LUNDS UNIVERSITET
Lunds Tekniska Högskola

Course syllabus

Matematik - System och transformer
Mathematics - Systems and Transforms

FMAF05, 7 credits, G2 (First Cycle)

Valid for: 2018/19
Decided by: PLED F/Pi
Date of Decision: 2018-03-23

General Information

Main field: Technology.
Compulsory for: E2, F2, I2, Pi2
Elective Compulsory for: D2
Elective for: BME4, C4, M4, N3
Language of instruction: The course will be given in English on demand

Aim

The aim of the course is to present mathematical concepts and methods from linear algebra and analysis which are important in systems theory (continuous and discrete), and for further studies within e.g. mathematics, economy, physics, mathematical statistics, mechanics, control theory, signal theory and for future professional work. The aim is also to develop the student's ability to solve problems, to assimilate mathematical text and to communicate mathematics.

Learning outcomes

Knowledge and understanding
For a passing grade the student must

- be familiar with the significance of eigenvalues in the context of stability and resonance, in linear systems, with continuous as well as discrete time.
- be able to describe and use the concepts of linearity, time and space invariance, stability, causality, impulse response and transfer function, in continuous as well as discrete time.
- be able to describe the structure of an exponential matrix, and be able to compute exponential matrices in simple cases.
- be able to characterize different types of quadratic forms using eigenvalue methods and via a completion of squares.

- be able to define the concept of convolution, continuous and discrete, and to use convolutions both in the context of linear, timeinvariant systems and in the description of certain types of integral equations.
- have some experience and understanding of mathematical and numerical software.

Competences and skills
For a passing grade the student must

- be able to demonstrate an ability to independently choose appropriate methods to solve systems of linear differential and difference equations, and to carry out the solution essentially correctly.
- be able to demonstrate an ability to use eigenvalue techniques, elementary distribution theory, function theory, Fourier and Laplace transforms and convolutions in problem solving within the theory of linear systems.
- in connection with problem solving, be able to demonstrate an ability to integrate knowledge from the different parts of the course.
- with proper terminology, in a well-structured manner and with clear logic be able to explain the solution to mathematical problems within the framework of the course.

Contents

Linear algebra: Spectral theory, quadratic forms.

Systems of linear differential equations: Equations in state form. Solution via diagonalization. Stability. Stationary solutions and transients. Solution via exponential matrix.

Input/output relations: Linearity, time and space invariance, stability, causality. Convolutions. Elementary distribution theory. Transfer and frequency functions. Discrete systems.

Fourier analysis: The Laplace and Fourier transforms. Inversion formulae, the convolution theorem and Plancherel's theorem. Transform theory and analytic functions. Applications to differential equations and systems of differential equations.

Examination details

Grading scale: TH - (U,3,4,5) - (Fail, Three, Four, Five)
Assessment: Written test comprising theory and problems. Assignments, requiring work with and without computer, which have to be completed BEFORE the exam.

The examiner, in consultation with Disability Support Services, may deviate from the regular form of examination in order to provide a permanently disabled student with a form of examination equivalent to that of a student without a disability.

Parts
Code: 0116. **Name:** Systems and Transforms.
Credits: 7. **Grading scale:** TH.
Code: 0216. **Name:** Assignments.
Credits: 0. **Grading scale:** UG.

Admission

Admission requirements:

- FMAB20. At least 13 university credits, in total, of the courses FMAA05 and FMAB30. Started FMAB30.

Required prior knowledge: FMAF01 Analytic functions.
The number of participants is limited to: No
The course overlaps following course/s: FMA030, FMA036, FMA062, FMA450, FMAF10

Reading list

- Spanne, S: Lineära system. KF-Sigma, 1997.
- Spanne, S: Övningar i Lineära system. KF-Sigma, 2009.

Contact and other information

Course coordinator: Studierektor Anders Holst, Studierektor@math.lth.se
Course administrator: Studerandeexpeditionen, expedition@math.lth.se
Course homepage: http://www.maths.lth.se/course/sot/
Further information: The written exams for this course may also be used as written exams on the earlier courses FMA450 and FMA036. In order for an exam to be graded it is necessary that the examinee has passed on the assignments before the exam.