DN2266 Mathematical Models, Analysis and Simulation Part 1 7.5 credits

Matematiska modeller, analys och simulering del 1

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

Establishment

Course syllabus for DN2266 valid from Autumn 2009

Grading scale

A, B, C, D, E, FX, F

Education cycle

Second cycle

Main field of study

Mathematics

Specific prerequisites

Single course students: 90 university credits including 45 university credits in Mathematics or Information Technology. English B, or equivalent.

Language of instruction

The language of instruction is specified in the course offering information in the course catalogue.

Intended learning outcomes

The overall goal of the course is to give basic knowledge of applied and numerical mathematics useful for scientific and engineering modeling. Especially, the close connection between the properties of mathematical models and their successful numerical treatment is emphasized.

This understanding means that after the course you should be able to

- identify and describe discrete equilibrium models using a network approach;
- relate equilibrium problems to minimum principles and solve simple constraint minimization problems via the Lagrange multiplier approach;
- formulate variational problems starting from simple physical principles and derive the corresponding Euler-Lagrange equation such that you can derive basic equations for continuous equilibrium problems in one, two, and three space dimensions;
- model (spatially discrete) time-dependent systems by ordinary differential equations;
- investigate the stability of autonomous systems and explore geometrically the phase space of 2D dynamical systems using analytical and numerical tools;
- derive asymptotic expansions for certain simple singular perturbation problems;
- understand the relation between convergence, consistency, and stability of numerical methods;
- understand essential properties of, and proof error estimations for, numerical methods for solving stationary and instationary problems such that you can compare different methods and select suitable algorithms for given problems;
- analyze and select iterative methods for large linear systems.

Course contents

Linear algebra, equilibrium and minimization problems. Applications on networks. Duality and calculus of variation, essential and natural boundary conditions. Systems of ordinary differential equations, linear and nonlinear. Phase plane, stability, bifurcation. Numerical methods for the solution of nonlinear systems and differential equations. Applications on mechanical and ecological systems.

Solution of systems of linear equations. Symmetrical positive definite matrices. Minimization problems. Eigenvalues and dynamical systems.

Assignments: One assignment every second week, from paper and pencil work to parameter studies of dynamical models in ecology and mechanics.

Course literature

Meddelas senast 4 veckor före kursstart på kursens hemsida. Tidigare läsår användes G. Strang: Computational Science and Engineering, Wellesley-Cambridge.

Examination

- TEN1 - Examination, 3.8 credits, grading scale: A, B, C, D, E, FX, F

- LAB1 - Laboratory Task, 3.7 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.

In this course all the regulations of the code of honor at the School of Computer science and Communication apply, see: http://www.kth.se/csc/student/hederskodex/1.17237?l=en_UK.

Other requirements for final grade

Examination (TEN1; 3,8 university credits).
Assignments (LAB1; 3,7 university credits).

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.