SK2540 Physics and Applications of Ultrasound 6.0 credits

Ultraljudsfysik och tillämpningar

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

Establishment

Course syllabus for SK2540 valid from Spring 2013

Grading scale

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

Education cycle

Second cycle

Main field of study

Physics, Engineering Physics

Specific prerequisites

Knowledge in physics corresponding to SK1102 (Classical Physics)

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 and optimize the performance of an ultrasonic transducer for a given set of specifications
- Describe the basic physical principles of, and give examples of applications of non-linear effects, for example acoustic streaming and cavitation
- Explain the physical background of, and describe the system design for different biomedical application areas treated in the course (see Main content)
- Interpret diagnostic ultrasound images based on understanding of the interaction between ultrasound and tissue

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: compressional waves and shear waves. Reflection, refraction and transmission. Absorption and attenuation. Diffraction, near field and far field. Non-linear effects. Acoustic streaming. Cavitation. Piezoelectricity and piezoelectric materials. Biological effects of ultrasound.

Instrumentation: Transducer design. Electronic beam steering and focusing. Acoustic properties of materials. Resonators. Acoustic lenses. Gain and filtering in medical imaging.

Biomedical applications of ultrasound: Diagnostics/imaging. Doppler. High power applications/therapy. Basic anatomical and functional findings with ultrasound, including the use of ultrasound in radiological, cardiological, vascular and gynological departments.

Lab course

The labs are performed in groups of two or more students, and are presented by a written report.

Course literature

J. D. N. Cheeke: "Fundamentals and Applications of Ultrasonic Waves", CRC Series in Pure and Applied Physics.

P. R. Hoskins, K. Martin and A. Thrush: "Diagnostic Ultrasound, Physics and Equipment", 2nd Edition, Cambridge Medicine.

Complement: L. E. Kinsler, A. R. Frey, A. B. Coppens and J. V. Frey, Fundamentals of Acoustics, John Wiley & Sons, Inc.

Examination

- TENA - Written Examination, 4.5 credits, grading scale: A, B, C, D, E, FX, F
- LABA - Laboratory Experiments, 1.5 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.

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

Other requirements for final grade

The examination is performed by a written exam (TEN1; 4,5 hp, grading A/B/C/D/E/Fx/F), and passed lab course (LAB1, 1,5 hp, grading P/F).

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.