Faculty of Science

MATC21, Mathematics: Complex Analysis 1, 7.5 credits

Matematik: Komplex analys 1, 7,5 högskolepoäng

First Cycle / Grundnivå

Details of approval

The syllabus was approved by The Education Board of Faculty of Science on 2024-12-02. The syllabus comes into effect 2024-12-02 and is valid from the autumn semester 2025.

General information

The course is an alternative-compulsory course at upper-basic level for a Degree of Bachelor of Science 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 overarching goal of the course is that the student develop an understanding of fundamental concepts, results, and methods in the theory of analytic functions, and the ability to apply these to describe, analyze, and solve relevant problems related to complex analysis. The course aims to develop the students' ability to communicate mathematics orally and in writing and to read mathematical texts. It also aims to prepare the student for further studies in mathematics, science, and technology.

Knowledge and understanding

After completing the course, students should be able to:

- give an account of the relationships between the main concepts and results included in the course and illustrate these with examples
- explain how the main concepts and results of the course are related to solution methods for relevant problems in complex analysis.

Competence and skills

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

- confidently apply basic methods to solve relevant calculation tasks within the course content
- demonstrate good calculation skills
- present solutions to relevant calculation tasks orally and in writing, logically coherent, and with appropriate terminology
- derive basic relationships between key concepts and reproduce proofs for the main results included in the course.

Judgement and approach

After completing the course, students should be able to:

- evaluate available solution methods in problem-solving and choose an appropriate solution method
- critically analyze their own and other students' solutions and evaluate solution alternatives in relation to each other
- argue for the value of mathematical theory in problem-solving
- argue for the value of mathematical analysis in other sciences.

Course content

The course treats basic theory of analytic functions:

- Elementary properties of analytic functions in one variable. Complex differentiability and Cauchy-Riemann equations. Calculation rules. Elementary examples of analytic functions: power series expansions, exponential functions, branches of logarithms, and functions defined by these calculation rules.
- Contour integrals in the complex plane. Cauchy's integral theorem and integral formula. Existence of a primitive function and local power series expansion of analytic functions. Cauchy estimates, Liouville's theorem, and the fundamental theorem of algebra.
- Theory of meromorphic functions: singular points, Laurent series expansion and the residue theorem. Residue calculus.
- Further elements of the theory of holomorphic functions such as argument principle, Rouché's theorem, and open mapping property.
- Harmonic functions. Regularity, existence of harmonic conjugate, mean value property, maximum principle, Poisson integrals.

Course design

The teaching consists of lectures and seminars. The seminars are based on selected exercises and require active student participation, including preparation.

Assessment

The examination consists of a written examination and an oral examination at the end of the course. The oral examination is only given for students who have passed the written examination. Students who do not pass the regular written and oral examinations are offered additional examination opportunities shortly thereafter.

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 written and the oral examination is Fail, Pass. For the grade "Pass" on the written examination the student must achieve at least 50% of the maximum number of points.

To achieve the final grade of Pass for the entire course, the student must have obtained a Pass grade on all the included examination components.

In addition, the grade Pass with distinction requires that the total number of marks obtained in the written and the oral examination is not less than 75% of the accumulated maximal number of points. The maximal number of marks that can be obtained in the written and the oral examination are weighted three to one.

Entry requirements

The course requires basic knowledge in analysis in one and several variables and linear algebra, corresponding to, for example:

- MATA31Analysis in One Variable, 15 credits
- MATA32 Algebra and Vector Geometry, 7,5 credits
- MATB21 Analysis in Several Variables, 7,5 credits
- MATB23 Analysis in Several Variables 2, 7,5 credits
- MATB32 Linear Algebra, 7,5 credits

Additionally, knowledge equivalent to MATB33 Mathematics: Introduction to Higher Analysis, 7.5 credits, or FYSB21 : Mathematical Methods for Vibrations, Waves and Diffusion, 7.5 credits, is required.

Further information

The course cannot be credited together with the course MATM12 Analytic Functions.
The course is given at the Centre for Mathematical Sciences, Lund University.