

MATH-486

Statistical mechanics and Gibbs measures

| Cursus | Sem. | Type |
|----------------|----------|------|
| Data Science | MA2, MA4 | Opt. |
| Ing.-math | MA2, MA4 | Opt. |
| Mathématicien | MA2 | Opt. |
| SC master EPFL | MA2, MA4 | Opt. |

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| Language of teaching | English |
| Credits | 5 |
| Session | Summer |
| Semester | Spring |
| Exam | Oral |
| Workload | 150h |
| Weeks | 14 |
| Hours | 4 weekly |
| Lecture | 2 weekly |
| Exercises | 2 weekly |
| Number of positions | |

Remark

Pas donné en 2024-25. Cours donné en alternance une année sur deux.

Summary

This course provides a rigorous introduction to the ideas, methods and results of classical statistical mechanics, with an emphasis on presenting the central tools for the probabilistic description of infinite lattice systems.

Content

The goals of this course are to present

- the probabilistic description of large systems with interacting components,
- the mathematical description of phase transitions occurring in certain discrete models (Curie-Weiss, Ising model, long-range models, etc.)
- the general theory of infinite-volume Gibbs measures (the so-called Dobrushin-Lanford-Ruelle approach)

If times permits, and depending on the interest of the participants, we consider the peculiar properties of certain models with an underlying continuous symmetry (Gaussian free field, Mermin-Wagner Theorem for $O(n)$ models).

This course is companion to the course "lattice models", where discrete models are also considered, but with an emphasis on different aspects.

The lectures will be largely based on the book *Statistical mechanics of lattice systems; a concrete mathematical introduction*, by S. Friedli and Y. Velenik (Cambridge University Press, 2017)

Keywords

statistical mechanics, phase transitions, Gibbs measures, entropy, Ising model, Gaussian Free Field

Learning Prerequisites**Required courses**

- Analyse 1 et 2
- Théorie de la Mesure
- Probabilités

Assessment methods

Examen oral.

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

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| Office hours | No |
| Assistants | No |
| Forum | No |

Resources

Virtual desktop infrastructure (VDI)

No

Bibliography

Statistical mechanics of lattice systems; a concrete mathematical introduction, by S. Friedli and Y. Velenik (Cambridge University Press, 2017)

Gibbs Measures and Phase Transitions, by H.-O. Georgii (De Gruyter Studies in Mathematics Vol. 9. Berlin: de Gruyter 1988)

Ressources en bibliothèque

- [Statistical mechanics of lattice systems / Friedli & Velenik](#)
- [Gibbs Measures and Phase Transitions / Georgii](#)
- [\(electronic version\)](#)

Websites

- <http://www.unige.ch/math/folks/velenik/smbook/>

Moodle Link

- <https://go.epfl.ch/MATH-486>