MICRO-561 **Biomicroscopy I**

Altug Hatice, Seitz Arne

Cursus	Sem.	Type
Bioengineering	MA2, MA4	Opt.
Biomedical technologies minor	E	Opt.
Computational Neurosciences minor	E	Opt.
Electrical and Electronical Engineering	MA2, MA4	Opt.
Microtechnics	MA2	Opt.
Photonics		Obl.
Sciences du vivant	MA2, MA4	Opt.

Language of teaching	English
Credits	3
Session	Winter, Summer
Semester	Spring
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 functioning of optical microscopes and their advantages and limitations. How to choose the type of microscope and the imaging method that are best suited for investigating the biological sample of interest?

Content

Geometrical and matrix (ABCD) optics, wave and Fourier optics, point-spread function (PSF), resolution and contrast, microscope elements (objectivs, eyepiece, filters, illuminations, detectors), confocal microscopy, fluorescence.

Keywords

Optical microscopy, fluorescence, wide field microscopy, confocal 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 confocal microscopes.
- Estimate the resolution of imaging systems.
- Propose a suitable microscopy configuration for imaging a sample.
- Characterize the 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.
- Support: manuscript of 2 sheets A4 (recto-verso). No 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)
- 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).
- Confocal microscopy: Min Gu, Principles of three-dimensional imaging in confocal microscopes (1996).

Ressources en bibliothèque

- Optics / Hecht
- Optics / Hecht
- 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

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

Moodle Link

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

Prerequisite for

Biomicroscopy II