GHENT UNIVERSITY

Course Specifications

Valid as from the academic year 2025-2026

Algebra II (C004110)

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

Credits 6.0 **Study time 180 h**

Course offerings and teaching methods in academic year 2025-2026

A (semester 2)	Dutch	Gent	seminar
			lecture

Lecturers in academic year 2025-2026

Desmet, Jari	WE02	lecturer-in-charge

Offered in the following programmes in 2025-2026	**crdts**	**offering**
Bachelor of Science in Mathematics	6	A
Preparatory Course Master of Science in Mathematics	6	A

Teaching languages

Dutch

Keywords

Solvable groups, simple groups, free groups.
fields, field extensions, galois theory.

Position of the course

The course builds further on the course Algebra I.
Group theory will be extended by introducing and studying solvable groups and simple groups. The fact that the alternating groups A_n are simple will be proven (this result will be used later in the study of polynomials in one variable). The course also contains an introduction to the theory of free groups.

The study of polynomials in one variable is closely related to study of algebraic field extensions. The symmetry of the set of roots (in a certain field) of such polynomials are described by the automorphism groups of field extensions. This is what is called Galois theory. Different applications of Galois theory, including the non-existence of formulas in radicals for the roots of polynomials of degree >4, will be studied.

Contents

1 Groups.

- Solvable groups.
- Simple groups.
- The simplicity of A_n, $n>4$, and of $PSL_2(k)$.
- Free groups.

2 Field extensions.

- Algebraic and transcendental extensions.
- Finite extensions.
- Separable and inseparable extensions.
- The main theorem of Galois theory.
- Applications (e.g. the fundamental theorem of algebra).

Initial competences

Final competences of the course Algebra I.

Final competences

1 The student should have some insight in how a theory of algebraic structures is set up. The student should have an idea of what structural properties are, and should understand the importance of these properties.
2 The student must be able to clarify the theoretical concepts with examples.
3 The student has to develop their algebraic intuition and should be able to apply methods from the theory of groups and the theory of field extensions.

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 explained at the blackboard. The exercises are discussed during the exercise sessions

Study material

Type: Syllabus

Name: Algebra II
Indicative price: Free or paid by faculty
Optional: no
Language : Dutch
Number of Pages : 110
Oldest Usable Edition : 2023-2024
Available on Ufora : Yes
Online Available : No
Available through Student Association : Yes

References

Artin M., Algebra, Birkhäuser, Basel 1993.
Lang S., Algebra, Addison Wesley, 1993.

Course content-related study coaching

Coaching during the exercise sessions. Homework will be corrected and commented. Question sessions will be organized if necessary. Teacher will be available for questions.

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

Theory: Open questions, aiming to test the insight in the material and the connections between the different parts of the theory. The student must be able to illustrate methods and concepts with examples.
Exercises: the student must show that he or she is able to apply techniques, ways of reasoning and methods of proof. Exercises test the algebraic intuition and the ability to prove theorems.

Calculation of the examination mark

Theory and exercises each count for 50% of the total score; in addition, however, a minimum of 2,5/10 for the exercises is needed to pass the course. If the student has a total score of 10/20 or higher but fails to meet the minimum requirement for

the exercises, the score is lowered to 9/20.