**EPFL**

| MATH-679 | **Group schemes** |
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| **Cursus** | **Sem.** | **Type** |
|---|---|---|
| Mathematics | | Opt. |

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|---|---|
| Language of teaching | English |
| Credits | 3 |
| Session | |
| Exam | Term paper |
| Workload | 90h |
| **Hours** | **42** |
| Courses | 28 |
| Project | 14 |
| **Number of positions** | |

**Frequency**

Every year

**Remark**

This is a course on group schemes with an emphasis on structural theorems for algebraic groups and with a stress on the modern presentation using scheme theory and modern algebrai

**Summary**

This is a course about group schemes, with an emphasis on structural theorems for algebraic groups (e.g. Barsotti--Chevalley's theorem). All the basics will be covered towards the proof of such theorem, with an estress on the modern presentation using scheme theory and modern algebraic geometry.

**Content**

The following seven contents constitute the core material for the course. It is designed towards the proof of the Barsotti--Chevalley's theorem.

1. Definition and basic properties of group schemes and algebraic groups.
2. Examples and basic constructions (e.g. neutral component and étale group of connected components).
3. Affine algebraic groups and Hopf algebras.
4. The (group-theoretic) isomorphism theorems and the category of commutative algebraic groups.
5. Solvable and nilpotent algebraic groups (subnormal series).
6. Actions of algebraic groups and torsors.
7. The structure theorems of algebraic groups: Rosenlincht's decomposition theorem and Barsotti--Chevalley's theorem.

Time permitting and depending on the attendants interests, we may cover the following more specialized and advanced contents.

8. Finite group schemes.
9. The structure of solvable algebraic groups (linearly reductive groups, unipotent groups, and tori).
10. Picard schemes.
11. Hochschild cohomology.

**Keywords**

Group schemes, algebraic groups, Barsotti--Chevalley's theorem, torsors, Picard schemes.

**Learning Prerequisites**

**Required courses**

MATH 510 Modern Algebraic Geometry

**Learning Outcomes**

By the end of the course, the student must be able to:

- structure of general algebraic groups

**Resources**

**Bibliography**

1. Algebraic groups by J. S. Milne.
2. Some structure theorems for algebraic groups by M. Brion.
3. Lectures on the structure of algebraic groups and geometric applications by M. Brion, P. Samueal, and V. Uma.

**Ressources en bibliothèque**

- Some structure theorems for algebraic groups / Brion
- Algebraic groups / Milne
- Lectures on the structure of algebraic groups and geometric applications / Brion, Samueal & Ulma