

MICRO+: Theoretical and Practical Course on Optical and Probe Microscopy

Total Duration: 10 hours

Course Description

The MICRO+ course offers a theoretical and practical training program focused on the main microscopy techniques employed in biomedical research and life sciences, with particular emphasis on conventional optical microscopy and nano-resolution imaging techniques.

The aim of the course is to provide participants with the theoretical background necessary to understand the physical principles governing the interaction between light and biological matter, the functioning of fluorescent molecules, and the main staining agents used in the preparation of biological samples. The course will also address the limitations of traditional optical microscopy and the potential of advanced imaging techniques for the morphological and functional analysis of cells, tissues, and biomaterials.

The program combines theoretical lectures with hands-on activities, offering an overview of the principal fluorescence-based and label-free optical microscopy techniques, together with an introduction to electron and probe microscopy methods. Particular attention will be devoted to the biomedical applications of advanced imaging technologies.

The course also includes practical workshops on confocal laser scanning microscopy (CLSM) and atomic force microscopy (AFM), held at the Department of Sciences of Roma Tre University, with the aim of providing basic operational skills for the acquisition, processing, and analysis of high-resolution microscopic images.

Detailed Course Program

- Interaction between light and biological matter
- Excited states and spectral properties of the main fluorophores used in biological labeling
- Techniques for preparation and staining of biological samples
- Optical resolution and Abbe's diffraction limit
- Conventional fluorescence microscopy techniques:
 - widefield microscopy
 - confocal laser scanning microscopy (CLSM)
 - total internal reflection fluorescence microscopy (TIRF)
- Label-free microscopy techniques:
 - phase-contrast microscopy
 - differential interference contrast microscopy (DIC)
- Introduction to electron and probe microscopy techniques
- Biomedical applications of advanced imaging techniques