**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
- Eugene Hecht, Optics (2002).

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

Prerequisite for