

PROGRAM OF STUDIES

FACULTY: .OF GEOENGINEERING, MINING AND GEOLOGY

MAIN FIELD OF STUDY: .MINING AND GEOLOGY

DISCIPLINE: D1 ENVIRONMENTAL, MINING AND POWER ENGINEERING

EDUCATION LEVEL second-level studies (4 semesters)

FORM OF STUDIES: full-time studies

PROFILE: general academic

LANGUAGE OF STUDY: English

Content:

1. Assumed learning outcomes – attachment no. 1... to the program of studies
2. Program of studies description – attachment no. 2... to the program of studies

In effect since .2023/2024

ASSUMED LEARNING OUTCOMES

FACULTY: Geoengineering, Mining, and Geology

MAIN FIELD OF STUDY: Mining and Geology

EDUCATION LEVEL: second-level studies

PROFILE: general academic

Location of the main-field-of study:

Branch of science: **engineering and technical sciences**

Discipline: **environmental engineering, mining and energy**

.....
Explanation of the markings:

P6U – universal first degree characteristics corresponding to education at the first-level studies - 6 PRK level *

P7U – universal first degree characteristics corresponding to education at the second-level studies - 7 PRK level *

P6S – second degree characteristics corresponding to education at the first-level studies - 6 PRK level *

P7S – second degree characteristics corresponding to education at the second-level studies - 7 PRK level *

W - category "knowledge"

U - category "skills"

K - category "social competences"

K (*faculty symbol*) _W1, K (*faculty symbol*) _W2, K (*faculty symbol*) _W3, ... - main-field-of study learning outcomes related to the category "knowledge"

K (*faculty symbol*) _U1, K (*faculty symbol*) _U2, K (*faculty symbol*) _U3, ... - main-field-of study learning outcomes related to the category "skills"

K (*faculty symbol*) _K1, K (*faculty symbol*) _K2, K (*faculty symbol*) _K3, ... - main-field-of study learning outcomes related to the category "social competences"

... _inż. – learning outcomes related to the engineer competences

* delete as applicable

Main field of study learning outcomes	Description of learning outcomes for the main-field-of study After completion of studies, the graduate:	Reference to PRK characteristics		
		Universal first degree characteristics (U)	Second degree characteristics typical for qualifications obtained in higher education (S)	
			Characteristics for qualifications on 6 / 7* levels of PRK	Characteristics for qualifications on 6 and 7 levels of PRK, enabling acquiring engineering competences
KNOWLEDGE (W)				
K2_GIG_W01	has knowledge of effective scientific expression and presentation, knows the rules and methods for conducting scientific research and presenting their results in a scientific publication	P7U_W	P7S_WG	
K2_GIG_W02	has extended and in-depth knowledge of physics and/or chemistry, necessary to understand the phenomena and processes affecting the properties of the Earth's crust and raw materials it contains.	P7U_W	P7S_WG	
K2_GIG_W03	has basic knowledge of the role and main principles of financial management in the enterprise; has in-depth knowledge of the economic evaluation of investment projects and investment risk assessment	P7U_W	P7S_WG P7S_WK	P7S_WG_inż P7S_WK_inż
K2_GIG_W04	has systematised knowledge of the fundamentals and types of environmental management systems in Poland and EU countries; knows the tools and instruments supporting their implementation and the applicable legal regulations.		P7S_WG P7S_WK	P7S_WG_inż P7S_WK_inż
K2_GIG_W05	has basic knowledge necessary to understand the social and psychological determinants of engineering activities	P7U_W	P7S_WK	P7S_WK_inż
K2_GIG_W06	has knowledge of the basic decision models in management with the use of IT tools/applications	P7U_W	P7S_WK	P7S_WK_inż
K2_GIG_W07	has knowledge of the processes and technologies used in geoenvironmental engineering, mining and processing of mineral resources		P7S_WG	P7S_WG_inż

