

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

**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 Poincaré's recurrence theorem in celestial mechanics and Boltzmann'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, dynamical 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 dynamical 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>