

Subject Area: Advanced Methods in Biotechnology and Biodiversity

Subject: Analytical scanning electron microscopy in biological and environmental researches

Level: PhD

Year: I – IV

Semester: 1-2

Speciality: N/A

Status: Facultative

ECTS: 3

Department(s): Laboratory of Microscopic Techniques
Scanning Electron Microscopy Lab (SEM-Lab)

Cooperating Department

Form of teaching (Number of hours; Form of assessment: Exam or Credit)

<i>Lectures</i>	<i>Seminars/Conversatoria -</i>	<i>Practicals</i>	<i>Total</i>
4		26	30

Staff:

SUBJECT COORDINATOR: dr Jagna Karcz, Ph.D.

LECTURE/CONVERSATORIA: dr Jagna Karcz, Ph.D.

PRACTICALS: dr Jagna Karcz, Ph.D.

Contents:

LECTURES:

Basics of electron microscopy and X-ray microanalysis based on the modern high-resolution FESEM Hitachi SU 8010 scanning electron microscope: SEM electron signals, parameters and image analysis. Examples of application of analytical electron microscopy in:

- biology (i.e. phenotypic features of plants and animals and their usefulness in the taxonomy and phylogeny)
- biotechnology (i.e. plant morphogenesis in in vivo and in vitro culture conditions)
- environmental protection (i.e. plant surface structures as biomarkers of environmental status, microorganisms in detection of toxic substances in the environment)
- material sciences (i.e. biodegradation of plastics)
- X-ray microanalysis of heavy metals in biological structures

New trends in scanning and transmission electron microscopy. Advanced microscopic techniques in material imaging (CLSM, micro-CT).

PRACTICALS:

The practicals include the following techniques:

SEM operation: electron-specimen interaction, topographical imaging and signal processing, image formation and artifacts. Sample preparation of soft and solid biological and material samples (plant and animal tissues, bacterial cells, polymers and fossil materials). Chemical procedure (fixation, dehydration, CPD or HMDS drying, sputter coating). Cryo-SEM method of liquid specimens. X-ray microanalysis: the energy-dispersive X-ray spectroscopy (EDS) is nondestructive method used for the chemical characterization of a sample. Digital image acquisition and analysis. Interpretation on results and their preparation for publication in research paper. SEM Image portfolio prepared by students (variety of samples)

Methods and forms of teaching: Lectures with projection of slides. Individual training in using scanning electron microscopy methods and X-ray microanalysis

Requirements: knowledge on general plant and animal morphology and anatomy

Literature (maximum 5, preferably recent sources, all in English):

1. Schatten H. 2013. Scanning Electron Microscopy for the Life Sciences, Cambridge University Press, pp. 257
2. Karcz J, Bernas T, Nowak A, Talik E, Woznica A. 2012. Application of lyophilization to prepare the nitrifying bacterial biofilm for imaging with scanning electron microscopy. Scanning 34: 26–36.
3. Goldstein J, Newbury D, Joy C, Lyman P, Echlin E, Lifshin L, Sawyer J. Michael J. 2003. Scanning Electron Microscopy and X-Ray Microanalysis. Kluwer Academics/ Plenum Publishers, 3rd Ed., New York, pp. 688.
4. Introduction to Electron Microscopy. 2012. FEI Company, pp.15.
5. Proceedings of the XV International Conference of Electron Microscopy, 15-18 September 2014, Cracow, Poland