Faculty of Science

FYTA14, Theoretical Physics: Fluid Dynamics, 7.5 credits

Teoretisk fysik: Fluiddynamik, 7,5 högskolepoäng

First Cycle / Grundnivå

Details of approval

The syllabus was approved by Study programmes board, Faculty of Science on 2012-09-10 (N 2012/446) and was last revised on 2024-05-13 by The Education Board of Faculty of Science. The revised syllabus comes into effect 2024-05-13 and is valid from the spring semester 2025.

General information

The course is an elective course in the first cycle for a degree of Bachelor of Science in physics. The course is compulsory for students on the Bachelor of Science programme with specialisation in Meteorology and Biogeophysics. The course can also be taken as a stand alone course.

Language of instruction: English

Main field of study	*Specialisation*
Physics	G2F, First cycle, has at least 60 credits in first-cycle course/s as entry requirements

Learning outcomes

The overall aim of the course is that the students should learn the basics of fluid dynamics.

Knowledge and understanding

On completion of the course, the students shall be able to:

- explain the origin of centrifugal and Coriolis forces
- describe the conditions for, and properties of, hydrostatic equilibrium
- explain the importance of the Reynolds number and when viscosity is important
- interpret the different terms in the Navier-Stokes equations
- at a general level explain basic properties of turbulence.

Competence and skills

On completion of the course, the student shall be able to:

- apply the tools of vector calculus and be able to apply fundamental integral relations
- calculate the equilibrium for hydrostatic atmospheres
- apply the laws of mechanics on continuous systems and work with velocity fields
- apply Coriolis forces on flows in rotating systems
- calculate geostrophic flow from the pressure field and judge under which assumptions this is a good approximation to the flow.

Course content

The course covers basic vector calculus and fluid dynamics with a focus on large-scale systems and flows in rotating systems. Examples and applications are mainly from oceanography, meteorology and astronomy.

In particular it includes

- vector calculus
- pressure and buoyancy, hydrostatic equilibrium
- continuum dynamics
- Bernoullis theorem, vorticity
- linear theory of hydrodynamic waves
- viscosity, Reynolds number, the Navier-Stokes equations
- centrifugal and Coriolis forces, geostrophic flow, Ekman layers
- turbulence

Course design

The teaching consists of lectures, exercise sessions and mandatory hand-in assignments.

Assessment

The examination consists of hand-in assignments during the course, and a written exam at the end of the course. Students who do not pass the regular exam will be offered another opportunity for a written exam soon thereafter.

The examiner, in consultation with Disability Support Services, may deviate from the regular form of examination in order to provide a permanently disabled student with a form of examination equivalent to that of a student without a disability.

Grades

Grading scale includes the grades: Fail, Pass, Pass with distinction
The grading scale for the compulsory assignments is Fail, Pass, whereas the written exam is graded according to the scale Fail, Pass, Pass with Distinction. Well executed assignments give extra points on the regular exam.

To pass the entire course, approved assignments and approved examination are required.

Entry requirements

Admission to the course requires general entry requirements and 37,5 credits of mathematics, including knowledge corresponding to:

- MATB21 Analysis in Several Variables 1, 7.5 credits

and either 37,5 credits of Physics, including knowledge corresponding to:

- FYSA22 Introduction to University Physics, with Mechanics, 7.5 credits
- FYSA23 Introduction to University Physics, with Electricity, 7.5 credits
- FYSA13 Introduction to University Physics, with Optics, Waves and Quantum Physics, 7.5 credits
- FYSA14 Introduction to University Physics, with Thermodynamics, Climate and Experimental Methodology, 7.5 credits and
- FYSB23 Basic Statistical Physics and Quantum Statistics, 7.5 credits

or an additional 37,5 credits of Mathematics, including knowledge corresponding to:

- MATB23 Analysis in Several Variables 2, 7.5 credits and
- MATB24 Linear Analysis, 7.5 credits.

Equivalent knowledge, gained in another way, also gives admission to the course.

Further information

The course is offered at the department of Physics, Lund University.