SK2540 Physics and Applications of Ultrasound 6.0 credits

Ultraljudsfysik och tillämpningar

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 SK2540 valid from Autumn 2007

Grading scale

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

Education cycle

Second cycle

Main field of study

Engineering Physics,Physics

Specific prerequisites

Recommended prerequisites: Knowledge in physics corresponding to SK1100 and in mathematics corresponding to SF1629.

Language of instruction

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

Intended learning outcomes

After the course is completed, the student should be able to:

- describe acoustic quantities and their relationships, namely: displacement, pressure, particle velocity, phase velocity, acoustic impedance, absorption, energy density and intensity
- perform calculations with the above quantities in order to design an ultrasonic transducer and optimize it for a given set of specifications
- describe the properties of different acoustic wave modes, including longitudinal waves, shear waves, Rayleigh waves and Lamb waves
- describe the basic physical principles behind, and give examples of applications of non-linear effects, for example: acoustic radiation pressure, acoustic streaming, cavitation and sonoluminescence
- explain the physical background of, and describe the system design for different industrial and biomedical application areas discussed in the course (see Main content)
- where applicable, compare and assess the ultrasonic applications with alternative available techniques.

Course contents

Lectures

Physical principles of acoustic wave propagation: Wave equation. Acoustic quantities: displacement, velocity, pressure, phase velocity, acoustic impedance, energy and intensity. Acoustic wave modes: bulk waves, Rayleigh waves and Lamb waves. Reflection, refraction and transmission. Absorption and attenuation. Diffraction, near field and far field. Non-linear effects. Acoustic streaming. Cavitation. Sonoluminescence. Piezoelectricity and piezoelectric materials. Biological effects of ultrasound.

Instrumentation: Transducers. Sensors. Acoustic properties of materials. Waveguides and resonators. Acoustic lenses and mirrors.

Applications of ultrasound: Diagnostics/imaging. Doppler. Material testing and industrial applications. High power applications. Sonar. Acoustic microscopy. Micro-cleaning and grinding. Drilling. MEMS. Laser ultrasound. Chemical applications. Agglomeration and particle manipulation.

Lab

The lab is performed in groups of two students, and is presented by a written report.

Project

A project is chosen within an elective but by the coordinator accepted subject. The project is presented as a written report and also as a 20-min oral presentation for the other students. The other students are supposed to provide opposition to the oral presentation.

Course literature

Course compendium supplied by the coordinator. Complement: L. E. Kinsler, A. R. Frey, A. B. Coppens and J. V. Frey, Fundamentals of Acoustics, John Wiley & Sons, Inc.

Examination

- FÖR1 - Assignment, 2.0 credits, grading scale: A, B, C, D, E, FX, F
- LAB1 - Laboratory Work, 1.0 credits, grading scale: P, F
- TEN1 - Examination, 3.0 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

Written exam (TEN1; 3 credits, grading A-F).
Project (FÖR1, 2 credits, grading A-F).
Passed lab course (LAB1, 1 credits, grading P/F).
In order to obtain passing grades for the project, >75% participation to the other students' presentations is requested, in addition to the written report and the oral presentation.

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.