K2_GIG_W08	has in-depth knowledge of the recognition and assessment of resources, quality, and value of the deposit, legal procedures to launch mine operations, and to conduct mining and mineral processing	P7U_W	P7S_WG P7S_WK	P7S_WG_inž P7S_WK_inž
K2_GIG_W09	has knowledge of the operation of mining or geoengineering enterprises as well as about their production management and optimization		P7S_WG P7S_WK	P7S_WG_inž P7S_WK_inž
K2_GIG_W10	has extended knowledge of the sciences describing the phenomena that are the basis of technologies used in mining and mineral engineering and the sciences explaining the phenomena and threats accompanying mining, mineral engineering, and environmental protection, in particular in the field of rock mass mechanics, soil mechanics, geophysics, hydrogeology, and ecology	P7U_W	P7S_WG P7S_WK	P7S_WG_inž P7S_WK_inž
K2_GIG_W11	knows the formal and legal conditions in the field of geology, mining, geoengineering, mineral engineering and environmental protection	P7U_W	P7S_WK	
K2_GIG_W12	has knowledge of the rational use of environmental resources, circular economy and economic activity sustainable in terms of innovation, environmental protection and safety	P7U_W	P7S_WG P7S_WK	P7S_WG_inž P7S_WK_inž
K2_GIG_W13	knows the environmental impact assessment procedures and their legal regulations, factors influencing such an assessment, its stages, and the effectiveness of the applied research methods; knows the basic concepts and frameworks of environmental risk and human health exposure assessments		P7S_WG P7S_WK	P7S_WG_inž P7S_WK_inž
K2_GIG_W14	has broadened knowledge of the threats that occur in mining and mineral engineering and knows how to counteract them		P7S_WG	P7S_WG_inž
K2_GIG_W15	has basic knowledge of computer modeling of geological structures, computer aided design, and monitoring of mining or geoengineering objects	P7U_W	P7S_WG P7S_WK	P7S_WG_inž P7S_WK_inž
K2_GIG_W16	has knowledge of changes in the rock mass under the influence of mining, with particular emphasis on its impact on the ground surface and methods of monitoring to protect the surface		P7S_WG	P7S_WG_inž

K2_GIG_W17	knows the methodology and techniques of occupational risk assessment in light of Polish and international law; knows the basics of organization and management of work safety, necessary for management and traffic supervision in mining, geoengineering and mineral engineering	P7U_W	P7S_WG P7S_WK	P7S_WG_inż P7S_WK_inż
K2_GIG_W18	knows methods and tools for designing, calculating, and optimizing systems for the extraction and processing of minerals and waste with the use of mathematical modelling and digital simulation of technological operations	P7U_W	P7S_WG P7S_WK	P7S_WG_inż P7S_WK_inż
K2_GIG_W19	has knowledge of machine systems used in raw material technologies and geoengineering, their reliability and life cycle		P7S_WG P7S_WK	P7S_WG_inż P7S_WK_inż
SKILLS (U)				
K2_GIG_U01	has linguistic resources appropriate for a specialist language and is able to use the specialist language in all linguistic activities to communicate in a professional environment in the field of studied discipline		P7S_UK	
K2_GIG_U02	has language skills in accordance with the requirements specified for the B2 + level of the European System for the Description of Languages (CEFR) in the foreign language in which learning is continued; understands and interprets professional texts in the field of mining and geology; speaks and writes using academic and engineering language.		P7S_UK	
K2_GIG_U03	concerning the second foreign language, understands quite well the content and intentions of an oral statement or written text on a topic known from everyday and professional life; can write a short text on a known topic, including a utility text (e.g. an informal letter); is able to participate in conversations on known topics and to a limited extent expresses themselves about studies and professional work, using socio-cultural knowledge		P7S_UK	
K2_GIG_U04	is able to use analytical methods and IT tools, including digital simulation, to design, calculate, optimize systems for extraction, processing, processing of minerals and waste or revitalization of post-mining facilities	P7U_U	P7S_UW	P7S_UW_inż

