# Program

## BASIC LEVEL

**1 . Principles of Optical Microscopy - Cesare Covino** *(University San Raffaele, Milano)*
An optical microscope is a type of microscope which uses visible light as an illumination source and a system of lenses to magnify and reveal microscopic features. From its, this instrument has opened a new world and a new way for scientists to explore the mysteries of living matter. Understanding how the microscope works and the concepts of resolution and contrast, is crucial for getting the best performances from our instruments for the correct interpretation of results.

**2 . Resolution and Sampling - Dario Parazzoli** *(IFOM, Milano)*
An image is worth a thousand words. This is true but we need to acquire it in a proper way in order to be faithful to reality. Sampling is key for a correct interpretation of the event we are interested in.

**3. Contrast Techniques in Transmitted Light Microscopy - Spartaco Santi** *(CNR, Bologna)*
Contrast in an image is essential to distinguish features in achieving high-quality images. The different contrast techniques in brightfield microscopy will be described: phase contrast, differential interference contrast (DIC), darkfield illumination and Kölher illumination.

**4. Fluorescence Microscopy and Photochemistry - Chiara Peres** *(CNR, Bologna)*
Fluorescence microscopy is an optical imaging technique that revolutionized observation of organic and inorganic substances. We discuss the principles of fluorescence and photochemistry, main properties of fluorochromes, fundamental components and operating principles of a fluorescence microscope.

**5. Confocal and Spinning Disk Microscopy - Chiara Cordiglieri** *(INGM, Milano)*
Confocal microscopy is the fundamental technique which enables multiple fluorescence imaging of complex biological samples via optical sectioning. Different methodologies have been developed over the years, including confocal laser scanning and spinning-disk confocal microscopy, to accomplish multi-labelling multi-dimensional imaging, going far beyond the visible in biology morphology, structure and functions.

**6. History of Microscopy - Alessandro Gambardella** *(Rizzoli, Bologna)*
The History of Microscopy, from antiquity to the present day, is an exciting journey through surprising intuitions and discoveries, bringing us face to face with the personalities who shaped the development of this discipline.

**7. Live Imaging - Cesare Covino** *(San Raffaele, Milano)*
Time-Lapse Microscopy of living cells is a powerful way to monitor cellular processes that occur over an extended time period. There are two main aspects of live imaging that make it essential for modern research. An ever-increasing number of investigations uses live-cell imaging techniques to obtain dynamic information about cellular and tissue functions. Because of these advantages, live-cell imaging has become a fundamental analytical tool in most biomedical research disciplines.

**8. Stereomicroscopy - Andrea Giacomini** *(EVIDENT Europe GmbH)*
In this module I am going to introduce stereomicroscopy, from its invention to its current applications. What's a stereomicroscope? How does it work? Why has it been invented? How many types of stereomicroscopes exist? When should I use a stereomicroscope? What are the different components of a stereomicroscope?

**9. Digital Imaging and Sensor Technologies - Spartaco Santi** *(CNR, Bologna)*
The role of the microscopy cameras in imaging experiments. Parameters: sensitivity, field of view, imaging speed, resolution, dynamic range. The main sources of noise: photon (Poisson) noise, readout noise and thermal (dark) noise. Main camera technologies: interline CCD, EMCCD and sCMOS.

**10. Image Processing and Deconvolution - Emanuele Martini** *(IFOM, Milano)*
This module will introduce the main concepts and topics of bioimage processing for visualization, analysis, image enhancement, and deconvolution for recovery from degradation processes.

# Program

## ADVANCED LEVEL

11. **Structured Illumination Microscopy (SIM) - Mario Faretta** *(IEO, Milano)*
12. **Total Internal Reflection Fluorescence Microscopy - Dario Parazzoli** *(IFOM, Milano)*
13. **2D and 3D Stochastic Optical Reconstruction Microscopy-Mario Faretta** *(IEO, Milano)*
14. **Two-Photon Excitation (2PE) Microscopy - Francesca Cella** *(University of Pisa)*
15. **Light-Sheet Microscopy - Zeno Lavagnino** *(IFOM, Milano)*
16. **Electron and Scanning Probe Microscopy - Alessandro Gambardella** *(Rizzoli, Bologna)*
17. **Stimulated Emission Depletion (STED) Microscopy - Marco Castello** *(IIT, Genova)*
18. **Image Scanning Microscopy (ISM) - Giuseppe Vicidomini** *(IIT, Genova)*
19. **Second Harmonic Generation Microscopy - Chiara Peres** *(CNR, Bologna)*
20. **Expansion Microscopy - Alberto Diaspro** *(IIT, Genova)*
21. **FRAP, FCS and Single Molecule Tracking - Davide Mazza** *(San Raffaele, Milano)*
22. **Label-Free Microscopy - Alberto Diaspro** *(IIT, Genova)*