

SYLLABUS

Computational Methods and Engineering Tools 7.5 credits R7027R

Beräkningsmetoder och ingenjörsvärktyg

Course syllabus admitted: Autumn 2023 Sp 1 - Present

**DECISION DATE
2022-01-14**

Computational Methods and Engineering Tools 7.5 credits R7027R

Beräkningsmetoder och ingenjörsverktyg

Second cycle, R7027R

Education level	Grade scale	Subject	Subject group (SCB)
Second cycle	G U 3 4 5	Rymdteknik	Space Technology

Main field of study

Space Technology

Entry requirements

M0047M Differential calculus, M0048M Linear algebra and integral calculus, M0049M Linear algebra and differential equations, M0055M Multivariate analysis or other mathematics courses that include multi-dimensional analysis and vector analysis.

M0046M Mathematics Space.

Mechanics in F0004T Physics 1 and F0006T Physics 3 or equivalent.

F0059T Engineering Mechanics

Good knowledge in English equivalent to English 6.

Selection

The selection is based on 30-285 credits

Course Aim

Divided into 3 categories below, after the course the student should show:

1. Knowledge and understanding

- Basic knowledge of numerical methods (NM) and numerical modeling of space science and space technological problems, technical and fluid engineering problems.
- Understand the underlying theories on which the Finite Element Method (FEM) and Computational Fluid Dynamics (CFD) are based.
- Basic understanding of how and why non-mechanical phenomena affect the choice of solution methods.
- Understand the importance of reliability in CFD modeling.
- Have increased knowledge about complex flow cases for space applications.
- Have knowledge of central areas for CFD and FEM modeling in space applications.

2. Skills and abilities

- Combine CAD, FEM, and CFD to solve problems.
- Feel increased experience of how NM, CAD, FEM and CFD are used in the space industry and space research.
- Be able to apply methods to make a flow mechanical simulation credible.

3. Judgment and approach

- Understand the role of NM in the space science and space industry
- Be familiar with today's challenges in the space industry related to NM, CFD and FEM.
- Be familiar with increased experience of engineering assessments and identification and formulation of problems

Contents

- Numerical methods for solving ordinary and partial differential equations, linear and non-linear equation system with application e.g. within orbital dynamics.
- Spectral analysis of time series of e.g. greenhouse gases. Simulation of gases with the Monte Carlo method.
- Computational fluid dynamics (CFD): Network generation, choice of equations and boundary conditions linked to different test cases for current simulations. Specifically, modeling, rheological models and ways of working with flow are addressed in space applications - for example, the flow of Mars's atmosphere at ground level. Furthermore, ways of validating simulations are demonstrated.
- Finite element method (FEM): Basic theories for linear and nonlinear finite element method. Practical exercises in modeling, simulation and analysis of engineering problems.
- Computer Aided Design (CAD).

Realization

Each course occasion's language and form is stated and appear on the course page on Luleå University of Technology's website.

The course is conducted through lectures and computational laboratory work.

Examination

If there is a decision on special educational support, in accordance with the Guideline Student's rights and obligations at Luleå University of Technology, an adapted or alternative form of examination can be provided. The course is examined through assignments in each of the four moments Numerical methods (NM), Computer Aided Design (CAD), Finite Element Method (FEM), and Computational Fluid Dynamics (CFD). The grade on the course (U, 3, 4,5) determines by weighing the grade on each of the parts.

Unauthorized aids during exams and assessments

If a student, by using unauthorized aids, tries to mislead during an exam or when a study performance is to be assessed, disciplinary measures may be taken. The term “unauthorized aids” refers to aids that the teacher has not previously specified as permissible aids and that may assist in solving the examination task. This means that all aids not specified as permissible are prohibited. The Swedish version has interpretative precedence in the event of a conflict.

Remarks

This course cannot be part of the degree together with the course F7002R Numerical methods.

Course offered by

Department of Computer Science, Electrical and Space Engineering

Modules

Code	Description	Grade scale	Cr	Status	From period	Title
0002	Assignment NM	G U 3 4 5	1.9	Mandatory	S21	
0003	Assignment CAD	G U 3 4 5	1.9	Mandatory	S21	
0004	Assignment FEM	G U 3 4 5	1.9	Mandatory	S21	
0005	Assignment CFD	G U 3 4 5	1.8	Mandatory	S21	

Study guidance

Study guidance for the course is to be found in our learning platform Canvas before the course starts. Students applying for single subject courses get more information in the Welcome letter. You will find the learning platform via My LTU.

Last revised

by Jonny Johansson, HUL SRT 2022-01-14

Syllabus established

by Jonny Johansson, HUL SRT 2019-02-15