

MATH-497

**Homotopy theory**

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
<b>Hours</b>	<b>4 weekly</b>
Lecture	2 weekly
Exercises	2 weekly
<b>Number of positions</b>	

**Remark**

pas donné en 2023-24

**Summary**

We propose an introduction to homotopy theory for topological spaces. We define higher homotopy groups and relate them to homology groups. We introduce (co)fibration sequences, loop spaces, and suspensions. We study long exact sequences. We construct Eilenberg-Mac Lane spaces.

**Content**

1. Compact-open topology
2. Higher homotopy groups
3. Cofibrations and fibrations
4. Loop spaces and suspension
5. Long exact sequences for homotopy groups
6. CW-approximation and cellular approximation
7. Eilenberg-Mac Lane spaces
8. Weak homotopy equivalences
9. Hurewicz homomorphism
10. Postnikov sections

**Keywords**

Homotopy groups, Cofibrations and fibrations, Loop spaces and suspension, Long exact sequence, Eilenberg-Mac Lane space, Hurewicz homomorphism

**Learning Prerequisites****Required courses**

Topology, Algebraic Topology, Group Theory, Rings and Fields

**Recommended courses**

Rings and modules

**Important concepts to start the course**

Fundamental group, Homology groups, cell complexes, excision in homology

**Learning Outcomes**

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

- Manipulate fibrations and cofibrations
- Perform elementary computations of homotopy groups
- Compare homotopy with homology groups
- Define the notions introduced in the course
- State the main theorems and prove them
- Apply the tools developed in the course to examples

### Teaching methods

ex-cathedra teaching, exercise classes

### 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

#### Bibliography

Algebraic Topology, Allen Hatcher

Algebraic Topology, Tammo Tom Dieck

Algebraic Topology, Edwin Spanier

Introduction to Homotopy Theory, Paul Selick

Modern Classical Homotopy Theory, Jeffrey Strom

#### Ressources en bibliothèque

- [Modern Classical Homotopy Theory / Strom](#)
- [Algebraic Topology / Dieck](#)
- [Algebraic Topology / Spanier](#)
- [Algebraic Topology / Hatcher](#)
- [Introduction to Homotopy Theory / Selick](#)

#### Moodle Link

- <https://go.epfl.ch/MATH-497>