MATH-535

Topics in algebraic geometry

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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	**4 weekly**
Courses	2 weekly
Exercises	2 weekly
Number of positions	

Summary

This course is aimed to give students an introduction to the theory of algebraic curves and surfaces. In particular, it aims to develop the students' geometric intuition and combined with the basic algebraic geometry courses to build a strong foundation for further study.

Content

â## Riemann surfaces, nonsingular algebraic curves â## Divisors and line bundles, linear systems â## Riemann-Roch, Riemann-Hurwitz, etc. â## Plane curve singularities, blowing up â## Algebraic surfaces, intersection forms â## Riemann-Roch for surfaces â## Kodaira dimension â## Ruled surfaces, rational surfaces â## Elliptic surfaces, K3, Enriques surfaces, etc. â## Birational classification (or â##MMPâ##) for surfaces â## Further topics

Keywords

Algebraic geometry, curves, surfaces, singularities, birational geometry, minimal model program

Learning Prerequisites

Required courses

- Linear algebra
- Group Theory
- Rings and Modules
- Complex analysis
- Modern Algebraic geometry

Recommended courses

- Topology I & II
- Algebraic topology
- Differential geometry
- Algebraic number theory
- Schemes
- Complex manifolds

Learning Outcomes

- Formulate a sketch of the birational classification of surfaces and how to approach its proof.
- Recall the statements of basic theorems like Riemann-Roch, the Hodge index theorem, Castelnuovo's criteria, etc., and understand their proofs
- Compute geometric and birational invariants of curves and surfaces in basic examples.
- Reason intuitively about curves and surfaces over the complex numbers.

Teaching methods

2h lectures+2h exercise sessions weekly.

Assessment methods

The final grade will be assigned based on the cumulative points of the student obtained from handed in homework solutions and from the written exam.
The weights of the two parts are:
50% homework
50% written exam

There will be biweekly homework which students will have to hand in before the exercise sessions.

Supervision

Office hours	Yes
Assistants	Yes
Forum	No

Resources

Bibliography

There is no single textbook we will follow, but references to relevant texts or notes will be given throughout the course. For curves, we will mainly be looking at

- B. Osserman, Notes on Varieties
- S. Donaldson, Riemann Surfaces
- Q. Liu, Algebraic Geometry and Arithmetic Curves

For surfaces, we will mostly follow

- A. Beauville, Complex Algebraic Surfaces
- R. Harthshorne, Algebraic Geometry Chapter V
- W. Barth, K. Hulek, C. Peters and A. Van de Ven, Compact Complex Surfaces.

Other resources students may want to look at are

- R. Miranda, Algebraic Curves and Riemann Surfaces
- M. Reid, Chapters on Algebraic Surfaces

Ressources en bibliothèque

- Riemann Surfaces / Donaldson
- Algebraic Geometry and Arithmetic Curves / Liu
- Complex Algebraic Surfaces / Beauville
- Algebraic Geometry / Hartshorne
- Compact Complex Surfaces / Barth, Hulek, Peters, Van de Ven
- Algebraic Curves and Riemann Surfaces / Miranda

Références suggérées par la bibliothèque

- Algebraic Varieties / Osserman
- Chapters on Algebraic Surfaces / Reid