Linnæus University

Course syllabus

Faculty of Technology

Department of Mathematics

1MA406 Linjär algebra, 7,5 högskolepoäng
1MA406 Linear Algebra, 7.5 credits

Main field of study
Mathematics

Subject Group
Mathematics

Level of classification
First Level

Progression
G1N

Date of Ratification
Approved 2018-10-15
Revised 2023-11-30 by Faculty of Technology. Prerequisites are revised. Field-specific entry requirements have been removed.
The course syllabus is valid from spring semester 2024

Prerequisites
General entry requirements + Mathematics 4/Mathematics D.

Objectives

After completing the course, the student should be able to:
A. *Knowledge and understanding*

- A.1 Explain central concepts in linear algebra as linear system of equations, echelon form, column interpretation, row interpretation, vector, linear independence, base, inner product, vector product, linear transformation, diagonalization, as well as
- A.2 formulate and explain the central results in linear algebra as theorems about existence and uniqueness of solutions of linear systems of equations.

B. *Ability and skills*

- B.1 Perform operations like gauss elimination, matrix operations, diagonalization, least square approximation, and calculations of inner products, vector products, orthogonal vector projections,

- B.2 use and combine knowledge about different concepts, methods and theory from linear algebra in problem solving activities,
- B.3 present and explain calculations and mathematical reasoning in written form in a correct, structured and logically coherent way, as well as
- B.4 use mathematical software in problem solving.

C. Judgement and approach

- C.1 Interpret and judge results in problem solving.

Content

The main goal of the course is to give an introduction to linear algebra for further studies in mathematics, economics, science and technology. In laborational tasks, the students are also trained in using mathematical software in solving problems from applications of linear algebra.

- Introduction to logic, set theory, and basics in mathematical reasoning and proof.
- Linear systems of equations: Gauss elimation, matrix representation, interpretation of linear systems of equations in terms of columns and rows of the coefficient matrix, echelon form, geometric interpretion of solution sets, existence and uniqueness of solutions. Examples of systems engineering and applications in traffic flow and Leontief's closed input-output model for production economics.
- Matrices: representation of systems of equations, matrix algebra, elementary matrices, matrix inverse, rowspace and column space, determinants.
- Vector spaces: Euclidean spaces, coordinate systems, geometric vectors, lines and planes, subspaces, linear independence, bases and dimension, change of basis, inner product, vector product, volume function. Exampel of applications in physics like velocity, force, and work.
- Introduction to linear transformations: matrix representation, nullspace, range, matrix rank. Applications in computer graphics and animation: scalings, projections, reflections, and rotations in 2D.
- Diagonalization: eigenvalue, eigenvector, diagonalizability. Factorization of polynomials and polynomial division. Exempels of applications like something on Leontief's open input-output model for production economics, something about harmonic motion.
- Ortogonality: Inner product in R^n, orthogonal vector projection, introduction to the least square method.
- Introduction to problem solving using mathematical software.

Type of Instruction

Lectures and seminars.

Examination

The examination of the course is divided as follows:

Code	Designation	Grade	Credits
2101	Written exam	AF	6,00
2102	Laborations	AF	1,50

The course is assessed with the grades A, B, C, D, E, Fx or F.

The grade A constitutes the highest grade on the scale and the remaining grades follow in descending order where the grade E is the lowest grade on the scale that will result in a pass. The grade F means that the student's performance is assessed as fail (i.e. received the grade F).

The student's knowledge in problem solving and theory is assessed in the form of written examination. Problemsolving using mathematical software is assessed in the form of assignments. The final grade is determined by a weighted average of the result of the two examinations.

Resit examination is offered in accordance with Linnaeus University's Local regulations for courses and examination at the first- and second-cycle levels.
In the event that a student with a disability is entitled to special study support, the examiner will decide on adapted or alternative examination arrangements..

Objectives achievement

The examination elements are linked to the course objectives in the following ways:

Goal	2101	2102
A.1	☑	
A.2	☑	
B.1	☑	☑
B.2	☑	☑
B.3	☑	
B.4		☑
C.1	☑	☑

Course Evaluation

A course evaluation should be conducted during the course or in connection with its conclusion. The results and analysis of the completed course evaluation should be promptly communicated to students who have completed the course. Students participating in the next course instance should be informed of the results of the previous course evaluation and any improvements that have been made, no later than at the start of the course.

Credit Overlap

The course cannot be included in a degree along with the following course/courses of which the content fully, or partly, corresponds to the content of this course: 1MA403 Vector Geometry, 7.5 credits and 1MA133 Linear algebra for engineers, 7.5 credits.

Other

Grade criteria for the A–F scale are communicated to the student through a special document. The student is to be informed about the grade criteria for the course by the start of the course at the latest.

Required Reading and Additional Study Material

Steven Leon, *Linear Algebra with Applications*, Pearsson, latest edition. Expected reading 275/485 pages.

Franco Vivaldi, Mathematical Writing, Springer, 2014. Expected reading 50/204 pages.

David Lay, Linear Algebra and Its Applications, Pearson, latest edition.

David Poole, Linear Algebra: a modern introduction, 4th edition or later, 2014.

Kenneth Hardy, Linear Algebra: for Engineers and Scientists, Pearson, 2006. Expected reading 323/480 pages.