MATH-485

Introduction to stochastic PDEs

Hairer Martin

Cursus	Sem.	Type
Ing.-math	MA2, MA4	Opt.
Mathématicien	MA2	Opt.

Language of teaching	English
Credits	5
Session	Summer
Semester	Spring
Exam	Oral
Workload	150h
Weeks	14
Hours	**5 weekly**
Lecture	3 weekly
Exercises	2 weekly
Number of positions	

Summary

Stochastic PDEs are used to model systems that are spatially extended and include a random component. This course gives an introduction to this topic, including some Gaussian measure theory and some analytic semigroup theory.

Content

Stochastic PDEs form a relatively recent area of mathematics that combines many different fields, including PDE theory, stochastic analysis, ergodic theory, functional analysis, etc. This course is an introduction to the area with the aim of being able to appreciate some 21st century developments towards the end of the course. We will mainly focus on the development of a rather general solution theory for linear and semilinear stochastic PDEs, including stochastically forced heat, Navier-Stokes, and reaction-diffusion equations.

Some of the tools developed in this course, in particular Gaussian measure theory and analytic semigroup theory, are of broader interest.

Keywords

probability, partial differential equations, semigroups, Gaussian measures

Learning Prerequisites

Required courses

Analysis I-IV
Probability

Recommended courses

Measure and integration
Probability theory
Functional Analysis I-II

Important concepts to start the course

Basic concepts in probability theory
Basic properties of Hilbert and Banch spaces

Teaching methods

Weekly lectures (on blackboard) and exercise sessions with assistant

Expected student activities

Attending the lectures and solving the exercises

Assessment methods

Oral exam

Supervision

Office hours	No
Assistants	Yes
Forum	No

Resources

Virtual desktop infrastructure (VDI)

No

Bibliography

G. DA PRATO and J. ZABCZYK. Stochastic equations in infinite dimensions, vol. 44 of Encyclopedia of Mathematics and its Applications. Cambridge University Press, Cambridge, 1992.
A. LUNARDI. Analytic semigroups and optimal regularity in parabolic problems. Progress in Nonlinear Differential Equations and their Applications, 16. Birkhäuser Verlag, Basel, 1995.
V. I. BOGACHEV. Gaussian measures, vol. 62 of Mathematical Surveys and Monographs. American Mathematical Society, Providence, RI, 1998.
P. BILLINGSLEY. Convergence of probability measures. John Wiley & Sons Inc., New York, 1968.
K. YOSIDA. Functional analysis. Classics in Mathematics. Springer-Verlag, Berlin, 1995. Reprint of the sixth (1980) edition.

Ressources en bibliothèque

- Convergence of probability measures / Billingsley
- Analytic semigroups and optimal regularity in parabolic problems / Lunardi
- Stochastic equations in infinite dimensions / Da Prato
- Functional analysis / Yosida
- Gaussian measures / Bogachev

Notes/Handbook

The lecture will mainly follow the notes available at https://www.hairer.org/notes/SPDEs.pdf, but might cover additional material if time permits.

Moodle Link

- https://go.epfl.ch/MATH-485