1. GENERAL INFORMATION

Study programme title	University Graduate Study Programme in Geological Engineering		
Course title	Environmental mineralogy	**Semester**	Winter
Teacher	Prof. Goran Durn, PhD, Prof. Ivan Sondi, PhD	**Course code**	27255
Course type	☒ obligatory ☐ elective	**ECTS**	5
Location	Faculty of Mining, Geology and Petroleum Engineering, Pierottijeva 6, Zagreb		
Language	☐ Croatian ☒ English		

Class type	Weekly hours	Teaching staff	Office hours	Room	E-mail
Class	2	Prof. Goran Durn, PhD Prof. Ivan Sondi, PhD	Monday 14-16 a.m.	P6 306 P6 314	goran.durn@rgn.hr ivan.sondi@rgn.hr
Practice	2	Prof. Goran Durn, PhD Prof. Ivan Sondi, PhD, Assist. Prof. Stanko Ružičić, PhD	Monday 10-12 p.m.	P6 316	stanko.ruzicic@rgn.hr
Field lecture					

E-learning level	2	**Percentage of on-line class (max. 20%)**	10%

2. COURSE DESCRIPTION

Course aims	The major goal of this course is to ger students acquainted with the basic knowledge about the role of mineralogy in various aspects of environment; e.g. importance of mineralogy in resolving specific problems in environment such as: contamination of environment, waste management, land use, remediation strategies, environmental impact analysis and risk assessment, preservation and restoration of cultural heritage.
Requirements for applicants	The requirement for this course is completed undergraduate studies.

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Programme level learning outcomes with course contribution	-
Expected course level learning outcomes (4-10 outcomes)	Students will be able to: - define and describe mineralogy of the main environmental systems (soil minerals, minerals of recent marine sediments, mineral particles in atmosphere); - recognize and explain physical, chemical and biological processes in soils and sediments and to implement this knowledge with other professions dealing with protection and use of soils and sediments; - compare and distinguish mineral composition of main environmental systems and based on that to define their physical and chemical characteristics; - based on mineralogical composition and physical-chemical surface characteristics of sediments, establish its reactivity and holding capacity for contaminants; - apply new knowledge about specific minerals in environmental protection (landfills, remediation, and storage of radioactive waste).

Course contents by individual lessons	
Class	Practice
P1 – Introduction to environmental mineralogy. Basic definitions. Examples of mineralogy importance in the environment (former factory of alumina in Obrovac, factory of alumina in Ajka, factory Salonit from Vranjic).	V1 - Task 1: Importance of manganese oxides and hydroxides in soils and sediments. Example: Zagreb water well field (Part 1.)
P2 – Mineralogy and key environment systems (soil minerals, minerals of recent marine sediments, mineral particles in atmosphere). Soil system. Primary and secondary minerals. Physical and chemical weathering. Biological processes.	V2 – Task 1: Importance of manganese oxides and hydroxides in soils and sediments. Example: Zagreb water well field (Part 2.)
P3 – Organic matter in soil. Gasses in soil. Soil water. Dynamic reactions in soil water. Soil and their properties (colour, horizons, structure, texture, soil colloids). Soil classification.	V3 - Task 2: Fractionation of metals in soils and sediments. Example: Zagreb water well field (Part 1.)

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P4 – Soil mineral changes in various phases of weathering parent material. Nutrients availability in soil due to different weathering phases. Colloidal part of soils and their influence on shrinkage and swelling, plasticity, cohesion, dispersion, aggregation, flocculation, adsorption of cations and anions, nutrients supply, transport of metals in soil and on soil structure. Specific soil surface. Surface charge. Example of excessive erosion of flysch in Slani potok (Vinodol).	V4 – Task 2: Fractionation of metals in soils and sediments. Example: Zagreb water well field (Part 2.)
P5 – Soil acidification. Acid Neutralising Capacity. CLA concept. Skokloster clasiffication.	V5 – Task 2: Fractionation of metals in soils and sediments. Example: Zagreb water well field (Part 3.)
P6 – Minerals in recent marine sediments. Mineral particles in atmosphere.	V6 – Task 3: Organophilic clays in environment protection. Example: Technological waste from the petroleum industry (Part 1.).
P7 – Minerals and mineral aggregates as isolation barriers in landfills. Clays and organophilic clays. Example of remediation of landfill Prudinec.	V7 – Task 3: Organophilic clays in environment protection. Example: Technological waste from the petroleum industry (Part 2.).
P8 – Minerals and radionuclides interaction. Smectites properties and smectite usage as long life isolation materials in transport and radioactive waste storage.	V8 – Colloquium.
P9 – Chemical and mineralogical characteristics lime stabilized waste in petroleum industry in Croatia. Pre-processing and processing of industrial waste from petroleum industry using organophilic clay.	V9 – Students seminars.
P10 – Structural, morphological, and surface physical-chemical characteristics of minerals in natural environment. Basic physical-chemical processes interaction of mineral surface, organic and inorganic compounds.	V10 – Students seminar on this topic.
P11 – Micro and nano particles in processes of bounding, transport and storage of pollutants in natural environments. Classification and methods of	V11 – Students seminar on this topic.

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characterization of micro and nano particles in natural environments.	
P12 – Mineral particles and colloid systems. Colloid stability, processes of aggregation micro and nano minerals in natural water environments.	V12 - Students seminar on this topic.
P13 – Examples of research of specific minerals and their surface-physical-chemical characteristics in biogeochemical circle in natural environments.	V13 - Students seminar on this topic.
P14 – Basic processes of biomineralization. Biomineral structures and their morphological, mineralogical and chemical characteristics. Biomineralization and global biogeochemical cycle.	V14 - Students seminar on this topic.
P15 – Authigenetic minerals in nature environments. Minerals as indicators of environment. Early diagenetic processes in recent sediments.	V15 – Students seminar on this topic.

Students' obligations	Student have to finish and upload all tasks, write two seminars for specific topic and pass colloquium.			
Students' work track *(indicate share in ECTS points for each activity so that overall ECTS number corresponds to class credits score):*	Class attendance	1.5	Research	-
	Project	-	Report	-
	Colloquium	1	Seminar paper	1
	Practical work	0.5	Oral exam	1
	Written exam	-	(Extra)	-
Type of exam, grades and evaluation of students work during class and on final exam	Oral exam is mandatory. The requirement for oral exam are: 1. successfully solved tasks; 2. submitted and held seminars; 3. positively rated colloquium. Grade from colloquium: 1. 60 to 69% - 2 2. 70 to 79% - 3 3. 80 to 89% - 4 4. 90 to 100% - 5 If more than 50% of the participants receive a negative rating from the colloquium, the same is canceled and a new colloquium will be written.			

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	If student gets a negative rating, he can repeat it for only one time. In case of re-gaining a negative rating, the student have to lesson lectures again.
Mandatory literature (available in the Library and via other media)	1. Vaughan, D.J. & Wogelius, R.A. (2000): Environmental Mineralogy.- Eötvös University Press, Budapest, 423s.
Aditional literature (at the moment of study program proposition application)	2. Parker, A. & Rae, J. E. (1998): Environmental Interactions of Clays.- Springer, Berlin Heidelberg, 271s. 3. Banfield J.F. & Navrotsky, A. (2001): Nanoparticles and the Environment. Reviews in Mineralogy and Geochemistry,vol 44, 349s. 4. Dove, P.M., De Yoreo, J.J. & Weiner, S. (2003): Biomineralization. Reviews in Mineralogy and Geochemistry,vol 54, 381s.
Examination terms	According to the agreement with the students.
Other	

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