GHENT UNIVERSITY

Course Specifications

Valid in the academic year 2023-2024

Discrete Mathematics II (C003551)

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 2023-2024

A (semester 2)	Dutch	Gent	lecture
			seminar

Lecturers in academic year 2023-2024

De Bruyn, Bart	WE01	lecturer-in-charge

Offered in the following programmes in 2023-2024	**crdts**	**offering**
Bachelor of Science in Mathematics	6	A

Teaching languages

Dutch

Keywords

Graph theory, adjacency matrix, Coloring numbers, matching, tree, permutation group, autmorphism group, alternating group, coding theory, linear code, error-correction, error-detection, finite fields.

Position of the course

This course is a continuation of Discrete Mathematics I and aims at further introducing the students in the world of discrete mathematics. The important new concept of a "graph" is introduced, and most mathematical concepts that are important for potential applications are studied. Using graphs, the concept of "permutation group" is introduced and some fundamental properties are proved, such as the orbit-stabilizer theorem, the orbit-counting theorem and the well-definedness of the alternating group. Also designs will be considered as structures defining in a natural way permutation groups. The aim is to get the student acquainted with abstract groups through the concrete situation of a permutation group. The course also contains some coding theory, as an example where discrete mathematics is applied in real life. Here, too, the most fundamental concepts are introduced and briefly studies: Hamming distance, weight distribution polynomial, linear codes, k-error-detecting codes, l-error-correcting codes, generator matrix with examples from designs. During the exercise sessions, the students are also trained in making computations with finite fields.

Contents

Chapter 1: Introduction to Graph Theory
- Introductory notions and concepts
- Algebraic properties of the adjacency matrix
- (spanning) Trees
- Matchings and flow
- Eulerian and Hamiltonian graphs
- Graph colorings

Chapter 2: Introduction to Permutation Groups
- Definition and examples from graphs
- Definition and properties of alternating and full symmetric groups
- Orbits, transitivity, stabilizers, regularity
- Cayley graphs
- Permutation matrices

Chapter 3: Introduction to Coding Theory
- General definitions (errors, Hamming distance)
- Linear codes, generator matrix

- Examples of codes from adjacency matrices of graphs

Finite Fields

- Fields
- Construction method
- Basic properties
- Zech logarithms

Initial competences

Discrete Wiskunde I, Linear algebra and geometry I.

Final competences

1 The student is able to translate suitable mathematical and practical problems to graph-theoretical problems, formulate a method of solution for them, and solve the problem.
2 The student is familiar with the basic concepts of graph theory, permutation group theory and coding theory, and important mathematical properties of graphs, permutation groups and (linear) codes.
3 The student can solve small theoretical and practical discrete and combinatorial problems by means of some basic techniques and logical deduction.
4 The student is familiar with making computations in finite fields.

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 theory is taught by lecturing. The exercise sessions are supervised by an assistant. Due to COVID19 alternative teaching methods can be used if this turns out to be necessary.

Learning materials and price

A free electronic copy of the syllabus will be available.

References

- D. West,"Introduction to Graph Theory", Prentice Hall, 1996.
- L. Lovász, J. Pelikán, K. Vesztergombi, "Discrete Mathematics, elementary and beyond", Springer, 2003.
- P. J. Cameron, "Permutation groups", London Mathematical Society Student Texts 45, 1999.
- R. Lidl and H. Niederreiter, "Finite Fields", Encyclopedia of Mathematics and its Applications 20, Cambridge University Press, 1997.

Course content-related study coaching

Students can ask questions on the theory and the exercises before, during and after the lectures. Moreover, the use of the discussion forum in the electronic learning environment is encouraged.

Assessment moments

end-of-term assessment

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

Written assessment with open-ended questions

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

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

- Theory: written examination (closed book).
- Exercises: written examination (closed book).

Calculation of the examination mark

- 50% for theory

- 50 % for exercises.