

## Projective Geometry (C000313)

**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 1)

Dutch

Gent

lecture

seminar

**Lecturers in academic year 2024-2025**

De Bruyn, Bart

WE01

lecturer-in-charge

Thas, Koen

WE01

co-lecturer

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

[Bachelor of Science in Mathematics](#)

**crdts**

6

**offering**

A

[Preparatory Course Master of Science in Mathematics](#)

6

A

**Teaching languages**

Dutch

**Keywords**

Vector spaces, affine spaces, projective spaces, collineations, polarities, conics, quadrics, hermitian curves, hermitian varieties, axiomatic projective spaces, axiomatic projective planes, exterior algebra, Klein correspondence, Plücker coordinates.

**Position of the course**

The students should apply their preknowledge on geometry from the courses Linear Algebra and Geometry to the study of projective spaces. The way of setting up the course will stimulate the student to be skilled in handling more abstract mathematical reasoning.

**Contents**

After giving a general definition of projective spaces over fields (including homogeneous coordinates, the theorems of Desargues and Pappus, collineations, correlations and perspectivities) a detailed study is given of projective lines over fields (isomorphisms between projective lines, cross ratio, the theorem of the complete 4-gon). After that a general study of polarities will be treated, including classification and standard forms, emphasizing the polarities in projective spaces over the reals, complex numbers and finite fields. The study of polarities in projective planes over fields give rise to conics and hermitian curves. These sets of points will be studied in detail. Also an axiomatic approach to the study of projective spaces will be discussed, as well as the so-called Klein correspondence. The last chapter of the course contains an axiomatic study of projective and affine planes; the desarguesian planes as well as some simple non-desarguesian planes will be discussed.

**Initial competences**

Final competences of the course Linear Algebra and Geometry II.

**Final competences**

- 1 The students will have a deep knowledge on projective geometry over fields.
- 2 The students will have a general knowledge on axiomatic projective spaces and planes.
- 3 The study of polarities in projective spaces and conics in projective planes is an important part of the course that can serve as a basis for a more advanced study

in other geometry courses.

### 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 aim is a combination of ex-cathedra teaching and self-study, supported by the standard electronic educational tools.

### Study material

Type: Syllabus

Name: Projective Geometry  
Indicative price: Free or paid by faculty  
Optional: no  
Language : Dutch  
Number of Pages : 101  
Available on Ufora : Yes  
Online Available : No  
Available in the Library : No  
Available through Student Association : No

Type: Syllabus

Name: Projective Planes  
Indicative price: Free or paid by faculty  
Optional: no  
Language : Dutch  
Number of Pages : 36  
Available on Ufora : Yes  
Online Available : No  
Available in the Library : No

### References

- R. Casse, *Projective Geometry: An Introduction*, Oxford Handbooks.
- J. W. P. Hirschfeld, *Projective Geometries over Finite Fields*, Oxford University Press.
- D. R. Hughes, F. C. Piper, *Projective Planes*, Graduate Texts in Mathematics 6, Springer-Verlag.
- A. Beutelspacher, U. Rosenbaum. *Projective Geometry: from foundations to applications*, Cambridge University Press.

### Course content-related study coaching

Students can ask questions on the theory and the exercises before, during and after the lectures. This is also possible on appointment or by email.

### 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

There will be a written exam on theory and exercises. The understanding, knowledge and skills are evaluated.

**Calculation of the examination mark**

Theory 12/20  
Exercises 8/20