FEM3220 Matrix Algebra 10.0 credits

Matrisalgebra

This is a translation of the Swedish, legally binding, course syllabus.

Establishment

The official course syllabus is valid from spring semester 2026 according to the Director of Third Cycle Education: dnr HS-2026-0051. Decision date: 2026-01-14

Grading scale

P, F

Education cycle

Third cycle

Specific prerequisites

Doctoral students at the School of Electrical Engineering. External participation by admission of the examiner.

Intended learning outcomes

After the course the student should be able to:

- use and explain some fundamental tools (specified by the course content) in matrix algebra.
- identify research problems in which matrix algebra tools may be powerful.
- apply the knowledge to solve and analyze the identified matrix algebra problems.

- combine several sub problems and solutions to solve and analyze more complex problems.
- show improved skills in problem solving and proof writing as well as in critical assessment of proofs and solutions.
- show improved skills in oral presentation of technical contents.
- reflect on sustainability and equity aspects as well as ethical issues related to the course content and its use

Course contents

Main content:

1. Review of vector spaces, inner product, determinants, rank

2. Eigenvalues, eigenvectors, characteristic polynomial

3. Unitary equivalence, QR-factorization

4. Canonical forms, Jordan form, polynomials and matrices

5. Hermitian and symmetric matrices, variational characterization of eigenvalues, simultaneous diagonalization

6. Norms for vectors and matrices

7. Location and perturbation of eigenvalues

8. Positive definite matrices. Singular value decomposition

9. Nonnegative matrices, positive matrices, stochastic matrices

10. Stable matrices; Lyapunov's theorem

11. Matrix equations and the Kronecker product, Hadamard product

12. Matrices and functions square roots, differentiation

Additional topics selected for the student presentations

Examination

- INL1 - Homework, 7.0 credits, grading scale: P, F
- SEM1 - Student presentation, 1.5 credits, grading scale: P, F
- PRA1 - Peer grading, 1.5 credits, grading scale: P, F

Based on recommendation from KTH's coordinator for disabilities, the examiner will decide how to adapt an examination for students with documented disability.

The examiner may apply another examination format when re-examining individual students.

If the course is discontinued, students may request to be examined during the following two academic years.

Other requirements for final grade

- Individual solutions to weekly written homework assignments, 80% of max score (Written exam if homework not satisfactorily solved)

- Peer-review grading of assigned problem sets

- Presentation of assigned topic and actively participating during other students presentations

Ethical approach

- All members of a group are responsible for the group's work.
- In any assessment, every student shall honestly disclose any help received and sources used.
- In an oral assessment, every student shall be able to present and answer questions about the entire assignment and solution.