K2_GIG_U05	is able to select and apply appropriate methods and IT tools for systemic management of environmental components under the given geological and mining conditions	P7U_U	P7S_UW	P7S_UW_inż
K2_GIG_U06	is able to build a simple financial model of an investment, examine its profitability and conduct a risk analysis on the ground of historical data and financial forecasts		P7S_UW	P7S_UW_inż
K2_GIG_U07	is able to design processes and technological systems used in geoengineering, mining or processing of mineral resources, is able to program basic models/algorithms of technological operations when applied to analyze the effectiveness of a complex industrial system	P7U_U	P7S_UW	P7S_UW_inż
K2_GIG_U08	understands the need for lifelong learning and is able to organize the learning of other people	P7U_U	P7S_UU	
K2_GIG_U09	is able to work in a group and lead a team to fully use its potential to solve assigned tasks	P7U_U	P7S_UO	
K2_GIG_U10	can use the knowledge of the sciences describing the phenomena that are the basis of technologies used in mining and mineral engineering and the sciences explaining the phenomena and threats accompanying mining, mineral engineering, and environmental protection for calculations, analyzes, and design of facilities, processes and technologies	P7U_U	P7S_UW P7S_UU	P7S_UW_inż
K2_GIG_U11	is able to carry out an occupational risk assessment for selected factors of the working environment with the use of computer tools; is able to independently develop elements of work safety documents required by law	P7U_U	P7S_UW P7S_UO P7S_UK	P7S_UW_inż
K2_GIG_U12	is able to carry out an assessment of the impact of industrial activities on the environment for a simple case study; is able to interpret the documentation regarding the risk assessment of the negative impact of mining activities on the health of the population and independently perform simple risk calculations		P7S_UW P7S_UO	P7S_UW_inż
K2_GIG_U13	is able to critically assess and draw conclusions from various sources and to prepare written documentation or oral presentations on the area of mineral resource engineering		P7S_UW P7S_UK	P7S_UW_inż

K2_GIG_U14	is able to apply and interpret basic decision models with the use of IT tools/applications	P7U_U	P7S_UW P7S_UO P7S_UU	P7S_UW_inż
K2_GIG_U15	is able to make a critical analysis of technical and organizational solutions used in mining, geoengineering and mineral engineering		P7S_UW P7S_UK	P7S_UW_inż
SOCIAL COMPETENCES (K)				
K2_GIG_K01	can think and act creatively and enterprisingly		P7S_KK P7S_KR	
K2_GIG_K02	understands the need to formulate and communicate to society, including through the mass media, information and opinions on the achievements of the mining industry, geoengineering and mineral engineering and other aspects of the engineer's activity; makes efforts to convey such information and opinions in a commonly understandable manner, presenting different points of view; is aware of the value and need of shaping a safety culture work and responsibility for the health and life of other employees	P7S_K	P7S_KK P7S_KO P7S_KR	
K2_GIG_K03	is aware of the importance of nontechnical effects of engineering activities, including their impact on the environment and the related responsibility for decisions made	P7U_K	P7S_KO P7S_KR	

FACULTY: **of Geoengineering, Mining and Geology**

MAIN FIELD OF STUDY: **Mining and Geology**

LANGUAGE OF STUDY: English

SPECIALIZATION: **Mineral Resources Exploration**

- Track UNI MISKOLC-WUST

DESCRIPTION OF THE PROGRAM OF STUDIES

Main field of study MINING AND GEOLOGY**Profile** general academic**Level of studies** second level studies**Form of studies** full-time studies**1. General description**

