

# Scientific Computing

Programme course

8 credits

Beräkningsmatematik

TANA22

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

G1X

## Course offered for

- Mathematics, Bachelor's Programme

## 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

Computational mathematics 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 computational mathematics
- use a selection of numerical algorithms for solving given mathematical problems using a pocket calculator
- estimate the accuracy of calculated results
- use mathematical software

## Course content

- Error analysis: Round off, truncation, error propagation and cancellation.
- 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, the trapezoidal rule, and Simpson's rule.
- Ordinary differential equations: Runge Kutta methods, local and global truncation error, stability and convergence.
- Floating point numbers: Floating point systems, machine epsilon and round off.
- 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 section 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 computational mathematics, 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 in group, where acquired knowledge and skills are used, and some exercises in MATLAB.

## Examination

UPG1	Project work	2 credits	U, G
LAB1	Laboratory work	2 credits	U, G
TEN1	Written examination	4 credits	U, 3, 4, 5

The first three course aims are examined with TEN1. The fourth is examined with LAB1 and UPG1.

## 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

<http://courses.mai.liu.se/GU/TANA22>

## Education components

Preliminary scheduled hours: 60 h

Recommended self-study hours: 153 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 Beräkningsmatematik, MAI, LiU

H Brandén, Övningar i Beräkningsmatematik, MAI, LiU

## 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://stydokument.liu.se/Regelsamling/Innehall/Utbildning\\_pa\\_grund-\\_och\\_avancerad\\_niva](http://stydokument.liu.se/Regelsamling/Innehall/Utbildning_pa_grund-_och_avancerad_niva).