Title: Fundamental and Practical Aspects of Microscopy [3-0-0-6]

Pre-requisites, if any :
(i) Biochemistry and Bioenergetics, (ii) Molecular Biology, (iii) Genetic Engineering and (iv) Analytical Biochemistry

Content *(List of the topics/sub-topics to be covered in the lectures/practicals/assignments)***:**
1. Optics for Microscopy a. Wave Nature of Light, Birefringence, Interference, Diffraction b. Optical elements: Lenses, Filters, Polarizers c. Lens Properties: Numerical Aperture, Magnification, Aberrations, Corrections d. Resolution: Rayleigh Criterion, Airy Disc, Abbe's Principle

2. Light-Matter Interaction a. Lasers b. Fluorescence

3. Microscope Design, Function and Usage a. Image Formation in a Microscope : Kohler Illumination, Critical illumination b. Brightfield, Darkfield Microscopy c. Phase Contrast Microscopy d. Differential Interference Contrast Microscopy e. Polarization Microscopy f. Epifluorescence (Widefield) Microscopy g. Total Internal Reflection Fluorescence (TIRF) microscopy h. Confocal Microscopy i. Super Resolution Microscopy

4. Image Detection a. Camera : Image capture by CCD devices b. PMTs c. GaAsp and Hybrid Silicon detectors

5. Image Analysis a. Intensity quantification b. Micrometry c. Video Tracking Algorithms

6. Manipulating Molecules in the Microscope a. Single Molecule Techniques - Introduction b. Atomic Force Microscopes c. Optical tweezers

Texts / References*:*

- Nikon Microscopy Resource Center https://www.microscopyu.com/
- Olympus Microscopy Resource Center https://www.olympus-lifescience.com/en/microscope-resource/
- Optics by M.P. Vaughan http://www.physics.ucc.ie/mvaughan/lecturing/PY3101/Optics.pdf
- Microscopy and Microscope optical systems, Lanni and Keller http://pre.mntp.pitt.edu/MNTP_Prtcp_res_2010/teaching/Optics_Chapter_95_Lanni Keller.pdf
- Fundamentals of Light Microscopy and Electronic Imaging, Douglas B. Murphy. Publisher:- WILEY-LISS
- Fundamentals of Optics Francis A. Jenkins and Harvey E. White. Publisher :- Mc Graw-Hill