



# FSF3607 Étale Cohomology 7.5 credits

## Étalkohomologi

This is a translation of the Swedish, legally binding, course syllabus.

If the course is discontinued, students may request to be examined during the following two academic years

## Establishment

Course syllabus for FSF3607 valid from Spring 2019

## Grading scale

G

## Education cycle

Third cycle

## Specific prerequisites

Knowledge of basic algebraic geometry (schemes, sheaves, etc.) on the level of Algebraic Geometry II (FSF3605). This implies that a solid basic knowledge of topology and commutative algebra is needed, for instance SF2735 Homological Algebra and Algebraic Topology and SF2737 Commutative Algebra and Algebraic Geometry. A second course in commutative algebra (FSF3603) is also desirable as is a course on sheaf cohomology (FSF3606).

## Language of instruction

The language of instruction is specified in the course offering information in the course catalogue.

## Intended learning outcomes

After the course, the student should have sufficient knowledge of étale cohomology to be able to read more advanced topics such as the proof of the Weil conjectures (Deligne), perverse sheaves and the decomposition theorem (Beilinson, Bernstein, Deligne and Gabber). In particular, the student should

- have a thorough understanding of étale morphisms and the étale topology,
- have a working knowledge of the machinery behind étale cohomology,
- be able to do computations with torsors and the étale fundamental group,
- be able to use the fundamental theorems (finiteness, base change),
- have a cursory knowledge of constructible sheaves and  $\ell$ -adic cohomology.

## Course contents

- Étale morphisms and the étale topology
- Étale cohomology
- The étale fundamental group
- Examples: curves, Pic and Brauer groups
- Torsors
- Comparison theorems
- Constructible sheaves
- Proper and smooth base change theorems
- Finiteness theorems
- $\ell$ -adic sheaves
- Lefschetz trace formula
- Weil conjectures

## Disposition

The course is given as a series of lectures (approx 18 x 2h).

## Course literature

Main text book: J.S. Milne, Étale cohomology, Princeton University Press, 1980

Other references:

- S. Milne, Lectures on Étale Cohomology,  
<http://www.jmilne.org/math/CourseNotes/lec.html>.

- Stacks project, Chapter on Etale cohomology, <http://stacks.math.columbia.edu/download/etale-cohomology.pdf>.
- Lei Fu, *Étale cohomology theory*, World Scientific, 2015.
- SGA 4, SGA 4½, SGA 5, Springer Lecture Notes in mathematics 269, 270, 305, 569, 589.
- G. Tamme, *Introduction to Étale Cohomology*, Springer-Verlag, 1994.
- E. Freitag and R. Kiehl, *Etale Cohomology and the Weil Conjecture*, Springer-Verlag, 1988.

## Examination

- INL1 - Assignment, 7.5 credits, grading scale: P, F

Based on recommendation from KTH's coordinator for disabilities, the examiner will decide how to adapt an examination for students with documented disability.

The examiner may apply another examination format when re-examining individual students.

Homework assignments.

## Other requirements for final grade

Homework assignments completed.

## Ethical approach

- All members of a group are responsible for the group's work.
- In any assessment, every student shall honestly disclose any help received and sources used.
- In an oral assessment, every student shall be able to present and answer questions about the entire assignment and solution.