SG1220 Fluid Mechanics for Engineers 6.0 credits

Teknisk strömningsmekanik

This is a translation of the Swedish, legally binding, course syllabus.

If the course is discontinued, students may request to be examined during the following two academic years

Establishment

Course syllabus for SG1220 valid from Autumn 2007

Grading scale

A, B, C, D, E, FX, F

Education cycle

First cycle

Main field of study

Technology

Specific prerequisites

Course participants are assumed to have successfully completed their first year of studies in Mechanical Engineering and the courses MJ1112 Applied thermodynamics and SG1140 Mekanik II from their second year studies or equivalent.

Language of instruction

The language of instruction is specified in the course offering information in the course catalogue.

Intended learning outcomes

After this course you shall be able to

- apply the conservation laws for mass and momentum in different fluid mechanical applications as e.g.

• analyse the flow in tube- and ductsystems

• analyse the interaction of forces between a solid body and a streaming or stationary fluid

- choose a suitable mathematical model and, with this, estimate the magnitude of fluid mechanical entities in specific generic problems.

To be more specific the students shall be able to:

- calculate the pressure in hydrostatic problems, especially in so called communicating vessels

- interprete and understand flow fields by using kinematic tools such as streamline, path line and stream tube

- apply the conservation law for momentum in integral form to calculate the reaction forces on

• tube and duct walls from a streaming fluid and,

• on submerged bodies

- determine if the viscosity of the fluid must be taken into account in a specific problem

- calculate the velocity and pressure distributions in inviscid and steady

• stream tube flow

• plane flow

- calculate the pressure loss and flow rate in viscous pipe and duct flows

- calculate the skin friction drag on plane walls

- explain the origin of the lift on an aerofoil

- calculate the drag acting on generic bodies in a flow field

- explain the origin of separation of flow close to the surface of bodies in a flow field and how this have an influence on the drag.

- calculate velocity- and pressuredistribution for isentropic stream tube flow

- calculate the change of state of a perfect gas passing through a normal shock wave.

After this course you shall have developed your ability to

- identify and formulate mathematical models describing the physical world

- apply mathematical methodology when analysing physical problems

- carry through a comparison analysis between results from a mathematical model and corresponding empirical data

- analyse english language information for further use in this field.

Course contents

Hydrostatics. Kinematics of flow fields. Streamlines and path lines. Dimensional analysis. Inviscid incompressible flow. The Bernoulli equation. Control volume formulation of the continuity and momentum equations. The stream function for plane flow. Irrotational flow and the velocity potential. Viscous flow: laminar and turbulent flow in ducts and boundary layers, separation. Isentropic stream tube flow. Normal shock waves.

Laboratory session:

Two compulsory laboratory session, carried through in groups of four students. Each laboratory session starts with a short test to check that all participants are satisfactory prepared. In addition some demonstrations of different flow phenomena are carried through in the fluid mechanics laboratory.

Project work:

One compulsory project work on flow phenomena in the flow field around a two-dimensional aerofoil, especially with regard to the determination of the lift. The laboratory sessions are an integrated part of this project work.

Course literature

Nakayama & Boucher; ”Introduction to Fluid Mechanics”, Butterworth-Heineman, 1999.

Examination

- PRO1 - Project, 2.2 credits, grading scale: P, F
- TENA - Examination, 3.8 credits, grading scale: A, B, C, D, E, FX, F

Based on recommendation from KTH’s coordinator for disabilities, the examiner will decide how to adapt an examination for students with documented disability.

The examiner may apply another examination format when re-examining individual students.

Other requirements for final grade

Project work including laboratory sessions (PRO1; 2,2 university credits).
Oral exam (TEN1; 3,8 university credits)

Ethical approach

- All members of a group are responsible for the group's work.
- In any assessment, every student shall honestly disclose any help received and sources used.
- In an oral assessment, every student shall be able to present and answer questions about the entire assignment and solution.