COURSE OUTLINE

1.GENERAL

SCHOOL	ENVIRONMENT AND AGRICULTURAL ENGINEERING		
ACADEMIC UNIT	NATURAL RESOURCES AND AGRICULTURAL ENGINEERING		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	176	**SEMESTER**	6th
COURSE TITLE	APPLIED MINERALOGY		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	**WEEKLY TEACHING HOURS**	**CREDITS**
lectures	3	3
Laboratory exercises	2	2
	5	5
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).		

COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Special background, Specialised general knowledge Skills development
PREREQUISITE COURSES:	No
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	No
COURSE WEBSITE (URL)	

2.LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

The course is a fundamental tool in the concepts of applied mineralogy.

Specifically, the general principles of mineralogy and the origin of the most important minerals are presented. By utilizing existed knowledge, supported by the basic knowledge in mineralogy and petrology, and in combination with specialized analytical techniques, students will gain the ability to judge the suitability of each mineral or rock for any application. The ultimate goal is for students to gain knowledge of the properties of minerals and rocks used in agriculture and industry in relation to their applications.

The course will aim on analytical techniques, through the use of which the student will be able to understand the structure and chemistry of minerals. Practical training in analytical instruments and software will be a significant part of the course. Finally, upon successful completion of the course, the student will be able to collaborate with fellow students to create and present a paper that includes the basic structure of a thesis (Abstract - Introduction - Materials and Methods - Results - Discussion - Conclusions - References).

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

Search for, analysis and synthesis of data and information, with the use of the necessary technology	*Project planning and management*
Adapting to new situations	*Respect for difference and multiculturalism*
Decision-making	*Respect for the natural environment*
Working independently	*Showing social, professional and ethical responsibility and sensitivity to gender issues*

Team work	*Criticism and self-criticism*
Working in an international environment	*Production of free, creative and inductive thinking*
Working in an interdisciplinary environment	*……*
Production of new research ideas	*Others…*
	…….

• Search for, analysis and synthesis of data and information, with the use of the necessary technology
• Working independently
• Team work
• Criticism and self-criticism
• Production of new research ideas
• Production of free, creative and inductive thinking

3.SYLLABUS

Theory

i Clay minerals

ii Methods of studying minerals and amorphous materials

Optical microscopy

Determination of crystal structure using X-ray diffraction (single crystal and powder)

Determination of chemical composition of minerals and amorphous materials (EPMA, LA-ICP MS)

Determination of chemical composition of whole rock (XRF, ICP OES, ICP MS)

iii Selected Applications in:

Agriculture

Fertilizers and soil amendments (kaolinite, bentonite, zeolite, phosphate, carbonate)

Hydroponic substrates (zeolite, perlite, vermiculite, pumice, rockwool)

Industry

Refractories (calcium aluminate cement, bauxite, vermiculite, chromite, lithium minerals)

Cement (CaO, gypsum, volcanic ash)

Fillers (kaolinite, bentonite, perlite, mica, zeolite, talc)

Weathering products of basic-ultrabasic rocks (bauxite, laterite)

iv Mineral resources of Greece

v Exercise

Evaluation of a full set of analyses

Laboratory exercises

Microscope I (parts of the microscope - familiarization)

Microscope II (silicate minerals)

X-ray diffraction (evaluation of a prepared diagram)

X-ray diffraction (analysis of a crystal sample)

X-ray diffraction (use of Diffracplus)

Chemical analyses of minerals - analysis method - methodology

Chemical analyses of minerals - determination of chemical type

Chemical analyses of minerals – in-situ analysis method using an electron microanalyzer

FTIR spectra - use in agricultural materials (e.g. zeolite)

Raman spectra - use in agricultural materials (e.g. zeolite)

Evaluation of Mineralogy paper

Implications/Conclusions on unknown data (XRD, XRF, EPMA, FTIR, Raman)

4.TEACHING and LEARNING METHODS - EVALUATION

<table>
<tr><td>DELIVERY
Face-to-face, Distance learning, etc.</td><td>1. Classroom, Face to face learning, synchronous teaching.

2. Visit the Museum of Minerals and Rocks of Greece "Prof. Eleftheria Davi" (Agricultural University of Athens). Presentation of the full collection to small group of students, and discussion on the special features of important minerals/rocks from Greece.

3. Visit and Usage of laboratory`s instruments (lab of Mineralogy-Geology) in order to learn the basics of sample analysis.</td></tr>
<tr><td>USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY
Use of ICT in teaching, laboratory education, communication with students</td><td>Lectures: Use of multimedia (power point presentations)

Use of Web applications: Interactive, open-access software, for 3D visualization of crystal structures (Smorf-http://www.smorf.nl/draw.php).

Support of Teaching process using the e-learning platform e-class (chat in-class showing in live time the questions/comments during the lecture).</td></tr>
<tr><td>TEACHING METHODS
The manner and methods of teaching are described in detail.
Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.

The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS</td><td>
<table>
<tr><th>Activity</th><th>Semester workload</th></tr>
<tr><td>Lecturer</td><td>36</td></tr>
<tr><td>Laboratory Exercises</td><td>24</td></tr>
<tr><td>Writing papers</td><td>25</td></tr>
<tr><td>Field Trip / Short individual projects</td><td>10</td></tr>
<tr><td>Homework</td><td>30</td></tr>
<tr><td>Course total</td><td>125</td></tr>
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</td></tr>
<tr><td>STUDENT PERFORMANCE EVALUATION
Description of the evaluation procedure

Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other

Specifically-defined evaluation criteria are given, and if and where they are accessible to students.</td><td>Theory:
I. Written final exam (80%) that includes:
Short answer questions
Problem solving
Error detection and correction in a text
Matching of theory elements
II. Written assignment (10%)
III. Group presentation of an assignment by 3-4 people (10%)

Laboratory exams:
Written final exam (60%) that includes:
Short answer question
Problem solving
Written assignment (30%)
Presentation of an assignment (10%)</td></tr>
</table>

5.ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

Mukherjee S., 2011. Applied Mineralogy Applications in Industry and Environment. Springer, ISBN 978-94-007-1162-4 (e-book), 575 p. (διαθέσιμο για τους φοιτητές)

Spectroscopic Methods in Mineralogy, A. Beran & E. Libowitzky (Editors), European Mineralogical Union, EOTVOS Univ. Press

- Related academic journals:

Applied Mineralogy, Clay minerals, Applied Clay Science.