<i>1.1 Number of semesters: 4</i>	<i>1.2 Total number of ECTS points necessary to complete studies at a given level: 120</i>
<i>1.3 Total number of hours: 1290</i>	<i>1.4 Prerequisites (particularly for second-level studies): Bachelor of Science in Engineering diploma, interview</i>
<i>1.5 Upon completion of studies graduate obtains professional degree of: magister inżynier - 2nd degree qualifications</i>	<p><i>1.6 Graduate profile, employability:</i></p> <p><i>The program will train T-shaped earth science specialists having a strong background in classical disciplines of geology and geophysics complemented with modern 3D modelling as well as data processing and interpretation skills, while the boundary-crossing competences will cover skills in innovative mineral exploration techniques and technologies used in the field, in laboratories, in an underground and underwater environment. Students will also be trained in sustainability, social responsibility and social licence to operate. T-shaped mineral explorers will use Industry 4.0-derived tools and methods for mineral resource exploration, mentored by experts.</i></p> <p><i>They will be prepared to work in enterprises, technical supervision institutions, public state and local administration, in research and development organisations, in Poland and</i></p>

	<p><i>abroad, will also be prepared to start own business or work as free lanced exploration geologists. The graduates will be able to use English freely and will be prepared to work in an international environment and intercultural groups during their professional career.</i></p>
<p><i>1.7 Possibility of continuing studies: eligibility to apply for admission to a doctoral school, non-degree postgraduate programmes</i></p>	<p><i>1.8 Indicate connection with University’s mission and its development strategy: The study programs of all specializations within the field of study Mining and Geology respond to the strategic goals of the University (Strategia Politechniki Wrocławskiej 2023–2030), by rising the level of correlation of the study offer with the needs of the market (C3), by enhancing the quality of education through didactic interdisciplinarity and by cooperation with industrial partners as well as increasing the level of entrepreneurship, creativity and involvement of students in research processes (C4, C2). Graduates of the faculty should be creative, professional, have theoretical background and practical abilities, as well as have interpersonal skills and cross-cultural experience (C5). The Faculty of Geoengineering, Mining and Geology, as one of the units of the Wrocław University of Science and Technology, educates in the field of engineering, broadened by knowledge in natural and economic sciences. The profile and quality of education are at the international level and are adapted to the needs of the national and global mineral industries.</i></p>

¹BU – number of ECTS points assigned to hours of classes requiring direct participation of academic teachers and other persons conducting classes

²Traditional – enter T, remote – enter Z

³Exam – enter E, crediting – enter Z. For the group of classes – after the letter E or Z - enter in brackets the final subject form (lec, cl, lab, pr, sem)

⁴University-wide subject /group of classes – enter O

⁵DN - number of ECTS points assigned to the classes related to the University's academic activity in the discipline/disciplines to which the main field of study is assigned

⁶Practical subject / group of classes – enter P. For the group of courses – in brackets enter the number of ECTS points assigned to practical courses

⁷KO – general education courses, PD – basic sciences courses, K – main field of study courses, S – specialization courses

2. Detailed description

2.1 Total number of learning outcomes in the program of study: W (knowledge) = 19, U (skills) = 15, K (competences) = 3,
W + U + K = 37

~~2.2 For the main field of study assigned to more than one discipline – the number of learning outcomes assigned to the discipline:~~

~~_____ D1 (major) (this number must be greater than half the total number of learning outcomes)~~

~~_____ D2~~

~~_____ D3~~

~~_____ D4~~

~~2.3 For the main field of study assigned to more than one discipline – percentage share of the number of ECTS points for each discipline:~~

~~_____ D1% ECTS points~~

~~_____ D2% ECTS points~~

~~_____ D3% ECTS points~~

~~_____ D4% ECTS points~~

2.4a. For the general academic profile of the main field of study – the number of ECTS points assigned to the classes related to the University's academic activity in the discipline or disciplines to which the main field of study is assigned – DN (must be greater than 50% of the total number of ECTS points from 1.2) 98 ECTS

