GHENT UNIVERSITY

Course Specifications

Valid as from the academic year 2018-2019

Geometry and Linear Algebra (E000661)

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

Credits	8.0	Study time	240 h	Contact hrs	110.0 h

Course offerings and teaching methods in academic year 2018-2019

A (semester 2)	Dutch	seminar: practical PC room classes	15.0 h
		seminar: coached exercises	10.0 h
		lecture: plenary exercises	15.0 h
		guided self-study	30.0 h
		lecture	40.0 h

Lecturers in academic year 2018-2019

De Schepper, Hennie	TW16	lecturer-in-charge

Offered in the following programmes in 2018-2019	crdts	offering
Bachelor of Science in Civil Engineering	8	A
Bachelor of Science in Computer Science Engineering	8	A
Bachelor of Science in Chemical Engineering and Materials Science	8	A
Bachelor of Science in Electrical Engineering	8	A
Joint Section Bachelors of Science in Engineering	8	A
Bachelor of Science in Engineering Physics	8	A
Bachelor of Science in Electromechanical Engineering	8	A
Preparatory Course Master of Science in Biomedical Engineering	8	A
Preparatory Course European Master of Science in Nuclear Fusion and Engineering Physics	8	A
Preparatory Course Master of Science in Engineering Physics	8	A

Teaching languages

Dutch

Keywords

Vector spaces, vectors, linear transformations, matrices, invariant subspaces, eigenvalues, eigenvectors, curves and surfaces, inner product spaces, orthogonal projection

Position of the course

The aim of this course is to provide insight in the basic abstracts concepts of linear algebra, by introducing them in a concrete way, through geometric examples and applications. Meanwhile, students also gain insight in the structure of threedimensional objects and they learn to apply algebraic and geometric techniques.

Contents

- ***Vector spaces:*** basis and dimension, subspace
- ***Vectors:*** vector manipulations, dot product, cross product
- ***Geometry of the first degree and related algebraic notions and methods:*** lines and planes, systems of linear equations, matrices, reduced forms of a matrix, determinant
- ***Transformations:*** affine transformation, co-ordinate transform, rotation, reflection and orthogonal projection, linear transforms on vector spaces, matrix representation, kernel and image, dimension counting

- ***Curves and surfaces:*** vector representation, tangent line, tangent plane, normal vector, singular point, surfaces of revolution
- ***Geometry of the second degree and related algebraic notions and methods:*** conic sections and quadratic surfaces, eigenvalues and eigenvectors of a matrix or a linear transformation, conditions for the existence of an equivalent diagonal form, inner product spaces, orthogonal projection and best approximation, bilinear and quadratic forms

Initial competences

Discrete Mathematics I, Basis Mathematics Tools

Final competences

1 Having acquired skills in the manipulation of vectors.
2 Having acquired insight in the notions vector space, linear dependence and independence, basis and dimension.
3 Being able to give the matrix representation and the corresponding formulae of an affine or co-ordinate transform in threedimensional space, or of a linear transform between abstract vector spaces.
4 Having acquired insight in the notions rank, image, kernel, invertability, and determinant of a linear transform.
5 Being able to write down the respective reduced forms of a matrix and use them for solving systems of linear equations.
6 Being able to write down vector representations of curves and surfaces, and to perform chains of active and passive transforms on them.
7 Having acquired insight in the mathematical, physical and geometric meaning of eigenvalues and eigenvectors.
8 Being able to construct an orthogonal basis by means of the Gram-Schmidt-procedure, to project a vector orthogonally onto a subspace and to perform a least squares algorithm.

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

Guided self-study, lecture, lecture: plenary exercises, seminar: coached exercises, seminar: practical PC room classes

Extra information on the teaching methods

During the lectures the most important concepts and their basic properties are introduced and further trained during particular lectures for exercises, where classical, well-structured methods are taught for standard applications.
During the exercises in the PC rooms, further skills are trained in the application of the learned techniques to new problems.
During the exercises in the class room priority goes to theoretical exercises enhancing the insight in the theoretical concepts.

Learning materials and price

Lecture notes in Dutch. Additional learning material available electronically (Minerva). Cost: ca 10 euro.

References

- J H Kindle, Theory and problems of plane and solid analytic geometry, Schaum's outline series, Mac Graw-Hill, New York
- J Golan, Foundations of Linear Algebra, Kluwer

Course content-related study coaching

The lecturer is available before and after classroom lectures. Personal coaching by the lecturer as scheduled. Interactive support (Minerva-forum). Additional tutoring services are available.

Evaluation methods

end-of-term evaluation and continuous assessment

Examination methods in case of periodic evaluation during the first examination period

Written examination

Examination methods in case of periodic evaluation during the second examination period

Written examination

Examination methods in case of permanent evaluation

Written examination, open book examination

Possibilities of retake in case of permanent evaluation

examination during the second examination period is not possible

Extra information on the examination methods

- During semester / permanent evaluation: two mandatory written tests with open book (exact dates will be announced at the start of the semester).
- During examination period: written closed-book examination in the PC-room (Maple available). The examination consists of exercises and applied theory.

Calculation of the examination mark

Continuous assessment:
The scores on the two tests T1 and T2 (both marked out of 20), form a weighted score of respectively 40% and 60%, thus T' = 0.4 T1 + 0.6 T2

The total result of the permanent evaluation T, is determined as follows:
- if $T' < 10$ then $T = T'$
- if $10 \leq T' < 17$ then $T = T' + 3$
- if $T' \geq 17$ then $T = 20$

End-of-term evaluation: written examination (marked out of 20, score E)

Calculation of the final mark in the first examination period:
- If $E \geq 8$ then the final mark equals $\max(0.25\ T + 0.75\ E;\ 0.1\ T + 0.9\ E) - 2A$
- If $E < 8$ then the final mark equals $E - 2A$

A sets the number of tests (T1 and T2) for which the student was illegitimately absent (A = 0, 1 or 2). For each test in which the student did not participate, two points will be deducted from the final mark (2A = 0, -2 or -4).

Calculation of the final mark in the second examination period (=resit):
- If $E \geq 8$ then the final mark equals $\max(0.25\ T + 0.75\ E;\ E)$
- If $E < 8$ then the final mark equals E