DN2251 Applied Numerical Methods III 9.0 credits

Tillämpade numeriska metoder III

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

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

Establishment

Course syllabus for DN2251 valid from Autumn 2008

Grading scale

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

Education cycle

Second cycle

Main field of study

Specific prerequisites

Language of instruction

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

Intended learning outcomes

An overall aim with this course is to give the student knowledge about how to formulate, use, analyse and implement advanced computer oriented numerical methods to solve problems in numerical algebra and differential equations from different application areas.

After completing the course the student should be able to

1) in numerical algebra

- identify algebra computations, linear and nonlinear, in a practical problem

- implement such a computation, estimate computer resource needs and judge the quality of the results.

- implement special numerical algorithms adapted to the properties of the problem

2) in numerical solution of differential equations

- for a given problem, identify problem type within the area of differential equations, ordinary and partial, and suggest an algorithm for the numerical solution

- utilise and analyze the most important algorithms for the kind of problems presented in this course

- utilise those algorithms from other areas of numerical analysis which are necessary for solving differential equations, e.g. large sparse linear systems of equations, Fourier analysis, etc

- set up and explain some fundamental mathematical models in science which are based on differential equations

- implement the algorithms i a programming language suitable for numerical computation, e.g. Matlab

- utilise computer tools for simulation and visualization of differential equation models in science and engineering.

Course contents

Numerical Algebra:

Linear systems of equations: direct algorithms, perturbation theory and condition, rounding errors. Sparse matrices. Iterative methods: stationary iterations, Krylov space methods and preconditioning.

Eigenvalue problems: Theory, transformation methods and iterative methods.

Singular value decomposition and its applications.

Nonlinear systems of equations and numerical optimization. Model fitting.

Differential equations:

Numerical treatment of initial value problems, boundary value problems, and eigenvalue problems for ordinary and partial differential equations. Discretization by finite differences, finite elements, and finite volumes. Convergence, stability and error analysis.

Application oriented computer labs and a project.

Course literature

To be announced at least 2 weeks before the course starts at the web page for the course.

Examination

- LABA - Laboratory Work, 1.5 credits, grading scale: P, F
- LABB - Laboratory Work, 3.0 credits, grading scale: P, F
- TENA - Examination, 1.5 credits, grading scale: A, B, C, D, E, FX, F
- TENB - Examination, 3.0 credits, grading scale: A, B, C, D, E, FX, 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.

Other requirements for final grade

Examination of first part (TEN1; 3 university credits) from course 2D1252/DN2252.
Examination (TEN2; 3 university credits) from course 2D1225/DN2225.
Computer assignments and project work (LAB1; 3 university credits.) from course 2D1225.

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.