MICRO-561

Fundamentals of biomicroscopy

Altug Hatice

Cursus	Sem.	Type
Biomedical technologies minor	H	Opt.
Computational and Quantitative Biology		Opt.
Life Sciences Engineering	MA1, MA3	Opt.
Microtechnics	MA1, MA3	Opt.
Minor in Imaging	H	Opt.
Minor in life sciences engineering	H	Opt.
Neuro-X minor	H	Opt.
Neuro-X	MA1, MA3	Opt.
Photonics minor	H	Opt.

Language of teaching	English
Credits	4
Session	Winter
Semester	Fall
Exam	Written
Workload	120h
Weeks	14
Hours	**4 weekly**
Courses	2 weekly
Exercises	2 weekly
Number of positions	

Summary

Introduction to the basic operational principles of the most commonly used optical microscopes such as widefield and fluorescence. Introduction to essential microscopy components such as lenses, objectives, filters, cameras and light sources.

Content

If you want to understand the principles behind operation of the optical microscope then this course is for you!
The course introduces the operation principle of the most commonly used optical microscopy technique: brightfield and fluorescence. The fundamentals of image formation is described using ray optics, matrix optics, wave optics and Fourier optics. The essential aspects behind image formation including 1) magnification, 2) resolution limit in light microscopy, 3) aberrations and 4) contrast issues are covered. The course introduces essential microscopy components such as lenses, objectives, filters, cameras and light sources. In addition, the course introduces the basics of fluorescence microscopy using description of fluorescence emission, various dye options, labelling techniques, use of filter sets along with practical applications of microscopy in bioimaging.

Keywords

Optical microscopy, wide field microscopy. fluorescence microscopy, diffraction limit, optical components, lenses, filters, detectors

Learning Prerequisites

Recommended courses

General physics III/IV, modern optics (PHY), Linear algebra,

Important concepts to start the course

Basic matrix calculations, electromagnetic waves, refraction and reflection, familiarity with Fourier transformation.

Learning Outcomes

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

- Sketch basic optical systems
- Sketch wide field and fluorescence microscopes.
- Estimate the resolution of imaging systems.
- Propose a suitable microscopy configuration for imaging a sample.

- Characterize the basic elements of a microscope

Transversal skills

- Use a work methodology appropriate to the task.
- Communicate effectively with professionals from other disciplines.

Teaching methods

Lecturing with exercises.

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.

Assessment methods

Written exam during the winter exam session

Supervision

Office hours	No
Assistant.e.s	Yes
Forum	Yes

Resources

Virtual desktop infrastructure (VDI)

No

Bibliography

Fundamentals of Light Microscopy and Electronic Imaging, 2nd Edition, by Murphy and Davidson. Wiley-Blackwell (2013).
Fundamentals of Photonics, 2nd Edition, by Saleh and Teich. Wiley (2007).

Ressources en bibliothèque

- Find the references at the Library

Notes/Handbook

The course slides are uploaded on Moodle.
Script covering various parts (e.g. geometrical optics, matrix optics, Fourier optics, microscopy and fluorescence) and notes from literature are uploaded on Moodle.

Moodle Link

- https://go.epfl.ch/MICRO-561

Prerequisite for

Research projects (master, thesis).
Recommended for Experimental Biomicroscopy.