~~2.4b. For the practical profile of the main field of study – the number of ECTS points assigned to the classes shaping practical skills (must be greater than 50% of the total number of ECTS points from 1.2)~~

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2.5 Concise analysis of compliance of the assumed learning outcomes with the needs of the labor market

The economic development of the country is closely dependent on natural resources, the ability to use them and having appropriate engineering workforce. The assumed learning outcomes correspond to the needs of practice in the field of the generally understood management of mineral resources - technologies and techniques for their identification, valuation, extraction, processing, revitalization of industrial areas, and the practice of managing an enterprise (especially mining) in the sense of managing information, environment and people, using the latest IT and marketing techniques and methods. This integration of economic needs and assumed educational effects favorably shape the labor market for the graduates of the Faculty. Additionally, a good command of English and experience of working in an international group will open up the possibility of working in foreign branches of Polish enterprises and in foreign companies.

2.6. The total number of ECTS points that a student must obtain in classes requiring direct participation of academic teachers or other persons conducting classes and students (enter the sum of ECTS points for courses / groups of courses marked with the BU¹ code) **63,2 ECTS**

2.7. Total number of ECTS points, which student has to obtain from basic sciences classes

Number of ECTS points for obligatory subjects	6
Number of ECTS points for optional subjects	0
Total number of ECTS points	6

2.8. Total number of ECTS points, which student has to obtain from practical classes, including project and laboratory classes (enter total number of ECTS points for courses/group of courses denoted with code P)

Number of ECTS points for obligatory subjects	18
Number of ECTS points for optional subjects	63
Total number of ECTS points	81

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⁴University-wide subject /group of classes – enter O

⁵DN - number of ECTS points assigned to the classes related to the University's academic activity in the discipline/disciplines to which the main field of study is assigned

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2.9. Minimum number of ECTS points, which student has to obtain doing education blocks offered as part of University-wide classes or other main field of study (enter number of ECTS points for courses/groups of courses denoted with code O)

3 ECTS points

2.10. Total number of ECTS points, which student may obtain doing optional blocks (min. 30% of total number of ECTS points)

92 ECTS points

3. Description of the process leading to learning outcomes acquisition:

1. Upon starting classes in each subject, the student has an appropriate level of knowledge and skills which constitute the prerequisites for a given course (it is verified by the teacher or the dean's office).
2. The student participates in classes organized at the university.
3. The student carries out the assigned work in class and at home (projects, computational tasks, analyzes, prepares presentations) and studies the literature and materials recommended by the teacher.
4. The student uses the appointed hours of the tutor's consultation, explaining his uncertainties and verifying the correct understanding of the course content.
5. The student participates in periodic tests of knowledge and skills, completes the tests available on the e-portal and is familiar with the correct answers, grades and comments from the teacher.
6. In some subjects, the student participates in group tasks, taking part in the organization of the group's work, assessment of the activities of individual participants and takes responsibility for the result of the group's work.
7. The student is encouraged to become involved in the work of research clubs, student organizations, discussion clubs, sports groups, participation in social life through work in public welfare organizations, voluntary work, thus gaining valuable interpersonal skills and social competences.
8. The student participates in meetings with companies from the industry, technical excursions, job fairs, tries to gain knowledge about the labor market and additional advantages when applying for a job
9. The student is encouraged to participate in an international student exchange, and through contact with foreigners at the faculty, he or she acquires additional interpersonal, cultural and language qualifications

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4. List of education blocks:

4.1. List of obligatory blocks:

4.1.1 List of general education blocks

4.1.1.1 Liberal-managerial subjects block (6 ECTS points):

No.	Subject / groups of classes code	Name of subject / groups of classes (denote group of courses with symbol GK)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form ² of course/group of courses	Way ³ of crediting	Subject / groups of classes			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN ⁵ classes	BU ¹ classes			University-wide ⁴	Concerning scientific activities ⁵	Practical ⁶	Type ⁷
1	W06GIG-SM3012G	Exploration Entrepreneurship GK	1			1	2	K2_GIG_W03,W05,W09 K2_GIG_U08,U09 K2_GIG_K01,K02,K03	60	100	4		3,0	Z	Z			P(3)	KO
2	W06GIG-SM3013P	SOC Internship				2		K2_GIG_W05,W09 K2_GIG_U08,U09 K2_GIG_K01,K02,K03	30	50	2		1,5	T	Z			P(2)	KO
Total			1			3	2		90	150	6		4,5					5	

