



## Chapter II. Image Analysis

- Image Properties and Image Processing
- Raster versus Vector Images
- Pixel, Neighbourhood, Morphological Operations. Kernel
- Frequency Domain and Image Reconstruction
- Image Analysis
- Feature Extraction and Elements of Machine Learning Algorithms

## Chapter III. Interaction and integration

- Medical Imaging and Photo-manipulation (optical tweezers)
- Correlative, Multimodal (for example, Light and Electron) Microscopy
- High-throughput and lab-on-chip technologies

### Initial competences

Basics of cell biology, optics and informatics

### Final competences

- 1 Understand the basic principles of modern imaging technologies, their components and methods, their advantages and disadvantages.
- 2 Apply imaging methods including selecting appropriate imaging techniques and sample preparation methods for a biological problem.
- 3 Apply basic image processing in ImageJ, analysis tools, and workflows for image analyses.
- 4 Know bio-chemical and biomolecular principles of fluorescence of molecules.
- 5 Be familiar with modern and recent developments in the area of instrumentation used for biological image formation.
- 6 Know and apply optical ray tracing and propagation in a lens system and a microscope.
- 7 Know the resolution limits of optical, label-free and electron microscopy in regard with applicaiton to cells and biological objects.
- 8 Understand the atomic structure, molecular mechanisms and the principles of vibrations of atoms in bio-molecules and thier effect on the scattering of light and electrons.
- 9 Be able to choose appropriate operation conditions and perform alignment of a microscope.
- 10 Know complementarity and applicability of label-free methods versus fluorescence microscopy in biological image formation.

### Conditions for credit contract

Access to this course unit via a credit contract is determined after successful competences assessment

### Conditions for exam contract

This course unit cannot be taken via an exam contract

### Teaching methods

Lecture, Practical, Independent work

### Extra information on the teaching methods

The course consists of theoretical lectures, which are accompanied by practical sessions/demonstrations (including PC). Hand-out and references contain comprehensive information about all subjects.

A number of practicum sessions are planned. In one of them students build their own microscope based on their calculations. Other practicums involve either direct hands-on work or demos with commercially available instruments.

There are also presentations by groups of students on a chosen subject, which is covered in the course. Some other groups are expected to ask a question or questions related to the subject of the presentation.

### Study material

None

### References

Most references are in the handout material

### Course content-related study coaching

### Assessment moments

end-of-term and continuous assessment

### Examination methods in case of periodic assessment during the first examination period

Written assessment

**Examination methods in case of periodic assessment during the second examination period**

Written assessment

**Examination methods in case of permanent assessment**

Participation, Assignment

**Possibilities of retake in case of permanent assessment**

examination during the second examination period is possible

**Calculation of the examination mark**

end-of-term evaluation (95 %) continuous assessment (5 %)