SD2155 Flow Acoustics 6.0 credits

Strömningsakustik

Course syllabus for SD2155 valid from Autumn 07

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

Grading scale: A, B, C, D, E, FX, F
Education cycle: Second cycle
Main field of study: Mechanical Engineering

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 main content

Mathematical tools. The fundamental equations of fluid mechanics. The classical wave equation and its solutions. The inhomogeneous wave equation. Lighthills theory for aerodynamic 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.

Language of instruction

Language of instruction is specified in the course offering information in the course and programme directory.

Eligibility

Basic courses in mathematics, mechanics.

Literature

Kompendium: An introduction to Flow Acoustics, av Mats Åbom

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

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).