GHENT UNIVERSITY

Course Specifications

Valid as from the academic year 2024-2025

Coding Theory (C000217)

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

Credits 6.0 **Study time 165 h**

Course offerings and teaching methods in academic year 2024-2025

A (semester 2)	Dutch	Gent	lecture
			seminar

Lecturers in academic year 2024-2025

Storme, Leo	WE16	lecturer-in-charge

Offered in the following programmes in 2024-2025	**crdts**	**offering**
Master of Science in Teaching in Science and Technology(main subject Mathematics)	6	A
Master of Science in Mathematics	6	A

Teaching languages

Dutch

Keywords

Codes, error detection, error correction, transmission of information

Position of the course

This course is a compulsary course within the master studies mathematics. The courses Linear Algebra and Geometry, and Discrete Mathematics from the bachelor studies mathematics are a direct preparation to coding theory.
The aim is to get the students acquainted with the mathematical ideas and techniques within coding theory, and give them through these ideas and techniques an excellent example of the importance of mathematics for our society. The importance of linear algebra, finite fields and finite geometry for studying these codes is emphasized. Some of the codes used in practice will be discussed in detail.

Contents

Introduction to the theory of error-detecting and error-correcting codes. The Hamming bound, also called sphere-packing bound, with a short introduction to perfect codes. Introduction to linear codes. Coding and decoding of linear codes, probability of error-detection and error-correction, theorem of Shannon. Dual code, parity-check matrix, syndrome decoding. Weight enumerators and the theorem of MacWilliams. Hamming codes. Perfect codes. Bounds on codes. Reed-Solomon codes with an introduction to Maximum Distance Separable codes. Some applications, e.g. QR-codes and constant dimension codes for random network coding.

Initial competences

Having successfully attended the courses Linear Algebra and Geometry, and Discrete Mathematics from the bachelor studies mathematics, or having acquired the requested starting competences in an other way.

Final competences

1 Having acquired and understood mathematical ideas from coding theory.
2 Having recognized and shown the coherence of mathematics.
3 Having acquired insight in recent developments of coding theory.
4 Being able to communicate about practical applications of pure mathematics.
5 Knowing how to work with mathematical techniques within a social context.

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

Seminar, Lecture

Extra information on the teaching methods

The lecturer of this course presents the mathematical ideas and techniques used within coding theory. During the exercise sessions, the assistant presents exercises in which problems within coding theory are solved

Study material

Type: Syllabus

Name: Coding theory
Indicative price: Free or paid by faculty
Optional: no

References

- R. Hill: A First Course in Coding Theory, Oxford University Press (1986)
- D. G. Hoffman et al.: Coding Theory: The Essentials, Marcel Dekker, New York-Basel-Hong Kong (1992)

Course content-related study coaching

It is always possible for the students to contact the lecturer and the assistant with questions regarding the theory and exercises, with questions regarding other problems within coding theory, or for more information regarding the use of codes within our society. There is also interactive support through Ufora (forum, e-mail).

Assessment moments

end-of-term assessment

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

Oral assessment, Written assessment with open-ended questions

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

Oral assessment, Written assessment with open-ended questions

Examination methods in case of permanent assessment

Possibilities of retake in case of permanent assessment

not applicable

Extra information on the examination methods

The theory is examined during an oral exam with written preparation. The exercise exam is a written exam.

Calculation of the examination mark

Theory counts for 40% and exercises count for 60% of the total number of points.