

## Linear Algebra and Geometry II (C003555)

**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**

Van Maldeghem, Hendrik

WE01

lecturer-in-charge

**Offered in the following programmes in 2024-2025**

[Bachelor of Science in Mathematics](#)

**crdts**

6

**offering**

A

**Teaching languages**

Dutch

**Keywords**

Affine geometry, bilinear forms, quadratic forms, sesquilinear forms.

**Position of the course**

Affine geometry is a basic theory which is necessary for a good understanding of several courses in later years of the curriculum, such as the geometrical ones. This is also true for the theory of bilinear and sesquilinear forms. The interaction between geometry and linear algebra is at the centre of this course.

The structure of the course will stimulate the student to use an abstract mathematical way of thinking, without ignoring the applications in other disciplines.

**Contents**

The course consists of two parts. In the first part affine spaces are introduced axiomatically and we study parallelism, affine subspaces, basis, dimension and dilatations. Then we show the existence of translations and homotheties using Desargues' theorem. Assuming the Axiom of Pappus, we prove that the affine space can be given the structure of a vector space over a field, after choosing an arbitrary origin. At the end we study affine transformations, coordinatisation and ratio, and we introduce the linear groups.

In the second part, we treat the theory of bilinear and sesquilinear forms. We introduce the theory as much as possible viewing the bilinear forms as special cases of the sesquilinear forms. The emphasis is on reflexive forms, which lead to alternating and symmetric bilinear forms, and on hermitian forms. Matrix representations and standard forms are treated and allow to study isometry groups such as the Euclidean group. At the same time also quadratic forms are studied, as much as possible independently of the characteristic of the field.

**Initial competences**

Foreknowledge from the course "Linear Algebra and Geometry I".

**Final competences**

- 1 The students master the theory of affine spaces and are able to argue starting from a limited set of axioms.
- 2 The students master the theory of bilinear and sesquilinear forms over arbitrary vector spaces.
- 3 The students are able to detect connections between the different parts of the course.

**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**

Theory: interactive lectures.

Exercises: in the exercise sessions the students try to solve the exercises under guidance. In these sessions the techniques are taught and examples that clarify the theory are given.

**Study material**

Type: Syllabus

Name: Linear algebra and geometry 2

Indicative price: Free or paid by faculty

Optional: no

Language : Dutch

Number of Pages : 88

Oldest Usable Edition : 2023–2024

Available on Ufora : Yes

Online Available : No

Available in the Library : No

Available through Student Association : No

Additional information: The students have the opportunity to buy a hardcopy of the notes for the price of 5 euro.

**References****Course content-related study coaching**

Students can ask questions on the theory and the exercises before and after the lectures. This is also possible by appointment or by e-mail.

**Assessment moments**

end-of-term assessment

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

Oral assessment

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

Oral assessment

**Examination methods in case of permanent assessment****Possibilities of retake in case of permanent assessment**

not applicable

**Extra information on the examination methods**

Theory: oral exam. Questions are directed to test the knowledge of the new concepts and their relations in the theory. One must be able to illustrate methods and concepts with examples. One must be able to explain the logical structure of the proofs and the underlying ideas, and to clarify them using examples. It is tested whether the student has enough insight in how the theory was built up, in the relations between various parts of the course, and the importance of the various parts in the course as a whole.

Exercises: oral exam on a blackboard. The student must show that he/she is able to apply to main techniques, and masters the arguments and proof methods of this field of study.

**Calculation of the examination mark**

To determine the final mark the following weighting factors are used: theory exam 50%, exercise exam 50%.