

## Linear Algebra (C004204)

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

**Credits 4.0**

**Study time 120 h**

**Course offerings and teaching methods in academic year 2024-2025**

A (semester 1)

Dutch

Gent

lecture

seminar

**Lecturers in academic year 2024-2025**

Van Antwerpen, Arne

WE01

lecturer-in-charge

De Medts, Tom

WE01

co-lecturer

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

[Bachelor of Science in Physics and Astronomy](#)

**crdts**

**offering**

4

A

**Teaching languages**

Dutch

**Keywords**

Vector spaces, matrices, determinants, linear maps, affine spaces

**Position of the course**

This course unit belongs to the learning pathway "Mathematics" in the Bachelor program Physics and Astronomy.

The course consists of a broad foundation in the theory of vector spaces and linear algebra over arbitrary fields, which is then applied to the concrete situation of Euclidean spaces. The course is set up in such a way that it will stimulate the student to get skilled in abstract mathematical reasoning, without ignoring the applications to other areas, in particular to physics

**Contents**

1. Vector spaces

- General definitions, vector space, subspace, intersection and direct sum, generating set, linear independence, basis and dimension, coordinate representation.

2. Linear maps and matrices

- Definitions, kernel and image, dimension theorems
- Matrices, determinants and matrix representations
- Change of basis and similarity

3. Systems of linear equations

- Gauss-Jordan method
- Minors and cofactors, adjunct of a matrix
- Cramer's rule

4. Euclidean geometry and orthogonality

- Length of a vector, norm, Cauchy-Schwarz and triangle inequalities
- Inproduct and orthogonality
- Scalar and vector product in  $\mathbb{R}^3$ , algebraic and geometrical interpretation
- Change of basis transformations, rotations and reflections, orthogonal matrices
- Translations, affine spaces, introduction to the Euclidean group

5. Eigenvalues and eigenvectors

- Characteristic polynomial, Cayley-Hamilton theorem
- Eigenvalues, eigenvectors, eigenspaces
- Diagonalisation

### Initial competences

This course is attuned to college mathematics, in particular Euclidean planes and Euclidean three-dimensional spaces.

### Final competences

- 1 Analyse and solve a problem (theoretical, practical, or arising from an application) situated in vector spaces, in theory of matrices and determinants, or in Euclidean geometry.
- 2 Use the new techniques both in pure mathematical or in applied context, such as physics or astronomy.
- 3 Apply computational linear algebraic skills in a useful manner, and think critically about mathematical arguments.

### 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

Lectures in which the theory is presented.  
Exercise classes in which the students solve exercises under supervision.

### Study material

Type: Syllabus

Name: Linear Algebra

Indicative price: Free or paid by faculty

Optional: no

Language : Dutch

Number of Pages : 120

Oldest Usable Edition : 2023-2024

Available on Ufora : Yes

Online Available : No

Available through Student Association : Yes

### References

- P. Igodt & W. Veys, "Lineaire algebra", Universitaire Pers Leuven, 2011. ISBN 978-90-5867-879-9. [in Dutch.]
- Gilbert Strang, "Introduction to Linear Algebra", Fourth Edition, Wellesley-Cambridge Press, ISBN: 9780980232714

### 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. There is interactive support via the Ufora forum.

### 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

The complete examination (both theory and exercises) are in written form, and open-book. The examination is made up in such a way that a large part of the course is covered, and such that it can be examined whether the students have sufficient understanding of the material.

**Calculation of the examination mark**

Theory and exercises are equally important for the computation of the end score (50% each).