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.
Life Sciences Engineering	MA1	Opt.
Microtechnics	MA1, MA3	Opt.
Photonics minor	H	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 biomicrocopy 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 (objectivs, 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 confocal microscopes.
- Estimate the resolution of imaging systems.
- Propose a suitable microscopy configuration for imaging a sample.
- Characterize the elements of a microscope.
- Sketch wide field and fluorescence microscopes.
- 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 sheets of A4 papers (recto-verso on both). Handwritings and prints are both accepted.

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

• 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

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