Linnæus University

Jnr: 2020/2163-3.1.2.2

Course syllabus

Faculty of Technology
Department of Mathematics

1MA907 Linjär algebra fortsättningskurs, 5 högskolepoäng
Linear Algebra Advanced Course, 5 credits

Main field of study
Mathematics

Subject Group
Mathematics

Level of classification
First Level

Progression
G1F

Date of Ratification
Approved by Faculty of Technology 2020-06-08
The course syllabus is valid from spring semester 2021

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, and
- 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.

B. Skills and abilities

- B.1 apply theory and methods from linear algebra to mathematically posed problems,
- B.2 demonstrate the ability to present and explain calculations and mathematical reasoning in writing and orally in a correct, structured and logically coherent manner, and
- B.3 use the Matlab software in problem solving for linear systems as Leontief's open model for production systems and report and evaluate the results.

C. Judgment and approach

- C.1 Demonstrate the ability to assess the plausibility of results from mathematical calculations and problem solving.

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.

Type of Instruction

Lectures, teacher-led exercise classes and computer labs. Assignments are made individually.

Examination

The examination of the course is divided as following:

Code	Appellation	Grade	Credits
2101	Assignment	U/G	2.00
2102	Oral exam	AF	3.00

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.

Renewed examination is given in accordance with Local rules for course and examination at undergraduate and advanced level at Linnaeus University.

If the university decides that a student is entitled to special educational support due to a disability, the examinator has the right to give an adapted test or that the student completes the test in an alternative way.

Objectives achievement

The examination parts are linked to the learning outcomes as follows:

Goal	2101	2102

A.1		✓
A.2		✓
B.1	✓	✓
B.2	✓	✓
B.3	✓	
C.1	✓	✓

Course Evaluation

During the course or in close connection with the course, course evaluation is carried out. Results and analysis of completed course evaluation will be quickly fed back to the students who have completed the course. Students who participate in the next course occasion will receive the feedback at the start of the course. Course evaluation is carried out anonymously.

Credit Overlap

The course cannot be included in a degree along with the following courses of which the content fully, or partly, corresponds to the content of this course: 1MA451 Linear algebra and Fourier series

Required Reading and Additional Study Material

Required Reading:

- Steven J. Leon, Linear Algebra with Applications, latest edition, Pearson. Approx. 500 pages

Reference literature:

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