Altogether for general education blocks

Total number of hours					Total number of ZZU hours	Total number of CNPS hours	Total number of ECTS points	Total number of ECTS points for DN classes ⁵	Number of ECTS points for BU classes ¹
lec	cl	lab	pr	sem					
1			3	2	90	150	6		4,5

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³Exam – enter E, crediting – enter Z. For the group of classes – after the letter E or Z - enter in brackets the final subject form (lec, cl, lab, pr, sem)

⁴University-wide subject /group of classes – enter O

⁵DN - number of ECTS points assigned to the classes related to the University's academic activity in the discipline/disciplines to which the main field of study is assigned

⁶Practical subject / group of classes – enter P. For the group of courses – in brackets enter the number of ECTS points assigned to practical courses

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4.1.2 List of basic sciences blocks

4.1.2.1 Mathematics block

No.	Subject / groups of classes code	Name of subject / groups of classes (denote group of courses with symbol GK)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form ² of course/group of courses	Way ³ of crediting	Subject / groups of classes			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN ⁵ classes	BU ¹ classes			University-wide ⁴	Concerning scientific activities ⁵	Practical ⁶	Type ⁷
1	W06GIG-SM3002W	Computer Aided Geological Modelling & Geostatistics (część: Geostatistics) w	1					K2_GIG_W06,W08,W15 K2_GIG_U04,U08,U14	15	50	2		0,8	T	Z				PD
2	W06GIG-SM3002L	Computer Aided Geological Modelling & Geostatistics (część: Geostatistics) l			1				15	25	1		0,6	T	Z			P (1)	PD
Total			1	0	1	0	0		30	75	3		1,4					1	

4.1.2.3 Physics block

No.	Subject / groups of classes code	Name of subject / groups of classes (denote group of courses with symbol GK)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form ² of course/group of courses	Way ³ of crediting	Subject / groups of classes			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN ⁵ classes	BU ¹ classes			University-wide ⁴	Concerning scientific activities ⁵	Practical ⁶	Type ⁷
1	W06GIG-SM3004W	Engineering Geophysics w	1					K2_GIG_W02,W08,W10 K2_GIG_U04,U13	15	25	1	1	0,8	T/Z	Z		DN		PD
2	W06GIG-SM3004P	Engineering Geophysics p				1			15	50	2	2	0,9	T	Z		DN	P(2)	PD
Total			1	0	0	1	0		30	75	3	3	1,7					2	

Altogether for basic sciences blocks:

Total number of hours					Total number of ZZU hours	Total number of CNPS hours	Total number of ECTS points	Total number of ECTS points for DN classes ⁵	Number of ECTS points for BU classes ¹
lec	cl	lab	pr	sem					
2	0	1	1	0	60	150	6	3	3,1

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⁴University-wide subject /group of classes – enter O

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4.1.3 List of the main field of study blocks

