**SYLLABUS**

# Advanced Fluid Mechanics 7.5 credits F7016T

## Strömningsmekanik

**Course syllabus admitted: Autumn 2023 Sp 1 - Present**

DECISION DATE
**2022-02-14**

Luleå University of Technology 971 87 Luleå, Sweden
Phone: +46 (0)920 49 10 00 • Corporate Identity: 202100-2841

LULEÅ TEKNISKA UNIVERSITET

# Advanced Fluid Mechanics 7.5 credits F7016T

## Strömningsmekanik

## Second cycle, F7016T

| Education level | Grade scale | Subject | Subject group (SCB) |
| --- | --- | --- | --- |
| Second cycle | G U 3 4 5 | Strömningslära | Engineering Physics |

### Main field of study

Mechanical Engineering

# Entry requirements

Basic courses in mathematics such as M0047M Differential Calculus, M0048M Linear Algebra and Integral Calculus, M0049M Linear Algebra and Differential Equations , or equivalent. Basic courses in physics such as F0004T Physics 1, F0006T Physics 3, or equivalent. Good knowledge in English, equivalent to English 6.

# Selection

The selection is based on 30-285 credits

# Course Aim

After completing the course, you should be able to

*Knowledge and understanding*

- Describe what happens in a flow process during laminar and turbulent flows

*Skills and Abilities*

- Use tensor notation to set up problems in fluid mechanics
- Make appropriate approximations for a given problem in fluid mechanics
- Apply appropriate mathematical methods to given problems in fluid mechanics
- Make estimates of interesting variables in a flow process.

*Valuation and approach*

- Verify and critizise results from commercial flow simulation programs.
- Determine when advanced simulations or experiments need to be performed.

The course will develop basic knowledge in fluid mechanics with the gouverning equations formulated in differential equation form. You will apply mathematical methods covered in the basic courses and experience some applied flow problems. This will enable you to familiarize with various problems within fluid mechanics, in the future, important for industry and society. You also get an insight into scientific issues in fluid mechanics and learn a couple of advanced tools that are used to study flow processes.

# Contents

**Tensors**
This includes notation, Kronecker delta, the Permutation symbol, various products and tensors.

**Model experiments**
Basic methodology for model experiments for flow processes is discussed.

**Kinematics**
Studies of flow fields without regard to how the flow is generated. It includes Lagrangian - Euler descriptions, streamlines, particle paths and streak lines as well as vorticity.

**Mass and momentum**
The basic equations in fluid mechanics are presented. Mass balance, Navier-Stokes equations and Bernoulli's equation.

**Laminar flows**
Solutions of Navier-Stokes equations for laminar flows in typical geometries are presented and discussed.

**Boundary layer**
Among other things, Euler's equation, laminar boundary layers, separation and jets are treated here.

**Turbulence**
This includes the concept of turbulence in fluid mechanics, how turbulence affects the basic equations, how turbulence alters the flow and turbulent boundary layers.

# Realization

Each course occasion´s language and form is stated and appear on the course page on Luleå University of Technology's website.
The main part of the course is of a theoretical nature where the teaching consists of teacher-led lectures and exercises. In order for the student to achieve the course objectives, the student is encouraged to participate in these activities, read the corresponding sections in the course literature and do the proposed exercises. At the lectures, each area is linked to current research and interesting issues in society and industry.

The course also includes compulsory laboratory work where students can train their ability to use two advanced tools in fluid mechanics: Programs for numerical flow calculations (CFD) and full-field measurements in the laboratory (PIV).

# 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 learning objectives under the heading *Knowledge and understanding* , as well as *Evaluation and attitudes* are examined through a written exam with the grading scale U G 3 4 5. The learning objective under the heading *Skills and abilities* is examined through reported laboratory work with the grading scale U G # and through the written exam.

# 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.

# Overlap

The course F7016T is equal to MTM162

# Course offered by

Department of Engineering Sciences and Mathematics

# Modules

| Code | Description | Grade scale | Cr | Status | From period | Title |
| --- | --- | --- | --- | --- | --- | --- |
| 0004 | Laboratory work | U G# | 0.5 | Mandatory | A21 | |
| 0005 | Written exam | G U 3 4 5 | 7 | Mandatory | A21 | |

# 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 Niklas Lehto, Programme Director 2022-02-14

# Syllabus established

The syllabus was established by the Department of Applied Physics and Mechanical Engineering 2007-02-28, and remains valid from autumn 2007.