Faculty of Science

MATA21, Mathematics: Analysis in One Variable, 15 credits

Matematik: Envariabelanalys, 15 högskolepoäng

First Cycle / Grundnivå

Details of approval

The syllabus was approved by Study programmes board, Faculty of Science on 2015-06-08 to be valid from 2015-07-01, autumn semester 2015.

General Information

The course is a compulsory course for first-cycle studies for a Bachelor of Science degree in mathematics and in physics.

Language of instruction: Swedish and English

Main field of studies	*Depth of study relative to the degree requirements*
Mathematics	G1N, First cycle, has only upper-secondary level entry requirements

Learning outcomes

The aim of the course is to enable students to acquire the following knowledge and skills on completion of the course.

Knowledge and understanding

On completion of the course, the students shall be able to:

- state axioms, definitions and theorems that are included in the course and illustrate them with examples;
- be able to use the rules and theorems for limits, derivatives and integrals to carry out calculations on number sequences, elementary functions, differential equations and series;
- be able to link axioms, definitions and theorems that are included in the course using mathematical proofs.

Competence and skills
On completion of the course, the students shall be able to:

- link different limit concepts to concrete numerical estimates;
- present and discuss mathematical calculations and proofs in speech and writing.

Judgement and approach
On completion of the course, the students shall be able to:

- analyse critically other students'solutions and presentations and evaluate alternative solutions in relation to their own solutions;
- argue for the importance of mathematical proofs.

Course content

The real numbers: axiomatic description and proofs of basic arithmetical rules.

Limits of number sequences: formal definition, proofs and use of arithmetical rules, The Bolzano--Weierstrass theorem.

Limits of functions: formal definition of limits of functions, proofs of the rules of differentiation.

Continuity: definition and basic properties of continuous functions, the intermediate value theorem, the extreme value theorem for continuous functions, uniform continuity.

Derivatives: definition, proofs and applications of computational rules for derivatives, the mean value theorem, optimisation, curve sketching, proof techniques for identities and inequalities.

Primitive functions: proofs and applications of basic computational rules and integration methods such as change of variables, partial integration and integration of elementary functions (trigonometric integrals, rational integrals, partial fraction decomposition).

Definite integrals: definition, integrability of monotonous functions and continuous functions, proof of the fundamental theorem of calculus and applications.

Differential equations: direction field, solution methods for first-order linear or separable differential equations and higher-order linear differential equations with constant coefficients.

Taylor expansions: Taylor's formula, proofs, applications and error term estimates.

Series: proofs and applications of convergence criteria for positive and alternating series.

Improper integrals: proof and applications of convergence criteria for improper integrals of positive functions.

Course design

The teaching consists of lectures, seminars, exercise classes and mentoring hours. An essential element of the seminars and exercise classes is training in problem solving and oral mathematical communication.

A project is included in the course requirements. The project concerns theoretical or numerical aspects, applications of the course content, but can also have a didactic specialisation. The project also aims at providing the students with training in mathematical communication in speech and writing.

Assessment

The examination consists of the following parts:

- written and oral presentations of the project (2 credits)
- a written examination possibly together with an oral examination (13 credits)

The oral examination is required to achieve the grade Pass with distinction and is offered only to students who passed the corresponding written examination.

Non-compulsory assessments that may affect the grade on the written and/or oral examination can be included in the course. In this case, students are informed at the start of the course.

Students who fail the ordinary examination are offered a resit examination shortly thereafter.

Subcourses that are part of this course can be found in an appendix at the end of this document.

Grades

Marking scale: Fail, Pass, Pass with distinction.
To achieve the grade Pass, it is required to pass the project and the written examination.

To achieve the grade Pass with distinction, it is also required to pass an oral examination. Whether the grade Pass with distinction should be given is decided by combining the results of the included examination parts.

Entry requirements

General and courses corresponding to the following Swedish Upper Secondary School Programs: Mathematics 4 or Mathematics D.

Further information

The course may not be included in a degree together with the courses Mathematics 1 alpha (MAT131 or MATA11) or Mathematics 1 beta (MAT132 or MATA12), Analysis 1 (MATA14) nor together with Mathematics for science students (MAT015, MATA01, MATA02).

Subcourses in MATA21, Mathematics: Analysis in One Variable

Applies from H15

1501 Project, 2,0 hp
Grading scale: Fail, Pass
1502 Written exam, 13,0 hp
Grading scale: Fail, Pass