SK2501 Physics of Biomedical Microscopy, Extended Course 7.5 credits

Bildfysik med inriktning mot biomedicinsk mikroskopi, utökad kurs

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 autumn 2022 according to the school principal's decision: S-2023-0145 Decision date: 2023-03-14

Grading scale

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

Education cycle

Second cycle

Main field of study

Biotechnology,Engineering Physics,Physics

Specific prerequisites

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

After completing the course the student should be able to:

- adjust the microscope and the illumination system to obtain optimal performance in transmission and fluorescence microscopy.
- select suitable contrast methods and microscope objectives for standard microscopic samples.
- perform and report quantitative microscopic measurements, including image computer processing and 3D visualization.
- extract and comprehensively present relevant information from a scientific publication.
- assess how different image quality measures are affected by physical limits connected to choices of microscopes and imaging parameters, and use this knowledge to choose suitable settings in new imaging experiments.

Course contents

- The basic layout of the light microscope as consisting of a microscope objective and an eye-piece, and their properties such as aberrations, magnification, numerical aperture, and field of view.
- Different methods for obaining contrast in a microscope, such as absorption, fluorescence, and phase-contrast methods.
- Different image-quality measures such as resolution, contrast, signal-to-noise ratio (SNR), modulation transfer function (MTF), sampling density, field of view, and depth of field.
- Layout of the illumination systems, particularly Köhler illumination for transmission and epi-fluorescence microscopy, and how the illumination system can be used to optimize image quality.
- How properties of the microscope and illumination system affect image quality such as resolution and contrast, mainly via Fourier methods including point-spread functions (PSF) and optical transfer functions (OTF, MTF).
- How the choice of detector affects image quality measures such as signal-to-noise (SNR) and sampling. How to sample to avoid loss of information and artefacts. Some microscope photometry.
- The basic layout for confocal microscopy and hence three-dimensional imaging, including resolution and sampling in different dimensions.
- The basics of nanoscopy and imaging beyond the classical resolution limit.

Examination

- LAB1 - Laboratory Experiments, 2.0 credits, grading scale: P, F

- SEM1 - Seminar, 1.5 credits, grading scale: P, F
- TEN1 - Examination, 4.0 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

The course is examined through a combination of oral and written examination (TEN1; 4 credits, grading scale A/B/C/D/E/Fx/F), as well as approved labs (LAB1; 2 credits, grading scale P/F), and a seminar presentation (SEM1; 1.5 credits, grading scale P/F). The grade for TEN1 determines the grade for the course.

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.