Linnæus University

Dnr: LNU-2023/2935

Course syllabus

Faculty of Technology

Department of Mathematics

1MA917 Linjär algebra fortsättningskurs, 7,5 högskolepoäng
1MA917 Linear Algebra Advanced Course, 7.5 credits

Main field of study
Mathematics

Subject Group
Mathematics

Level of classification
First Level

Progression
G1F

Date of Ratification
Approved 2021-09-27
Revised 2023-09-25 by Faculty of Technology. Assessment methods are revised.
The course syllabus is valid from autumn semester 2024

Prerequisites
1MA901 Linear algebra, 7.5 credits or equivalent

Objectives

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

- A.1 Explain key concepts and calculation methods in linear algebra such as scalar product space, Gram-Schmidt's orthogonalization process, orthogonal polynomial, Hermitean matrix, singular value decomposition, positive definite matrix, quadratic form, matrix norm, condition number,
- A.2 formulate, prove and explain the relevance of results that are central in linear algebra, such as the Cauchy-Schwarz inequality, the theorem of best approximation in least squares, the spectral theorem for symmetric matrices, and
- A.3 demonstrate knowledge and understanding of the basics of report writing.

B. Skills and abilities

- B.1 apply theory and methods from linear algebra to mathematically posed problems,

- B.2 demonstrate the ability to clearly present and discuss orally and in writing their conclusions and the knowledge and arguments on which they are based, and
- B.3 use mathematical software in problem solving of linear systems.

C. Judgment and approach

- C.1 Demonstrate the ability to assess the plausibility of results from mathematical calculations and problem solving, and
- C.2 reproduce and use other people's materials and data correctly.

Content

The aim of the course is to provide an in-depth study of linear algebra with applications in mathematics, technology and economics. In particular, the course is preparatory for further studies in function theory, numerical methods, signal processing and machine learning.

- Orthogonality: Vector spaces and function spaces, orthogonal subspace, least squares method and best approximation, scalar product space, orthonormal sets, Gram-Schmidt's orthogonalization process, orthogonal polynomials.
- Eigenvalues: Cayley-Hamilton's theorem, Hermitean matrices, real Schur decomposition, spectral theorem for symmetric matrices, singular value decomposition, quadratic forms, positive definite matrices, positive semi-definite matrices, Perron-Frobenius' theorem.
- Numerical linear algebra: Matrix norms and condition numbers, something about QR factorization and modified version of Gram-Schmidt's orthogonalization process.
- Something about applications in optimization, linear systems, Markov chains and Leontief's open model for production economy.
- Problem solving and visualization using Matlab.

The course also contains the following elements on technical communication:

- Academic and popular science text types: design, analysis and use.
- Basics of writing technical reports.
- Information retrieval and reference management.
- Ethics, copyright and plagiarism.

Type of Instruction

Lectures, teacher-led exercise classes, seminars and computer labs.

Examination

The examination of the course is divided as follows:

Code	Designation	Grade	Credits
2401	Assignments	U/G	2,00
2402	Written exam	AF	3,00
2403	Written report	AF	2,50

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

The grade A constitutes the highest grade level, the remaining grades follow in

descending order where the grade E constitutes the lowest grade level for passing. The grade F means that the student's performance has been assessed as failed.

For a pass grade on the course, at least grade G is required for assignments and grade E for the oral exam. The final grade is determined by the oral exam.
The assignments are presented in writing and orally.

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	2401	2402	2403
A.1		☑	
A.2		☑	
A.3			☑
B.1	☑	☑	
B.2	☑	☑	☑
B.3	☑		
C.1	☑	☑	
C.2			☑

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: 1MA451 Linear algebra and Fourier series, 5 credits

Required Reading and Additional Study Material

Required Reading:

- Steven J. Leon, Linear Algebra with Applications, latest edition, Pearson. Approx. 500 pages
- Guides for written and oral communication avalible at the web-classroom of the course.

Reference literature:

- Sadun, Lorenzo, Applied linear algebra, latest edition, American Mathematical Society.