Joint Faculties of Humanities and Theology

# ÄMAB03, Introduction to Higher Analysis for Subject Teachers, 7.5 credits

*Introduktion till högre analys för ämneslärare, 7,5 högskolepoäng*

**First Cycle / Grundnivå**

## Details of approval

The syllabus was approved by The Education Board of Faculty of Science on 2025-06-10. The syllabus comes into effect 2025-06-10 and is valid from the spring semester 2026.

## General information

The course is part of the subject teacher education program at Lund University. The course is a mandatory course at basic level for the subject teacher degree in mathematics.

*Language of instruction:* English

| *Main field of study* | *Specialisation* |
|---|---|
| Mathematics | G1F, First cycle, has less than 60 credits in first-cycle course/s as entry requirements |

## Learning outcomes

The overall goal of the course is for students, upon completion, to have acquired an understanding of central concepts, results, and methods relevant for further studies involving mathematical analysis and make connections to subject didactical perspectives. The course is designed to improve students' ability to effectively communicate mathematical ideas both orally and in writing, and to enhance their skills in reading mathematical texts. Additionally, the course aims to prepare students for further courses in analysis, such as linear analysis, ordinary differential equations, or complex analysis, that are elective courses within the teacher education programme in mathematics.

### Knowledge and understanding

On completion of the course, the student should be able to:

- give a detailed account of the concepts that are listed under the contents of the course
- explain the logical relation between the most important axioms, definitions and theorems included in the course
- explain how the results of this course are related to, and generalise, results from courses in analysis in one and several variables
- explain how axioms, definitions, examples, theorems, and proofs serve a pedagogical function in mathematics.

### Competence and skills

On completion of the course, the student should be able to:

- use the most important axioms, definitions and theorems included in the course to solve problems in mathematical analysis
- perform routine calculations neccessary for solving problems in mathematical analysis within the course frame
- reproduce proofs of the most important theorems included in the course, as well as be able to derive relations between key concepts
- numerically, analytically and visually illustrate concepts related to convergence
- present mathematical problems, solutions and arguments within course framework, in speech and writing, logically coherent and with good terminology
- critically assess and give constructive feedback on other students' work
- perform assignments within a given time frame.

### Judgement and approach

On completion of the course, the student should be able to:

- relate, by giving examples, the contents of the course to use of mathematical analysis in research
- concretise, by giving examples, abstract mathematical concepts within the course frame
- highlight connections between higher mathematics and school mathematics
- identify their need to aquire further knowledge.

## Course content

The course treats:

- Properties of the real numbers R: completeness axiom, Cauchy sequences, cardinality of rational and irrational numbers.
- Topology in $R^n$: open and closed sets, p-norms, convergence, compactness and the Bolzano-Weierstrass theorem, connected sets.
- Continuous functions in $R^n$: intermediate value theorem, min-max theorem, uniform continuity, continuity of inverse functions, implicit function theorem.

- Convergence of sequences and series of functions: pointwise, absolute and uniform convergence, termwise differentiation and integration, power series.
- Examples of applications to selected topics relevant to research in mathematics and subject didactics at the Centre for Mathematical Sciences.

## Course design

The teaching consists of lectures and seminars. A mandatory project assignment is included in the course.

## Assessment

The examination consists of the following parts:

- project assignment (2.5 credits)
- written examination at the end of the course (2.5 credits)
- oral examination at the end of the course (2.5 credits)

The project assignment is examined in writing during the course and presented orally at the end of the course. Peer response is included in the requirements for the project.

The oral examination is only given to those students who have passed the written examination and also concerns questions about the project assignment.

Students who do not pass the regular examination are offered an additional examination opportunity during the scheduled re-examination period.

The examiner, in consultation with Disability Support Services, may deviate from the regular form of examination in order to provide a permanently disabled student with a form of examination equivalent to that of a student without a disability.

## Grades

Grading scale includes the grades: Fail, Pass, Pass with distinction
The grading scale for the project assignment and the written examination is Fail, Pass, while the oral examination is graded according to the grading scale Fail, Pass, Pass with distinction.

In order to obtian the grade Pass on the entire course, it is required to pass the project assignment as well as the written and oral examinations. The final grade for the entire course is determined by the grade on the oral examination.

## Entry requirements

Admission to the course requires 30 credits including knowledge equivalent to the following courses:

- ÄMAA01 Mathematics 1 for subject teachers: Analysis in One Variable, 13 credits
- ÄMAA02 Mathematics 1 for subject teachers: Algebra and Vector Geometry, 7.5 credits
- ÄMAA03 Mathematics 1 for subject teachers: Computational Programming with Python, 6 credits
- ÄMAA04 Mathematical Didactics 1, 3.5 credits.

## Further information

The course is included in the second semester of studies in mathematics within the teacher education programme. In order to be able assimilate the course content, it is recommended that the students have the course ÄMAB01 Mathematics 2 for subject teachers, 15 credits.

The course is given at the Centre for Mathematical Sciences, Lund University.