

MICRO-561

Biomicroscopy I

Altug Hatice

Cursus	Sem.	Type
Bioengineering	MA1, MA3	Opt.
Biomedical technologies minor	H	Opt.
Computational Neurosciences minor	H	Opt.
Electrical and Electronical Engineering	MA1, MA3	Opt.
Microtechnics	MA1, MA3	Opt.
Photonics		Obl.
Sciences du vivant	MA1, MA3	Opt.

Language of teaching	English
Credits	3
Session	Winter
Semester	Fall
Exam	During the semester
Workload	90h
Weeks	14
Hours	3 weekly
Courses	3 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

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

- Continuous evaluation with two intermediate exams: the mean grade will constitute the final grade.
- Allowed support: Notes are allowed on 2 pieces of A4 sheets (recto-verso). Handwritings and prints are both accepted.
- No permission to use calculators.

Supervision

Office hours	No
Assistants	Yes
Forum	Yes
Others	Possible to take dates.

Resources

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).
- 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).
- Wave optics: Max Born and Emil Wolf, Principles of optics: electromagnetic theory of propagation, interference and diffraction of light (1980).

Ressources en bibliothèque

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

- <http://moodle.epfl.ch/enrol/index.php?id=1341>

Prerequisite for

Biomicroscopy II

