Faculty of Science

MATB32, Mathematics: Linear Algebra, 7.5 credits

Matematik: Lineär algebra, 7,5 högskolepoäng

First Cycle / Grundnivå

Details of approval

The syllabus was approved by The Education Board of Faculty of Science on 2024-06-03. The syllabus comes into effect 2024-06-03 and is valid from the spring semester 2025.

General information

The course is a compulsory course for first-cycle studies for a Bachelor of Science degree in mathematics and in physics.

Language of instruction: English

Main field of study	*Specialisation*
Mathematics	G1F, First cycle, has less than 60 credits in first-cycle course/s as entry requirements

Learning outcomes

The overarching goal of the course is for the students to acquire basic knowledge of linear algebra which is necessary for further studies in mathematics and natural sciences. Special emphasis is placed on developing the mathematical theory for vector spaces in a systematic way that contributes to strengthening the students' ability to absorb mathematical text, to conduct mathematical reasoning, to solve problems of both theoretical and applied nature and to communicate mathematics.

Knowledge and understanding

On completion of the course, the student should be able to:

- give a detailed account of the concepts, theorems and methods included in the course give an account of and apply the theory of linear algebra
- exemplify and interpret important concepts in the course in concrete situations
- derive relevant algebraic relationships and formulas

- identify the logical structure in mathematical arguments and carry out mathematical proofs.

Competence and skills

On completion of the course, the student should be able to:

- interpret relevant information, independently identify, state and solve problems that concern linear algebra,
- use appropriate mathematical methods from linear algebra and integrate concepts from the different parts of the course in connection with problem solving,
- demonstrate a good algebraic computation ability within the framework of the course, both to describe algorithms and carry out calculations
- to translate mathematical theory into computer programs in order to solve problems related to the course contents
- give, orally and in writing, an account of mathematical arguments within the course frame in a logical and structured way.

Judgement and approach

On completion of the course, the student should be able to:

- show insight into how the theory of linear algebra can be a powerful tool in solving problems
- evaluate and discuss advantages and disadvantages of different solution methods for a given problem within the frame of the course.

Course content

The course treats:

- Matrices: matrix operations, matrix inverse, matrix rank
- Determinants: definition and properties
- Linear spaces: subspace, span, linear dependence/independence, basis, dimension
- Euclidean spaces: scalar product, Cauchy-Schwarz inequality, orthogonality, orthonormal bases, orthogonalisation, orthogonal matrices, orthogonal projection, orthogonal complement, least squares method, isometries.
- Linear mappings: matrices of linear mappings, kernel and image, composition and inverse, change of basis, rank-nullity theorem
- Spectral theory: eigenvalues, eigenvectors, eigenspace, characteristic polynomial, diagonalisability, the spectral theorem
- Systems of linear ordinary differential equations.
- Quadratic forms: bilinear forms, diagonalisation, quadratic curves, quadratic surfaces, law of inertia

Course design

The teaching consists of lectures, seminars and, depending on the specialisation of the project, computer exercises. An essential element of the seminars is training in problem solving and oral mathematical communication.

A mandatory project that can consist of a number of problems is included in the course requirements. The project aims to translate mathematical theory into computer programs in order to be able to solve problems that apply the content of the course. The project also aims at providing the students with training in mathematical communication in speech and writing.

Assessment

The examination consists of the following parts:

- written and oral presentation of the project during the course (1.5 credits)
- written examination at the end of the course (6 credits)

Students who fail the ordinary written examination are offered a resit examination shortly thereafter.

The examiner, in consultation with Disability Support Services, may deviate from the regular form of examination in order to provide a permanently disabled student with a form of examination equivalent to that of a student without a disability.

Grades

Grading scale includes the grades: Fail, Pass, Pass with distinction
The grading scale for the project is Fail, Pass. The grading scale for the written examination is Fail, Pass, Pass with Distinction.
For a Pass grade on the whole course, the student must have Pass grades in the project and in the written examination.

The final grade is determined by the grade in the written examination.

Entry requirements

To be eligible for the course, 30 credits in science studies including knowledge corresponding to the courses MATA31 Analysis in One Variable 15 credits, MATA32 Algebra and Vector Geometry 7.5 credits, as well as one of the courses NUMA01 Computational Programming with Python, 7.5 credits, or an introductory course in university physics, 7.5 credits, are required.

Further information

The course may not be included in a degree together with MATB22 Linear Algebra 2, 7.5 credits.

The course is given at the Centre for Mathematical Sciences, Lund University.