SF2710 Mathematics, Advanced Course 7.5 credits

Matematik, fördjupning

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

Establishment

Grading scale

A, B, C, D, E, FX, F

Education cycle

Second cycle

Main field of study

Mathematics

Specific prerequisites

5B1212/SF1637 Differential equations and transforms III, or equivalent.

Language of instruction

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

Intended learning outcomes

After taking this course the student is supposed to be able to

- explain the structure of the number system, both intuitively and axiomatically, especially Peano's axioms for the natural numbers and Dedekind's construction of the reals

- carry out cardinality arguments showing the denumerability of the rational numbers and the non-denumerability of the real numbers

- give an account of mathematics as a logical system with axioms, rules of inference, definitions, theorems and proofs, and carry out deductions in sentential and predicate logic, and explain the content of Gödel's theorems

- understand and use set-theoretical and topological notions in mathematical reasoning, and have some knowledge of naive and axiomatic set-theory

- analyze different types of convergence in different types of spaces, for example Euclidean spaces, general metric spaces and different function spaces, and understand and analyze compactness, continuity and connectivity

- use the supremum property of the real numbers to prove some properties of continuous functions

- understand, prove and apply certain important theorems from differential and integral calculus, such as the inverse function theorem, Weierstrass' approximation theorem and Picard's theorem on existence and uniqueness of solutions to differential equations

- elucidate connections and differences between notions in analysis using examples, i.e. give examples of a nowhere differentiable continuous function, a connected set that is not pathwise connected, a sequence of functions that is pointwise but not uniformly convergent, etcetera

- explain introductory complex analysis and some of its applications

- give an account of the basic facts in euclidean and non-euclidean geometry

Furthermore, the student is supposed to carry out an individual project in some area of mathematics that can be chosen freely. Possible examples are

- explain the basic ideas of Lebesgue integration

- explain the classical problems of construction, i.e. doubling the cube, trisecting the angle and the quadrature of the circle

- give an account of the basic ideas of Galois theory

- give an account of the basic ideas of functional analysis.

Course contents

Mathematics as a logical system, including sentential and some predicate logic and Gödel's theorems. The number system, especially Peanos axioms for the natural numbers and

Dedekind's construction of the reals. Cardinality. Some aspects of Euclidean and non-Euclidean geometry. Basic set-theory and topology, metric spaces. Convergence, continuity, compactness, connectivity. Contractions and fix-point theorems. In-depth study of differential and integral calculus, including the inverse function theorem, Weierstrass' approximation theorem and Picard's theorem on existence and uniqueness of solutions to ordinary differential equations. An orientation about Lebesgue integration, complex analysis and functional analysis.

An individual project is mandatory.

Course literature

To be announced at course start.

Examination

- TEN1 - Examination, 7.5 credits, grading scale: A, B, C, D, E, FX, 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.

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

Other requirements for final grade

An exam (TEN 1; 7,5 hp) which in all or in parts can be replaced by examination procedures decided on by teacher and students.

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.