

# Syllabus

for course at advanced level

**Advanced algebra**  
**Avancerad algebra**

**7.5 Higher Education  
Credits**  
**7.5 ECTS credits**

<b>Course code:</b>	MM7033
<b>Valid from:</b>	Autumn 2023
<b>Date of approval:</b>	2022-09-07
<b>Department</b>	Department of Mathematics (incl. Math. Statistics)
<b>Main field:</b>	Mathematics/Applied Mathematics
<b>Specialisation:</b>	A1N - Second cycle, has only first-cycle course/s as entry requirements

## Decision

This course syllabus was approved by the Board of Science at Stockholm University on 7 September 2022.

## Prerequisites and special admittance requirements

For admission to the course, knowledge is required equivalent to Mathematics III - Abstract Algebra, 7.5 credits (MM5020).

Also required is knowledge equivalent to Swedish upper secondary course English 6.

## Course structure

Examination code	Name	Higher Education Credits
HELA	Advanced algebra	7.5

## Course content

The course covers fundamental algebraic structures och theorems that provide a foundation for more advanced algebraic studies, e.g., in algebraic geometry.

In particular, the following is covered.

Field theory: Splitting fields, minimal polynomials. Finite fields. Zorn's Lemma. Existence of algebraic closure and transcendental bases. Existence of maximal ideals in rings.

Module theory: Submodules and quotient modules, direct sums and products, free modules, isomorphism theorems. Finiteness conditions. Short exact sequences. Tensor products. Localization. Universal properties. Multilinear algebra. General definitions of trace and determinant. Noetherian rings and modules. The Hilbert basis theorem.

Applications: An assortment of applications within commutative algebra, representation theory, algebraic geometry and category theory.

## Learning outcomes

After the course the student should be able to

- formulate central definitions and theorems within the topic of the course,
- apply and generalize theorems and methods within the topic of the course,
- describe, analyze and formulate basic proofs within the topic of the course.

## Education

Instruction consists of lectures and exercises.

The course is offered in English.

### **Forms of examination**

a. The course is examined as follows: Assessment takes place through written exam. The examination will be conducted in English.

The examiner can decide on adapted or alternative examination formats for students with disabilities.

b. The course has no compulsory instruction.

c. Grading: The course's final grade is set according to a seven-point criterion-referenced scale:

A = Excellent

B = Very good

C = Good

D = Satisfactory

E = Adequate

Fx = Failed, some additional work is required

F = Failed, much additional work is required

d. The course's grading criteria are handed out at the start of the course.

e. Students who receive a failing grade on a regular examination are allowed to retake the examination as long as the course is still provided. The number of examination opportunities is not limited. Other mandatory course elements are equated with examinations. A student who has received a passing grade on an examination may not retake the examination to attain a higher grade. A student who has failed the same examination twice is entitled to have another examiner appointed, unless there are special reasons to the contrary. Such requests should be made to the department board. Under normal circumstances, the course includes at least three examination opportunities per academic year the course is offered. For the academic years that the course is not offered, at least one examination opportunity is offered.

f. There is no possibility to improve the grade Fx to a pass grade in this course.

### **Interim**

Students may request that the examination be conducted in accordance with this course plan even after it has ceased to be valid. However, this may not take place more than three times over a two year period after course instruction has ended. Requests must be made to the departmental board. The provision also applies in the case of revisions of the course syllabus and revisions of the required reading.

### **Limitations**

The course may not be included in a degree together with the course Commutative Algebra and Algebraic Geometry (MM7042).

### **Misc**

The course is part of the Master's programme in Mathematics, but may also be taken as a separate course. The course is given in cooperation with KTH Royal Institute of Technology.

### **Required reading**

The required reading is decided by the departmental board and published on the Department of Mathematics' website at least 2 months before the start of the course.