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 (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**
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<tr>
<th>Office hours</th>
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<tr>
<td>Assistants</td>
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<td>Others</td>
<td>Possible to take dates.</td>
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**Resources**

**Bibliography**
- Eugene Hecht, Optics (2002).

**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

**Moodle Link**
Prerequisite for
Biomicroscopy II