

MATH-618

**Topics in the theory of Markov processes (2018)**

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Cursus	Sem.	Type
Mathematics		Obl.

Language of teaching	English
Credits	2
Session	
Exam	Oral presentation
Workload	60h
<b>Hours</b>	<b>41</b>
Courses	15
TP	26
<b>Number of positions</b>	

**Frequency**

Only this year

**Remark**

From March 6 to April 4, 2019

**Summary**

The goal of these lectures is to present some aspects of the theory of Markov processes, with particular emphasis to Ito diffusion processes, both linear and nonlinear.

**Content**

The goal of these lectures is to present some aspects of the theory of Markov processes, with particular emphasis to Ito diffusion processes, both linear and nonlinear. In the first part of the course we will present some elements of the theory of Markov diffusion semigroups: infinitesimal generators, ergodic theory for Markov processes, convergence to equilibrium, functional inequalities, Bakry-Emery theory/Gamma calculus. If time permit we will discuss about nonlinear diffusion processes of McKean type, the long time behaviour of solutions to the (forward Kolmogorov) McKean-Vlasov equation and we will study the possible non-uniqueness of invariant measures for such processes.

**Contents:**

## • 1. Chapter:

Markov diffusion processes, generators and Markov semigroups, stochastic differential equations

## • 2. Chapter:

Dirichlet forms, reversible diffusions, operateur carre du champ, Gamma calculus, Bakry-Emery theory

## • 3. Chapter:

Ergodic theory for Ito diffusions, convergence to equilibrium, functional inequalities

## • 4. Chapter:

Mean field limits for weakly interacting diffusions, derivation of the Mc Kean SDE and of the McKean-Vlasov equation. The stationary McKean-Vlasov equation, non-uniqueness of invariant measures.

**Bibliography:**

Pavliotis, Grigorios A. Stochastic processes and applications. Diffusion processes, the Fokker-Planck and Langevin equations. Texts in Applied Mathematics, 60. Springer, New York, 2014.

Bakry, Dominique; Gentil, Ivan; Ledoux, Michel Analysis and geometry of Markov diffusion operators. Grundlehren der Mathematischen Wissenschaften [Fundamental Principles of Mathematical Sciences], 348. Springer, Cham, 2014

Bogachev, Vladimir I.; Krylov, Nicolai V.; Röckner, Michael; Shaposhnikov, Stanislav V. Fokker-Planck-Kolmogorov equations. Mathematical Surveys and Monographs, 207. American Mathematical Society, Providence, RI, 2015

Dawson, Donald A. Critical dynamics and fluctuations for a mean-field model of cooperative behavior. J. Statist. Phys. 31 (1983), no. 1, 29–85.

Chayes, L.; Panferov, V. The Mc Kean-Vlasov equation in finite volume. J. Stat. Phys. 138 (2010), no. 1-3, 351–380.

Chazelle, Bernard; Jiu, Quansen; Li, Qianxiao; Wang, Chu Well-posedness of the limiting equation of a noisy consensus model in opinion dynamics. *J. Differential Equations* 263 (2017), no. 1, 365–397.

Long-time behaviour and phase transitions for the Mc Kean--Vlasov equation on the torus J. A. Carrillo, R. S. Gvalani, G. A. Pavliotis, A. Schlichting arXiv:1806.01719