4.1.3.1 Obligatory main field of study blocks

No.	Subject / groups of classes code	Name of subject / groups of classes (denote group of courses with symbol GK)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form ² of course/group of courses	Way ³ of crediting	Subject / groups of classes			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN ⁵ classes	BU ¹ classes			Unive ⁴ rsity-wide	Concerning scientific activities ⁵	Practical ⁶	Type ⁷
1	W06GIG-SM3002L	Computer Aided Geological Modelling & Geostatistics (Część: Computer Aided Geological Modelling)			2			K2_GIG_W06,W08,W15 K2_GIG_U04,U08,U14	30	50	2	2	1,3	T	Z		DN	P(2)	K
2	W06GIG-SM3000W	Digital Mine w	1					K2_GIG_W07,W12,W18,W19 K2_GIG_U04,U07,U08	15	25	1	1	0,8	T/Z(w)	Z		DN		K
3	W06GIG-SM3000L	Digital Mine l			1				15	25	1	1	0,8	T	Z		DN	P(1)	K
4	W06GIG-SM3005W	Occupational Health and Safety w	1					K2_GIG_W11,W12,W14,W17 K2_GIG_U11,	15	25	1	1	0,7	T/Z(w)	Z		DN		K
5	W06GIG-SM3005P	Occupational Health and Safety p				1		K2_GIG_K02, K03	15	25	1	1	0,8	T	Z		DN	P(1)	K
6	W06GIG-SM3007W	Principles and Application of InSAR and GIS in mining w	2					K2_GIG_W15,W16,W18 K2_GIG_U04,U07,U08	30	50	2	2	1,4	T/Z(w)	E		DN		K
7	W06GIG-SM3007L	Principles and Application of InSAR and GIS in mining l			3				45	75	3	3	2,0	T	Z		DN	P(3)	K
8	W06GIG-SM3055W	Geochemistry	2					K2_GIG_W02,W10 K2_GIG_K03	30	50	2	2	1,4	T/Z(w)	Z	O	DN		PD
9	W06GIG-SM3016P	Applied Field Exploration				3		K2_GIG_W08,W15 K2_GIG_U04,U09,U10,U13 K2_GIG_K02	45	75	3	1	2,1	T	Z		DN	P(3)	S
Total			6	0	6	4			240	400	16	14	11,3					10	

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²Traditional – enter T, remote – enter Z

³Exam – enter E, crediting – enter Z. For the group of classes – after the letter E or Z - enter in brackets the final subject form (lec, cl, lab, pr, sem)

⁴University-wide subject /group of classes – enter O

⁵DN - number of ECTS points assigned to the classes related to the University's academic activity in the discipline/disciplines to which the main field of study is assigned

⁶Practical subject / group of classes – enter P. For the group of courses – in brackets enter the number of ECTS points assigned to practical courses

⁷KO – general education courses, PD – basic sciences courses, K – main field of study courses, S – specialization courses

Altogether (for main field of study blocks):

Total number of hours					Total number of ZZU hours	Total number of CNPS hours	Total number of ECTS points	Total number of ECTS points for DN classes ⁵	Number of ECTS points for BU classes ¹
lec	cl	lab	pr	sem					
6	0	6	4	0	240	400	16	14	11,3

4.2 List of optional blocks

4.2.1 List of general education blocks

4.2.1.2 Foreign languages block (min. 3 ECTS points):

No.	Subject / groups of classes code	Name of subject / groups of classes (denote group of courses with symbol GK)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form ² of course/group of courses	Way ³ of crediting	Subject / groups of classes			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN ⁵ classes	BU ¹ classes			University-wide ⁴	Concerning scientific activities ⁵	Practical ⁶	Type ⁷
1	SJO-SM0003	Foreign Language 1		3				K2_GIG_U03	45	60	2		1,6	T	Z	O		P (2)	KO
2	SJO-SM0004	Foreign Language 2		1				K2_GIG_U01,U02	15	30	1		0,6	T	Z	O		P(1)	KO
Total			0	4	0	0	0		60	90	3		2,2					3	

Altogether for general education blocks:

Total number of hours					Total number of ZZU hours	Total number of CNPS hours	Total number of ECTS points	Total number of ECTS points for DN classes ⁵	Number of ECTS points for BU classes ¹
lec	cl	lab	pr	sem					
0	4	0	0	0	60	90	3	0	2,2

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²Traditional – enter T, remote – enter Z

