UNIVERSITY OF PANNONIA

COURSE DATASHEET

Semester:	2014/15/2
Course:	Microscope methods in materials analysis
Code:	VEMKFTM152M
Responsible department:	Department of Earth and Environmental Sciences
Department code:	MKFT
Responsible instructor:	dr. Mihály Pósfai

Course objectives:

Introduction of the principles of optical, electron and scanning probe microscopy methods. Demonstration of the basic practices of microscopy techniques, primarily on examples from earth and materials sciences. (Biological applications of microscopy are covered in other courses, and more comprehensive background in the practice of microscopy can be obtained in the Elective laboratory practice.)
Development of competences: Knowledge of the fundamentals of various microscope techniques, ability to choose the appropriate technique for the analysis of the composition, structure, and distribution of solid components in environmental samples in the nm-mm size range. Hands-on experience in observing the properties and interactions of environmentally important materials on the nano- and micro scales.

Course content:

Optical microscopy:

- A brief history of microscopy. The nature of light, refraction, polarization. Optical properties of crystalline materials; isotropic and anisotropic materials, birefringence.
- Methods in optical microscopy. The polarization microscope, observations using the petrographic microscope: shape, color, pleochroism, refractive index, birefringence.

Electron microscopy:

- Interactions between the electron beam and the sample in the electron microscope. The scanning and the transmission electron microscope: components, main functions, and their spatial resolutions.
- Electron diffraction. Kinematical and dynamical scattering. Crystallographic information from electron diffraction patterns.
- Image formation in the transmission electron microscope. Amplitude- and phase contrast imaging, the basics of high-resolution transmission electron microscopy.
- X-ray microanalysis and electron-energy-loss spectroscopy in the transmission electron microscope.
- Applications of electron microscopy in environmental science.

Scanning probe microscopy:

- Working principles of the scanning tunnelling and atomic force microscopes.
- Atomic force microscopy: contact and dynamic modes of operation, atomic force spectroscopy.
- Environmental applications of atomic force microscopy.

Requirements, evaluation and grading:

Mandatory attendence of practical sessions.

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Requirements, evaluation and grading:

Grading is based on two test written during the semester.

Required and recommended readings:

Optical Microscopy and Specimen Preparation. DoITPoMS Teaching and Learning Packages, University of Cambridge (http://www.doitpoms.ac.uk/tlplib/optical-microscopy/index.php), 2007.
Williams, D. B., Carter, C. B.: Transmission Electron Microscopy. Plenum Press, 1996.
Bonnell, D.: Scanning Probe Microscopy and Spectroscopy. Wiley-VCH, 2000.