FSK3501 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

Course syllabus for FSK3501 valid from Spring 2019

Grading scale

P, F

Education cycle

Third cycle

Specific prerequisites

Admitted to PhD studies in Physics or related fields of study.

Basic knowledge of waves, geometrical optics and photometry (course SK1100 or similar). Elementary knowledge of the Fourier transform.

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 illumination system to obtain optimal performance in transmission microscopy.
- select a suitable light source and optical filters, and correctly adjust the illumination system for fluorescence microscopy.
- select a suitable objective (correction, immersion etc) for various types of microscopic investigations.
- select a suitable contrast method (phase contrast, DIC, fluorescence, darkfield etc) and correctly use this technique to obtain high-quality images.
- calculate the expected image quality regarding resolution and signal-to-noise ratio for different practical imaging situations.
- understand and be able to describe the physical limitations for microscope performance concerning resolution and signal-to-noise ratio.
- describe performance for different types of microscopes by using (and in some simple cases calculating) optical transfer functions.
- select a suitable sampling density for digital image recording in microscopy.
- do computer processing of microscopic images to visualise three-dimensional structures.
- perform quantitative measurements in microscopic images using a computer.
- extract relevant information from a scientific publication and present this in the form of a seminar.

Course contents

Basic optical layout of the light microscope. Aberrations. Microscope objectives. Magnification. Numerical aperture. Microscope photometry. Detectors. Noise. Contrast methods (fluorescence, phase contrast, DIC). Resolution. Fourier methods. Optical transfer functions. Three-dimensional imaging in microscopy. Sampling and reconstruction of image data. Confocal microscopy. A brief introduction to tunnel and atomic force microscopy, electron microscopy, scanning near-field optical microscopy and X-ray microscopy.

Course literature

Carlsson, K. Imaging physics, KTH.
Carlsson, K. Light microscopy, KTH.
Lab. instructions.
Scientific publications.

Examination

- LAB1 - Laboratory work, 2.0 credits, grading scale: P, F
- SEM1 - Seminar, 1.5 credits, grading scale: P, F
- TEN1 - Exam, 4.0 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.

Written examination (TEN1; 4 hp, grading scale P/F), completed laboratory course (LAB1; 2 hp, grading scale P/F) and seminar presentation (SEM1; 1.5 hp, grading scale 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.