

MICRO-561

Biomicroscopy I

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.
Photonics		Opt.

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

Summary

Introduction to geometrical and wave optics for understanding the principles of optical microscopes, their advantages and limitations. Describing the basic microscopy components and the commonly used biomicroscopy methods such as widefield and fluorescence.

Content

Geometrical and matrix (ABCD) optics, wave and Fourier optics, point-spread function (PSF), resolution and contrast, microscope elements (objectives, eyepiece, filters, illuminations, detectors), fluorescence microscopy, and preparation of biological samples for microscopy.

Keywords

Optical microscopy, fluorescence, wide field microscopy.

Learning Prerequisites**Required courses**

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

Important concepts to start the course

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

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
- 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

- 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
Assistants	Yes
Forum	Yes
Others	Possible to take dates.

Resources

Bibliography

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

ζ Fundamentals of Photonics, 2nd Edition, by Saleh and Teich. Wiley (2007).

ζ Geometrical and matrix optics: José-Philippe Pérez, Optique: fondements et applications (2004).

ζ Eugene Hecht, Optics (2002).

ζ Miles V. Klein and Thomas E. Furtak, Optics (1986).

- Optique : fondements et applications / Pérez
- Optics / Hecht
- Fundamentals of Photonics / Saleh
- Principles of optics: electromagnetic theory of propagation, interference and diffraction of light / Born
- Fundamentals of Light Microscopy and Electronic Imaging / Murphy
- Optics / Klein

Ressources en bibliothèque

- [Optique : fondements et applications / Pérez](#)
- [Optics / Hecht](#)
- [Optics / Klein](#)
- [Principles of optics: electromagnetic theory of propagation, interference and diffraction of light / Born](#)
- [Fundamentals of Light Microscopy and Electronic Imaging / Murphy](#)
- [Fundamentals of Photonics / Saleh](#)

Notes/Handbook

Script covering geometrical and matrix optics, Fourier optics, microscopy and fluorescence. Script chapters

and course slides are published on Moodle.

Websites

- <http://www.olympusmicro.com/>
- <http://zeiss-campus.magnet.fsu.edu/tutorials/index.html>
- <http://moodle.epfl.ch/enrol/index.php?id=1341>

Moodle Link

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

Prerequisite for

Biomicroscopy II