

# Advanced Mathematics MASTER 2 IN LYON 2023-2024

## FIVE THEMATIC PROGRAMS

- Refresher courses (late August  $\Rightarrow$  early September)
- Basic courses, first semester (September  $\Rightarrow$  December)
- Advanced courses, second semester (January  $\Rightarrow$  March)
- Research internship (April  $\Rightarrow$  July)

More info on the program, applications, scholarships ... available at  
 $\leadsto$  <http://mathematiques.ens-lyon.fr>

## PARTIAL DIFFERENTIAL EQUATIONS AND APPLICATIONS

### Basic Courses

- PDE modeling in the natural sciences: an asymptotic viewpoint (Vincent Calvez)
- Evolutionary PDEs (Dragoş Iftimie)
- Calculus of variations and elliptic partial differential equations and systems (Petru Mironescu)

### Advanced Courses

- Optimal transport: introduction, applications and derivation (Aymeric Baradat)
- Compressible viscous flows with low or intermediate regularity, (Didier Bresch)
- On the non linear Schrödinger equation (Nikolay Tzvetkov)
- Kinetic equations with collisions (Cédric Villani)

## PROBABILITY AND STATISTICS

### Basic Courses

- Stochastic calculus (Marielle Simon)
- Concentration of measure in probability and high-dimensional statistical learning (Guillaume Aubrun, Aurélien Garivier, Rémi Gribonval)
- Stochastic modelization and statistical learning (Aurélien Garivier, Clément Marteau)

### Advanced Courses

- An approach of disordered systems via PDEs (Jean-Christophe Mourrat)
- Graphs and ecological networks (Clément Marteau, Thibault Espinasse)
- Neural Networks (Aurélien Garivier)
- Optimal transport and learning (Filippo Santambrogio, Ievgen Reedko, Nicolas Bonneel)
- Inverse problems and parcimony (Yohann de Castro, Rémi Gribonval)

## TRANSCENDENCE

*... between number theory, differential equations and model theory.*

### Basic Courses

- Introduction to transcendental number theory (Boris Adamczewski)
- Linear differential equations (Julien Roques)
- Introduction to model theory,  $\omega$ -stability and  $o$ -minimality (Frank Wagner)

### Advanced Courses

- Diophantine approximation and transcendence theory (Anthony Poëls)
- An introduction to  $G$ -functions (Eric Delaygue)
- Model theory of differential fields of characteristic zero (Rémi Jaoui)

## GROUPS AND DYNAMICS

### Basic Courses

- Representation theory (Sophie Morel, Bruno Sévenec)
- Geometric group theory (Adrien Le Boudec)
- Introduction to dynamical systems and ergodic theory (Jean-Claude Sikorav)

### Advanced Courses

- Amenability and orbit equivalence (Damien Gaboriau, Todor Tsankov)
- Groups arising from dynamical systems (Nicolás Matte Bon)
- Dynamics of complex differential equations (Aurélien Alvarez, Ghani Zeghib)
- Geodesic flows (Marco Mazzucchelli)

## MATHEMATICAL PHYSICS

### Basic Courses

- Fiber Bundles in Differential Geometry and Gauge Theories (Eveline Legendre)
- Symplectic Geometry and Lie Groupoids (Leonid Ryvkin)
- Quantum Mechanics and Quantum Information Theory (Guillaume Aubrun)

### Advanced Courses

- Topological phases of matter (Johannes Kellendonk)
- Quantum Field Theory and Renormalization (Alessandra Frabetti)
- Seiberg-Witten Invariants (Klaus Niederkrüger)
- Poisson Sigma Models (Thomas Strobl)