SD2155 Flow Acoustics 6.0 credits

Strömningsakustik

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

The course syllabus is valid from Spring 2022 according to the school principal's decision: S-2022-0529 Decision date: 2022-02-24

Grading scale

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

Education cycle

Second cycle

Main field of study

Mechanical Engineering

Specific prerequisites

Basic courses in mathematics, mechanics.

English B / English 6

Language of instruction

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

Intended learning outcomes

To present the fundamental theories for sound generation and propagation in fluids with non-stationary (turbulent) flow fields.

Students graduating from the course should:

- Be able to derive the classical wave equation and be familiar with the solutions under plane and spherical symmetry including Greens functions.
- Be able to explain and apply a multipole-expansion and know the character of the simplest point sources (monopole, dipole, quadrupole).
- Know about Lighthills acoustic analogy and its limitations and be able to explain the physical mechanisms that generate sound in a flow.
- Know how flow and motion affects sound propagation and generation and be able to explain phenomena such as the Doppler-shift and the Mach-cone.
- Be able to apply Lighthills analogy to fluid machines and vehicles and know how the different mechanisms scale with the flow speed.
- Be able to explain how fluid driven self-sustained oscillators (”whistles”) are created and how they can be eliminated.
- Be able to apply 2-port theory to analyse sound propagation in pipe and duct systems in particular with application to vehicle exhaust systems.
- Have obtained training in experimental techniques for analysis of sound in ducts.

Course contents

Mathematical tools. The fundamental equations of fluid mechanics. The classical wave equation and its solutions. The inhomogeneous wave equation. Lighthills theory for aero-dynamic sound. Curles equation. The convective wave equation. Sound propagation in ducts and pipes. Multi-port theory. Sound from moving sources. (”Ffowcs Williams&Hawkings equation”). Fluid driven self sustained oscillators – Whistles. Applications with focus on fluid machines and vehicles.

Laboratory exercise: Measurement of 2-port for a muffler.

Project assignment: Analysis of an exhaust muffler.

Examination

- LAB1 - Exercises, 1.0 credits, grading scale: P, F
- LAB2 - Project, 1.0 credits, grading scale: P, F
- TEN1 - Examination, 2.0 credits, grading scale: A, B, C, D, E, FX, F

- ÖVN1 - Assignments, 2.0 credits, grading scale: P, 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

Written examination (TEN1; 2 university credits), approved exercises (ÖVN1; 2 university credits) approved measurement exercises (LAB1; 1 cr) and project work (LAB2; 1 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.