

Course information

Welcome to the upcoming course(s) in Matrix algebra. This is a course in two versions, one for Master, and one for PhD students. The corresponding course homepages can be found at:

<https://kth.instructure.com/courses/17149> [\(https://www.kth.se/social/group/em3220-matrix-algebr/\)](https://www.kth.se/social/group/em3220-matrix-algebr/)

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The first meeting is scheduled to Thursday 19/3. However, in line with the general trend to reduce travel and face to face meetings the current plan is to cancel the physical meetings for the time being. We will still try to run the course as planned in all other aspects.

Updated lecture material and information will be uploaded as we progress. Homework problems will be published each week etc. More detailed information will follow.

Best regards,

Magnus

Course responsible/examiner: Magnus Jansson

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- Lectures: Magnus Jansson, Mats Bengtsson
- Teaching Assistant: ?
- When: Study period 4. See further [the schedule](https://www.kth.se/social/course/EQ2820/calendar/) [\(https://www.kth.se/social/course/EQ2820/calendar/\)](https://www.kth.se/social/course/EQ2820/calendar/).
- Who: The course is suitable as an advanced course in the final year of the M.Sc. program (e.g., for students considering to join the PhD program, or as a first course in the Ph.D program. See EM3220 for the PhD version of the course). External participants upon request. If you are interested, please contact the course responsible. Note that the examiner decides who is admitted.
- Where: see schedule
- Course literature: "Matrix Analysis 2nd ed" by R.A. Horn and C. R. Johnson. We will also use some parts of "Topics in Matrix Analysis" by the same authors, but it should not be strictly necessary to buy this book (it is available in electronic form through KTH library) + lecture slides
- Format: Lectures and homework on a weekly basis.
- Requirements: Individual solutions to homework problems, active participation. Preliminary grading for the masters level course will be: E=60%, D=65%, C=70%, B=80%, A=90% of max score. Each problem is graded according to 0 points (0-40% correct), 1 p (40-60% correct), 2p (60-80% correct), 3 p (80-100% correct).
- Number of credits: 7.5 ECTS

Aim

This is a course aimed at an intermediate MS / PhD level. We will refresh and extend the basic knowledge in linear algebra from previous courses in the undergraduate program. Matrix algebra is of fundamental importance for scientists and engineers in many disciplines. In this course we will focus on topics that are of particular interest in communications, signal processing and automatic control. The course requires a large amount of self study and homework problems will be handed out every week and will be due the following week. The course assumes some familiarity with basic concepts from linear algebra (as one can expect from talented final year MS students).

Goal

You will get a working knowledge of the fundamental tools in matrix algebra, which are useful in many engineering disciplines. This gives a good starting point for easier understanding of coming graduate courses as well as of research articles. Another goal is, of course, that the acquired knowledge should inspire to further reading about matrix algebra and that these tools should be useful in your own research.

Course Outline (preliminary)

- Review: vector spaces, inner product, determinants, rank
- Eigenvalues, eigenvectors: characteristic polynomial
- Unitary equivalence: QR-factorization
- Canonical forms: Jordan form, polynomials and matrices
- Hermitian and symmetric matrices: Variational characterization of eigenvalues, simultaneous diagonalization
- Norms for vectors and matrices
- Location and perturbation of eigenvalues
- Positive definite matrices: Singular value decomposition
- Nonnegative matrices: positive matrices, stochastic matrices
- Stable matrices: Lyapunov's theorem
- Matrix equations and the Kronecker product, Hadamard product
- Matrices and functions: square roots, logarithms, differentiation