Numerical Algorithms

Programme course

6 credits

Numeriska algoritmer

TADI02

Valid from: 2017 Spring semester

Determined by
Board of Studies for Electrical Engineering, Physics and Mathematics

Date determined
2017-01-25

Main field of study
Mathematics, Applied Mathematics

Course level
First cycle

Advancement level
G2X

Course offered for
- Computer Engineering, B Sc in Engineering
- Engineering Electronics
- Mechanical Engineering, B Sc in Engineering

Entry requirements
Note: Admission requirements for non-programme students usually also include admission requirements for the programme and threshold requirements for progression within the programme, or corresponding.

Prerequisites
Basic courses in calculus, linear algebra and programming.

Intended learning outcomes
Scientific computing is the art of developing and analysing numerical algorithms for solving mathematical problems in for example natural science and technology. After finishing the course the student should be able to

- explain and separate fundamental terms and concepts in scientific computing
- use a selection of numerical algorithms for solving given mathematical problems using a pocket calculator
- estimate the accuracy of calculated results
- use mathematical software
- implement and validate numerical methods

Course content

- Error analysis: Error propagation and cancellation.
- Floting point numbers: Floating point systems, machine epsilon and round off.
- Linear systems of equations: LU decomposition, pivoting, backward and forward substitution, condition and arithmetic complexity.
- Interpolation and approximation: Newton's and Lagrange's methods, splines, Horner's scheme, least squares and overdetermined systems.
- Differentiation and integration: Difference approximation, order of accuracy, Richardson extrapolation, the trapezoidal rule, Simpon's rule and Romberg's method.
- Ordinary differential equations: Runge Kutta methods, local and global truncation error, stability and convergence.
- Non-linear equations: The bisection method, Newton-Raphson's method, fixed point iteration, condition and order of convergence.

Teaching and working methods

The course is divided into a number of sections that are described under Course contents below. Each sections begins with a preparatory computer laboration that gives training in using mathematical software and raises questions about the properties of the numerical algorithms. These questions are answered during lectures, when the algorithms are explained.

The ability to explain and separate terms and concepts in scientific computing, the ability to use numerical algorithms using a pocket calculator and the ability to estimate the accuracy of calculated results are trained during exercise time.

A number of minor projects are also carried out, where acquired knowledge and skills are used. The results are discussed at the seminars and reported in short written reports.

Examination

LAB1	Laboratory work	2.5 credits	U, G
TEN1	Written examination	3.5 credits	U, 3, 4, 5

The first three course aims are examined with TEN1. The other two are examined with LAB1. Laboratory work includes computer exercises, minor projects, written reports and seminars.

Grades

Four-grade scale, LiU, U, 3, 4, 5

Other information

Supplementary courses: Numerical linear algebra, Numerical linear calculus

Department
Matematiska institutionen

Director of Studies or equivalent
Ingegerd Skoglund

Examiner
Ingegerd Skoglund

Course website and other links

Education components
Preliminary scheduled hours: 54 h
Recommended self-study hours: 106 h

Course literature

Additional literature

Books

L Eldén, L Wittmeyer-Koch, (2001) *Numeriska beräkningar - analys och illustrationer med MATLAB* fjärde upplagan Studentlitteratur

Compendia

H Brandén, Formelsamling i Beräkningsvetenskap
H Brandén, Övningar i Beräkningsvetenskap

Common rules

Regulations (apply to LiU in its entirety)

The university is a government agency whose operations are regulated by legislation and ordinances, which include the Higher Education Act and the Higher Education Ordinance. In addition to legislation and ordinances, operations are subject to several policy documents. The Linköping University rule book collects currently valid decisions of a regulatory nature taken by the university board, the vice-chancellor and faculty/department boards.

LiU's rule book for education at first-cycle and second-cycle levels is available at http://styrdokument.liu.se/Regelsamling/Innehall/Utbildning_pa_grund-_och_avancerad_niva.