Faculty of Health, Science and Technology
Mathematics

Syllabus

Complex analysis and transforms

Course Code:	MAGB61
Course Title:	Complex analysis and transforms *Komplex analys och transformer*
Credits:	7.5
Degree Level:	Undergraduate level
Progressive Specialisation:	First cycle, has less than 60 credits in first-cycle course/s as entry requirements (G1F)

Major Field of Study:
MAA (Mathematics)

Course Approval
The syllabus was approved by the Faculty of Health, Science and Technology 2020-03-11, and is valid from the Spring semester 2021 at Karlstad University.

Prerequisites
Registered on Mathematics 30 ECTS credits, including Foundation Course in Mathematics (7.5 ECTS credits), Calculus and Geometry (7.5 ECTS credits), Linear Algebra (7.5 ECTS credits), and Calculus in Several Variables (7.5 ECTS credits), with at least 15 ECTS credits completed

Learning Outcomes
Upon completion of the course, students should be able to:
- determine the differentiability of complex functions directly and with the help of the Cauchy-Riemann equations,
- calculate the convergence radius of power series with the help of the Cauchy-Hadamard theorem,
- give an account of the most important elementary functions: the exponential function, logarithm, the complex trigonometric and hyperbolic functions,

- develop complex analytical functions in the Taylor series,
- develop functions in the Laurent series centered on singular points and calculate residues,
- calculate curve integrals of complex functions with residue calculation-based methods,
- calculate certain types of real integrals with complex analysis methods,
- give an account of the properties of the Laplace transformation and solve linear ordinary differential equations with this transformation, and
- give an account of the most important properties of the Fourier transformation and solve certain types of partial differential equations with this transformation.

Content
Instruction is in the form of lectures and exercises.

The course includes the following components:

Series:
Series of real numbers. Series of functions. Fourier series. Different types of convergence. Convergence criteria.

Complex analysis:
The field of complex numbers. Elementary functions: Complex exponential function, complex logarithmic function, complex trigonometric and hyperbolic functions.
Real and complex differentiability, Cauchy-Riemann equations, analyticity of complex function Ln, power functions. Complex integration, the ML inequality and its consequences, Cauchy integration formula.
Leibniz-Newton theorem. Power series. Abel theorem. Cauchy-Hadamard theorem in complex analysis. Analytical functions in circular regions. Laurent series and residue. Isolated singular points of analytical functions and the residue theorem.
Calculation of certain real improper integrals with the residue theorem. Cauchy principal value for improper integrals and their calculation with the residue theorem.

Transformation theory:
Laplace transformation and its basic applications in solving differential equations and systems of differential equations with constant coefficients.
Determination of inverse Laplace transformations with the residue theorem. Fourier transformation and some applications of this transformation in certain types of partial differential equations.

Reading List
See separate document.

Examination
Assessment is based on a written exam. The number of assessment opportunities is limited to three per academic year.

If students have a decision from Karlstad University entitling them to special pedagogical support due to a documented disability, the examiner has the right to give such students an adapted examination or to examine them in a different manner.

Grades
One of the grades Fail (U), Pass (G), or Distinction (VG) is awarded in the examination of the course. For students in Engineering programmes, one of the grades U (Fail), 3 (Pass), 4 (Pass not without distinction), or 5 (Pass with Distinction) is awarded in the examination of the course.

Quality Assurance
Follow-up relating to learning conditions and goal-fulfilment takes place both during and upon completion of the course in order to ensure continuous improvement. Course evaluation is partly based on student

views and experiences obtained in accordance with current regulations and partly on other data and documentation. Students will be informed of the result of the evaluation and of any measures to be taken.

Course Certificate
A course certificate will be provided upon request.

Additional information
The local regulations for studies at the Bachelor and Master levels at Karlstad University stipulate the obligations and rights of students and staff.