MICRO-562 **Biomicroscopy II**

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Cursus	Sem.	Type
Biomedical technologies minor	E	Opt.
Computational Neurosciences minor	E	Opt.
Electrical and Electronical Engineering	MA2, MA4	Opt.
Life Sciences Engineering	MA2, MA4	Opt.
Microtechnics	MA2, MA4	Opt.
Minor in Imaging	E	Opt.
Neuro-X minor	E	Opt.
Neuro-X	MA2, MA4	Opt.
Photonics minor	E	Opt.
Photonics		Opt.

Language of teaching	English
Credits	4
Session	Summer
Semester	Spring
Exam	During the semester
Workload	120h
Weeks	14
Hours	**4 weekly**
Lecture	1 weekly
Exercises	1 weekly
Project	2 weekly
Number of positions	

Summary

Introduction to the different contrast enhancing methods in optical microscopy. Basic hands-on experience with optical microscopes at EPFL's BioImaging and Optics Facility. How to investigate biological samples? How to obtain high quality images?

Content

The course combines theory with hands-on experience to teach the basic principles of commonly used optical microscopy techniques including bright-field, dark-field, phase-contrast, DIC, polarization, fluorescence as well as introduce advanced techniques such as confocal, multi-photon, and super-resolution microscopy. The course also provides hands-on experience with wide field and confocal microscopes.

Keywords

Optical microscopy and tomography, fluorescence spectroscopy, aberrations.

Learning Prerequisites

Required courses

Advanced optics (MT) or Biomicroscopy I (SV).

Recommended courses

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

Important concepts to start the course

Basic matrix calculations, Fourier transformation, electromagnetic waves, wide field and confocal microscopy.

Learning Outcomes

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

- Choose an appropriate imaging method for investigating the biological sample of interest.
- Estimate the performance and limitations of optical microscopes.
- Sketch the essential elements of optical microscopes.
- Operate wide field and confocal microscopes.

- Assess / Evaluate the operation principles of commonly used microscopy methods

Transversal skills

- Use a work methodology appropriate to the task.
- Communicate effectively with professionals from other disciplines.
- Continue to work through difficulties or initial failure to find optimal solutions.

Teaching methods

Lecturing with exercises (50%) and practice in the microscopy facility (50%).

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. An active participation in the laboratory leads to the mastering of different microscopes.

Assessment methods

20% Homework, individual

- In the second half of the semester: 3 homeworks on computer (2 weeks)

80% End-term exam, individual

- written exam with handwritten notes during the exam period

Supervision

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

Resources

Bibliography

- 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).

- Hayat, M.A. Microscopy, Immunohistochemistry, and Antigen Retrieval Methods for Light and Electron Microscopy. Kluwer Academic / Plenum Publishers (2002).
- Theory and Practice of histological techniques, ed. John D Bancroft, Marilyn Gamble, Churchill Livingstone).
- Handbook of Biological Confocal Microscopy, Pawley, James (Ed.), 3rd ed., 2006, XXVIII, 988 p., 545 illus., 236 in colour, Hardcover.

Notes/Handbook

The course slides are published on Moodle.

Websites

- https://micro.magnet.fsu.edu/primer/
- https://microscopyfocus.com/
- https://focalplane.biologists.com/network/

Moodle Link

- https://go.epfl.ch/MICRO-562