GHENT UNIVERSITY

Course Specifications

Valid in the academic year 2025-2026

Vector Analysis (C004209)

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	lecture
			seminar

Lecturers in academic year 2025-2026

Vernaeve, Hans	WE16	lecturer-in-charge

Offered in the following programmes in 2025-2026	**crdts**	**offering**
Bachelor of Science in Physics and Astronomy	6	A

Teaching languages

Dutch

Keywords

Real-valued functions of several real variables, vector-valued functions, differential calculus, integral calculus.

Position of the course

This course unit belongs to the learning pathway "Mathematics" in the Bachelor program Physics and Astronomy.
This course offers a well-founded and at the same time widely applicable introduction to real functions of several real variables and to vector-valued functions. It consists of 'broad basic knowledge', and it supplies knowledge and skills that are useful and often indispensable in many other domains. Students get gradually familiarized with the methods and the typical reasoning for mathematical analysis with several real variables. Completeness or depth has not always been aimed at, and geometric aspects are explained on intuitive grounds. The theory is inextricably linked to exercises aiming at self-activity.

Contents

1. Functions of several real variables: norm and distance on R^n, sequences, limits, continuity, short introduction to complex valued functions as functions from R^2 to R^2
2. Differentiability, partial and directional derivatives, higher order partial derivatives, generalisation to vector valued functions, the Jacobian matrix, chain rule, mean value theorem, Taylor expansion.
3. Gradient, divergence, curl and Laplacian: definition and meaning, expressions in cylindrical and spherical coordinates, Helmholtz decomposition.
4. Inverse function theorem, implicit function theorem.
5. Smooth curves, parametrisations, line integrals of scalar and vector fields, conservative vector fields.
6. Riemann integrals of functions of two and of three variables, transformations of coordinates, polar coordinates, cylindrical coordinates, spherical coordinates, Green's theorem.
7. Smooth surfaces, surface integrals of scalar and vector fields, Stokes' theorem and divergence theorem of Gauss.
8. Maxima and minima of a function: extrema, saddle points, the Hessian matrix and the method of Lagrange multipliers.

Initial competences

A working knowledge of analysis of functions of one real variable is assumed.

Final competences

1 The student understands how a number of concepts in analysis that are used in physics (such as a number of standard vector fields, integrals defined on, possibly curved, higher dimensional surfaces, ...) can be mathematically defined, and understands that the abstract definition coincides with geometric intuition.
2 The student understands a number of mathematical reasonings that have been taught to construct the theory of real analysis in several variables.
3 The student can solve an elementary problem from real analysis in several variables or from vector calculus, e.g. originating from physics, by a thoughtful application of the acquired methods.

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: oral presentation supplemented with slides.

Study material

Type: Syllabus

Name: Vector analysis
Indicative price: Free or paid by faculty
Optional: no
Language : Dutch
Number of Pages : 115
Oldest Usable Edition : 2024-2025
Available on Ufora : Yes
Online Available : Yes
Available in the Library : No
Available through Student Association : No
Additional information: PDF file, free to be used and printed

References

1 Apostol, Tom M. Calculus. 2. *Multivariable Calculus and Linear Algebra, with Applications to Differential Equations and Probability.* 2nd ed. New York (N.Y.): John Wiley, 1969.
2 Apostol, Tom M. Mathematical Analysis. 2nd ed. Reading (Mass.): Addison-Wesley, 1974.

Course content-related study coaching

Besides regular support by the officially appointed coaches, there is permanent availability before and after classes, and possibility of consultation (after appointment by mail).

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

Written evaluation in two parts, theory and exercises. In the theory part, knowledge and skills acquired will be tested, as well as the ability to relate

different parts of the theory. In the exercise part, the acquired skills will have to be applied. In view of the supporting character of this course for the Physics and Astronomy program, emphasis will be on computational exercises.

Calculation of the examination mark

Periodic evaluation 100%.