MATH-518

Ergodic theory

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

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

Summary

This is an introductory course in ergodic theory, providing a comprehensive overlook over the main aspects and applications of this field.

Content

Ergodic theory is the study of group actions on measure spaces. Its history traces from Poincare's recurrence theorem in celestial mechanics and Boltzman's ergodic hypothesis in statistical physics to its mathematical proliferation in the 1930s through the ergodic theorems of von Neumann, Birkhoff, and Koopman. It has since grown into a hugely important research area with striking applications to other areas of mathematics. This course provides an introduction to the basics of ergodic theory. This includes the structure and convergence of ergodic averages, the theory of recurrence, and the notion of entropy. We will motivate the main ideas and results through simple examples.

Keywords

ergodic theory, dynamcial systems, measure-preserving transformation, entropy

Learning Prerequisites

Recommended courses

Measure and integration

Important concepts to start the course

This course is aimed at master's or advanced bachelor's students. Since ergodic theory is largely based on the notions of measure theory, either some background in measure theory or the willingness to learn some of this material along the way is expected. I will provide a handout summarizing the prerequisites from measure theory that are needed for this course at the beginning of the semester.

Learning Outcomes

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

- Formalize dynamcial ideas and concepts such as ergodicity, entropy, chaos, determinism, etc.
- Apply tools and techniques from ergodic theory in other areas
- Interpret examples of dynamical systems
- Prove results in ergodic theory

Transversal skills

- Use a work methodology appropriate to the task.
- Demonstrate a capacity for creativity.
- Demonstrate the capacity for critical thinking
- Continue to work through difficulties or initial failure to find optimal solutions.

Teaching methods

in-person lectures, in-person exercise sessions with the teaching assistant

Assessment methods

oral exam

Supervision

Office hours	Yes
Assistants	Yes
Forum	Yes

Resources

Bibliography

- M. Einsiedler, T. Ward, *Ergodic Theory with a view towards Number Theory*, Springer-Verlag London, 2011.
- P. Walters, *An Introduction to Ergodic Theory*, Graduate Texts in Mathematics, Springer New York, 1982.

Ressources en bibliothèque

- Ergodic Theory with a view towards Number Theory / Einsiedler
- An Introduction to Ergodic Theory / Walters

Notes/Handbook

Lecture notes will be provided

Moodle Link

- https://go.epfl.ch/MATH-518