra, exact sequences, cell complex

Learning Outcomes

By the end of the course, the student must be able to:

- Manipulate chain complexes
- Compute cohomology groups and products
- Compare singular with group cohomology
- Define the concepts from the course
- Prove important properties of cohomology
- Apply the concepts to examples

Transversal skills

- Make an oral presentation.
- Write a scientific or technical report.
- Communicate effectively, being understood, including across different languages and cultures.

Teaching methods

ex-cathedra teaching, exercise classes, project in pairs

Expected student activities

Attend the lectures and exercise sessions, solve exercises, hand in homework, prepare a presentation

Assessment methods

The final grade will be assigned based on:
20% - homework in small groups
20% - oral presentation during an exercise session
60% - written exam
Dans le cas de l'art. 3 al. 5 du Règlement de section, l'enseignant décide de la forme de l'examen qu'il communique aux étudiants concernés.

Supervision

Office hours	Yes
Assistants	Yes
Forum	Yes

Resources

Virtual desktop infrastructure (VDI)

No

Bibliography

Algebraic Topology, Allen Hatcher
Algebraic Topology, Edwin Spanier
Modern Classical Homotopy Theory, Jeffrey Strom
Algebraic Topology, Tammo Tom Dieck
Cohomology of groups, Kenneth S. Brown
Cohomology of finite groups, Alejandro Adem and R. James Milgram

Ressources en bibliothèque

- Cohomology of groups / Brown
- Algebraic Topology / Spanier
- Modern Classical Homotopy Theory / Strom

- Algebraic Topology / Hatcher
- Cohomology of finite groups / Adem
- Algebraic Topology / Dieck