ANALYTICAL TECHNIQUES IN MINERALOGY AND PETROLOGY

MSc in Earth Science and Engineering

2018/19 II. semester

COURSE COMMUNICATION FOLDER

University of Miskolc
Faculty of Earth Science and Engineering
Institute of Mineralogy and Geology

Datasheet of the course

Course title: Analytical techniques in mineralogy and petrology **Teacher:** Dr. Zajzon Norbert, associate professor	**Code of the course:** MFFAT720025 **Responsible institute:** Institute of Mineralogy - Geology
	Type of course: C
Recommended semester: 2	**Pre-requisites:** none
No. of contact hours/week (sem.+lab.): 1+1	**Type of assessment (exam/pr. mark/other):** pr. mark
Credit points: 2	**Course:** full-time

Task and target of the course: The key target of the course is to introduce the different analytical methods used in mineralogy and geology for the students. There are laboratory classes with individual work about the learned methods nearby the theoretical classes. Thru these exercises the students learn what is the best available method to answer certain geological questions.

Competencies to evolve:

Knowledge: T1, T2, T3, T4, T7, T8, T9

Ability: K1, K2, K3, K5, K11, K12, K13

Attitude: A1, A2, A3, A4, A5, A7

Autonomy and responsibility: F1, F2, F3, F4, F5

Thematic description of the course:

1. Description of the work, formulating analytical pairs, work and lab safety teaching
2. Physical properties (hardness, magnetic, solubility, density), density measurements
3. X-ray diffraction lecture I.
4. X-ray diffraction lecture II.
5. X-ray diffraction practice
6. DTA lecture
7. DTA quantitative calculations
8. Writing of test 1.
9. Scanning electron microscopy lecture I.
10. Scanning electron microscopy lecture II.
11. Scanning electron microscopy practice
12. Formula calculations
13. Consultation
14. Writing of test 2.

Type of assessment during the semester: There are two written tests about the theoretical part (50% of the final grade). Both must be written to minimum 50%. Two laboratory report must be written about the individual work (50% of the final grade). Missing, or not passed tests can be completed at the end of the semester in oral exam. To have accepted grade, the student must be present at least 80% of the classes.

Grading limits:

> 80 %: excellent
70 – 80 %: good
60 – 70 %: average
50 – 60 %: satisfactory
< 50 %: unsatisfactory

Recommended literature:

Reed SJB (2005): Electron Microprobe Analysis and Scanning Electron Microscopy in Geology. Cambridge University Press.
O'Donoghue M (2006): Gems: Their sources, descriptions and identification. Elsevier.
Pracejus B (2008): The ore minerals under the microscope: an optical guide. Elsevier.
Goldstein J et al. (2003): Scanning Electron Microscopy and X-ray Microanalysis. Kluwer Academic/Plenum Publishers.
King M. et al. (1993): Mineral Powder Diffraction File Search- and Databook. ICDD, USA.

Description of the course

Advanced mineralogy
2018/19 year, II. semester
Time of lectures and laboratories: Wednesday, 16:00-17:00

Week	Topic of the class
2019.02.13.	Description of the work, formulating analytical pairs, work and lab safety teaching
2019.02.20.	Physical properties (hardness, magnetic, solubility, density), density measurements
2019.02.27.	X-ray diffraction lecture I.
2019.03.06.	X-ray diffraction lecture II.
2019.03.13.	X-ray diffraction practice
2019.03.20.	DTA lecture
2019.03.27.	DTA quantitative calculations
2019.04.03.	Writing of test 1.
2019.04.10.	Scanning electron microscopy lecture I.-II.
2019.04.17.	Sport day
2019.04.24.	Scanning electron microscopy practice
2019.05.01.	Holiday
2019.05.08.	Consultation
2019.05.15.	Writing of test 2.

Example of the written test

Written test of Analytical technics in mineralogy and petrology 1

1. How is the exfoliation of the calcite, and how many directions it has? And what kind of geometric shape is formed by (3)?
2. List the Mohs-scale (3).
3. How characteristic X-ray radiation is created (2)?
4. How characteristic X-ray radiation can be monochromatised (2)?
5. Why do we use monochromatic radiation for X-ray diffraction (XRD) instead of continuous (2)?
6. Draw and X-ray powder diffractometer with goniometer, and also a Gandolfi-camera (3).
7. What kind of X-ray sources you know (for diffraction) (2)?
8. What are the main points for choosing filter for the different X-ray sources? Give examples (2).
9. Write down the Braggs-law, and explain the parts (3).
10. What are the advantages and drawbacks of the goniometer and Gandolfi-camera during XRD (2).
11. What is the optimal grain size for XPRD, and why (2)?
12. Explain the idea of parallel beam geometry for XRD (3).
13. What is the advantage of the parallel beam geometry compared to Bragg-Brentano geometry (2)?

Written test of Analytical technics in mineralogy and petrology 2

1. Make a schematic drawing of a SEM-EDX system (3).
2. Make a schematic drawing of an electron gun, where is it located, and what is the purpose of it (2)?
3. Why do we need to produce vaacum in any electronmicroscope (1)?
4. Why do we call it "Scanning" Electron Microscopy? How that part works? Make a schematic drawing also (3).
5. What kind of particles and radiations are created during the interaction of electron beam and thick smple (4)?
6. What is the difference between BSE and SE images (what can be seen in the picture, for what purpose you would use them…) (3)?
7. How characteristic X-ray radiation forms (2)?
8. How big is the smallest area of a solid matter from where individual chemical analysis can be performed by EDX or WDX? And what parameters define the exact size (3)?
9. Make a schematic drawing of a WDX spectrometer (2).
10. Why do we need to use standards for accurate measurements for EDX and WDX (2)?
11. Compare the advantages and disadvantages of EDX and WDX systems (speed, detection limit, accuracy, resolution price…) (4)?
12. Which method can separate the following mineral pairs from each other, EDX or WDX: aragonite-calcite, magnetite-hematite and pyrope-almandine (3)?