Summary

Introduction to the different contrast methods in optical microscopy. Basic hands-on experience with optical microscopes. How to investigate biological samples? How to obtain high quality images?

Content

Dark field and phase contrast microscopy, molecular spectroscopy, optical coherence tomography, aberrations and image quality, deconvolution, advanced microscopy (multiphoton, super-resolution). Hands-on experience with wide field and confocal microscopes.

Keywords

Optical microscopy and tomography, fluorescence spectroscopy, aberrations.

Learning Prerequisites

Required courses
Advanced optics (MT) or Biomicroscopy I (SV).

Recommended courses
Analysis IV, Linear algebra, General physics III/IV.

Important concepts to start the course
Basic matrix calculations, Fourier transformation, electromagnetic waves, wide field and confocal microscopy.

Learning Outcomes

By the end of the course, the student must be able to:

• Choose an appropriate imaging method for investigating the biological sample of interest.
• Estimate the performance and limitations of optical microscopes.
• Sketch the essential elements of optical microscopes.
• Operate wide field and confocal microscopes.

Transversal skills
• Use a work methodology appropriate to the task.
• Continue to work through difficulties or initial failure to find optimal solutions.
• Communicate effectively with professionals from other disciplines.

Teaching methods
Lecturing with exercises (50%) and practice in the microscopy facility (50%).

Expected student activities
Following the lecturing and solving the exercises regularly is necessary for mastering the course contents. The solutions of the exercises are distributed at the next lecture. The student is invited to find his/her own solutions and to discuss them with the assistants. An active participation in the laboratory leads to the mastering of different microscopes.

Assessment methods
• Continuous evaluation with exams on theory and practice.
• Support: manuscript of 2 sheets A4 (recto-verso). No calculators.

Supervision
| Office hours | No |
| Assitants    | Yes|
| Forum        | Yes|
| Others       | Possible to take dates.|

Resources
Bibliography
• Geometrical and matrix optics: José-Philippe Pérez, Optique: fondements et applications (2004).
• Eugene Hecht, Optics (2002).
• Miles V. Klein and Thomas E. Furtak, Optics (1986).
• Confocal microscopy: Min Gu, Principles of three-dimensional imaging in confocal microscopes (1996).

Ressources en bibliothèque
• Handbook of Biological Confocal Microscopy / Pawley
• Optique : fondements et applications / Pérez
• Optics / Hecht
• Optics / Klein
• Principles of optics: electromagnetic theory of propagation, interference and diffraction of light / Born
• Principles of three-dimensional imaging in confocal microscopes / Gu
• Microscopy, Immunohistochemistry / Hayat
• Bancroft's theory and practice of histological techniques / Bancroft
Notes/Handbook
The course slides are published on Moodle.

Websites
• http://www.olympusmicro.com/
• http://zeiss-campus.magnet.fsu.edu/tutorials/index.html

Moodle Link
• http://moodle.epfl.ch/enrol/index.php?id=411

Prerequisite for
Research project (master, thesis).