GHENT UNIVERSITY

Course Specifications

Valid as from the academic year 2016-2017

Transform Analysis (C002680)

Course size (nominal values; actual values may depend on programme)

Credits	6.0	Study time	165 h
Contact hrs	45.0 h		

Course offerings and teaching methods in academic year 2018-2019

A (semester 2)	Dutch	group work	7.5 h
		guided self-study	30.0 h
		lecture	7.5 h

Lecturers in academic year 2018-2019

De Schepper, Hennie	TW16	lecturer-in-charge
Sommen, Franciscus	TW16	co-lecturer

Offered in the following programmes in 2018-2019	crdts	offering
Master of Science in Mathematics	6	A

Teaching languages

Dutch

Keywords

Hilbert transform, Cauchy transform, Hardy space, continuous wavelet transform, (fractional) Fourier transform, signal analysis

Position of the course

Elective course in the Master in Mathematics.
The student has to gain knowledge and insights in the Hilbert transform of functions and distributions and the associated Cauchy transform on the one hand, and the continuous wavelet transform on the other, with an eye on the unifying role of the (fractional) Fourier transform, developed in the framework of harmonic and holomorphic functions.

Contents

The first part treats the Hilbert Transform (one-dimensional as well as multi-dimensional), which is basic in the classical theory of the singular integral operators. The Hilbert Transform is at the crosspoint of real and complex analysis and fundamental to the study of boundary values of Cauchy transforms of L2-functions on the real line, the unit circle, halfspace and the unit sphere. It leads to the study of Hardy spaces of holomorphic and harmonic functions. The Hilbert Transform is used in the theoretical description of electronic devices and systems, and the elements of the Hardy space, the so-called analytic signals, are fundamental to the theories of signals, circuits and systems.
The second part treats the Continuous Wavelet Transform [CWT] as well as on the real line as in Euclidean space. The CWT is, besides the Windowed Fourier Transform or Gabor Transform, a successful tool for the analysis of signals and feature detection in signals, in particular the time-frequency analysis of non-stationary inhomogeneous signals.
In the study of the Hilbert Transform (first part) and the CWT (second part) the Fourier Transform plays a fundamental rôle. In a third part a generalization of the Fourier Transform, the so-called Fractional Fourier Transform is treated. It has been intensively studied during the last decade because of its importance for optics and signal processing.

Initial competences

Bachelor in Mathematics and more specifically: the Mathematical Analysis I-V courses

Final competences

1 The student possesses a thorough knowledge of and insights in the integral transforms studied, and is able to apply them for problem analysis.
2 The student comprehends the interconnections between the integral transforms studied and is able to demonstrate them.
3 The student possesses insights in the structure and the characterisation of abstract function spaces.
4 The student can apply the fundamental theories of harmonic and holomorphic functions to problems of transform analysis.
5 The student is able to study a recent mathematics paper in English and situate it within his knowledge of the subjects already acquainted.
6 The student masters the mathematical modelling of signal analysis problems.

Conditions for credit contract

Access to this course unit via a credit contract is determined after successful competences assessment

Conditions for exam contract

This course unit cannot be taken via an exam contract

Teaching methods

Guided self-study, group work, lecture

Extra information on the teaching methods

seminars or "reading course" regarding the number of students

Learning materials and price

Printed lecture notes in English
Cost: 8 EUR

References

P Koosis, Introduction to Hp-spaces, Cambridge University Press, Cambridge, 1980
E M Stein, Harmonic analysis, Princeton University Press, Princeton, 1993
F W King, Hilbert Transforms, vol 1, vol 2, Cambridge University Press, 2009

Course content-related study coaching

During classes the theory is explained and illustrated by examples and applications.
Additional individual coaching is available.

Evaluation methods

end-of-term evaluation and continuous assessment

Examination methods in case of periodic evaluation during the first examination period

Oral examination

Examination methods in case of periodic evaluation during the second examination period

Oral examination

Examination methods in case of permanent evaluation

Assignment

Possibilities of retake in case of permanent evaluation

examination during the second examination period is possible

Calculation of the examination mark

project: 60%
oral examination: 40 %