Fluid Mechanics

Programme course

6 credits

Fluidmekanik

TMMV18

Valid from: 2019 Spring semester

Determined by
Board of Studies for Mechanical Engineering and Design

Date determined
2018-08-31

Main field of study

Aeronautical Engineering, Energy and Environmental Engineering, Mechanical Engineering

Course level

Second cycle

Advancement level

A1X

Course offered for

- Master's Programme in Mechanical Engineering
- Design and Product Development, M Sc in Engineering
- Energy-Environment-Management M Sc in Engineering
- Industrial Engineering and Management - International, M Sc in Engineering
- Industrial Engineering and Management, M Sc in Engineering
- Mechanical Engineering, M Sc in Engineering
- Applied Physics and Electrical Engineering - International, M Sc in Engineering
- Applied Physics and Electrical Engineering, M Sc in Engineering

Specific information

The course provides abstract understanding about fluid dynamics and analysis and interpretation of fundamental fluid dynamics problems of elementary flow cases and some flows of engineering importance. An overview to fluid properties and flow characteristics such as incompressible/compressible fluids, inviscid and viscous fluids, steady/transient flow and laminar/turbulent flows is given. The physical ideas forming fluid dynamics including the continuum hypothesis, mass conservation, balance of momentum and conservation of energy are discussed. Fundamental understanding about analytic and numerical methods used for solving fluid dynamics problems are taught by reviewing classification of the governing equations and different numerical solution strategies for one dimensional, quasi-one-dimensional and two dimensional flows. The laminar boundary layer theory will be discussed in depth and an overview to the turbulent boundary layer theory is also given. A brief introduction to turbulent flow and derivation of the Reynolds-Averaged Navier-Stokes (RANS) equations will be given in the end of the course.

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

Thermodynamics

Intended learning outcomes

After completion of the course, the student must be able to:

- Describe fundamental laws that governs equations of fluid flow motions.
- Describe the physical and mathematical understanding of the fluid dynamics problems.
- Explain the physical and mathematical state of a given fluid dynamics problem through analysis of fluid properties and flow characteristics.
- Choose appropriate equations, boundary conditions and implement numerical schemes to solve fluid dynamics problems of elementary flow cases based on physical and mathematical state of the problem in hand.
- Explain the boundary layer theory (viscous laminar/turbulent and thermal) for varieties of fluid engineering problems.
- Apply physical and mathematical assumptions to formulate semiempirical relations for solving boundary layer related flow problems.
- Evaluate and assess solution to fluid dynamics problems from physical and mathematical perspectives, used numerical scheme, applied boundary conditions and assumptions/simplifications.

Course content

Historical perspective, fundamental equaions (continuity, Euler´s equations, Navier-Stokes´ equations, boundary layer equations, etc), laminar and turbulent flow, external and internal flows, compressible flow and non-stationary flow, introduction to numerical methods in fluid mechanics and an introduction to modelling of turbulence

Teaching and working methods

The course consist of given lectures, seminars and computer lab sessions. The lectures address the fundamental concepts and methods of the fluid dynamics. The seminars aim at digging deeper into the numerical aspects and indeed formulating the foundations for completing the assignments. The computer labs will provide further assistance for programming and solving the assignments to establish know-how and know-why knowledge.

Examination

UPG3	Tasks to be examined in written and oral (seminar) form	2 credits	U, 3, 4, 5
UPG2	Assignments, written presentation	4 credits	U, 3, 4, 5

Contribution to the final grade: UPG2 70 % and UPG3 30 %. Both UPG2 and UPG3 must be approved to pass the courses.

Grades

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

Other information

Supplementary courses: Computational Fluid Dynamics and Computational Fluid Dynamics – advanced course

Department

Institutionen för ekonomisk och industriell utveckling

Director of Studies or equivalent

Roland Gårdhagen

Examiner

Hossein Nadali Najafabadi

Course website and other links

http://www.iei.liu.se/mvs/utbildning/avancerade-kurser/

Education components

Preliminary scheduled hours: 98 h
Recommended self-study hours: 62 h

Course literature

Fastställs senare