³Exam – enter E, crediting – enter Z. For the group of classes – after the letter E or Z - enter in brackets the final subject form (lec, cl, lab, pr, sem)

⁴University-wide subject / group of classes – enter O

⁵DN - number of ECTS points assigned to the classes related to the University's academic activity in the discipline/disciplines to which the main field of study is assigned

⁶Practical subject / group of classes – enter P. For the group of courses – in brackets enter the number of ECTS points assigned to practical courses

⁷KO – general education courses, PD – basic sciences courses, K – main field of study courses, S – specialization courses

4.2.4 List of specialization blocks

4.2.4.1 Specialization subjects (e.g. whole specialization) blocks (68 ECTS points):

No.	Subject / groups of classes code	Name of subject / groups of classes (denote group of courses with symbol GK)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form ² of course/group of courses	Way ³ of crediting	Subject / groups of classes			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN ⁵ classes	BU ¹ classes			University-wide ⁴	Concerning scientific activities ⁵	Practical ⁶	Type ⁷
1	W06GIG-SM3017G	Physical Geology GK	2			1		K2_GIG_W08,W10 K2_GIG_UU10,U13 K2_GIG_K02,03	45	100	4	4	2,4	T/Z(w)	E		DN	2	S
2	W06GIG-SM3018G	Mineralogy and Geochemistry GK	2		1			K2_GIG_W02,W08,W10 K2_GIG_U08,U10,U13 K2_GIG_K03	45	100	4	4	2,2	T/Z(w)	E		DN	2	S
3	W06GIG-SM3019G	Geophysical Exploration Methods I GK	2		1			K2_GIG_W02,W08,W10 K2_GIG_U07,U10,U13 K2_GIG_K01,K03	45	100	4	4	2,2	T/Z(w)	E		DN	2	S
4	W06GIG-SM3048G	Engineering physics GK	2				1	K2_GIG_W02 K2_GIG_U01, U13 K2_GIG_K02	45	100	4		2,2	T/Z(w)	E			2	S
5	W06GIG-SM3047G	Numerical methods and optimization GK	1		1			K2_GIG_W02,W09 K2_GIG_U04,U13,U14 K2_GIG_K01,K03	30	50	2	2	1,5	T/Z(w)	Z		DN	1	S
6	W06GIG-SM3049G	Geodesy, spatial informatics GK	2				1	K2_GIG_W02,W08,W15,W16 K2_GIG_U04,U10,U13 K2_GIG_K01,K03	45	100	4	4	2,2	T/Z(w)	E		DN	2	S
7	W06GIG-SM3050L	Computer science for engineers			2			K2_GIG_U04,U13 K2_GIG_K01,K03	30	50	2	2	1,4	T	Z		DN	2	S
8	W06GIG-SM3051G	Data and information processing GK	2				1	K2_GIG_W02,W15,W16 K2_GIG_U04,U13 K2_GIG_K01,K03	45	100	4	4	2,1	T/Z(w)	Z		DN	2	S
	W06GIG-SM3031S	Graduate research seminar					2	K2_GIG_W01,W07,W10 K2_GIG_U01,U08,U13 K2_GIG_K02	30	50	2	2	1,4	T/Z(w)	Z		DN	2	S
9	W06GIG-SM3025G	Structural geology GK	1			2		K2_GIG_W02,W08,W10,W15 K2_GIG_U04,U07,U10,U13 K2_GIG_K03	45	100	4	4	2,4	T/Z(w)	E		DN	2	S
10	W06GIG-SM3026G	Mineral Deposits GK	2		1			K2_GIG_W08,W09,W10 K2_GIG_U01,U10,U13 K2_GIG_K03	45	100	4	4	2,2	T/Z(w)	E		DN	2	S
11	W06GIG-SM3027G	Engineering geology and hydrogeology GK	2		1			K2_GIG_W02,W08,W10,W14 K2_GIG_U04,U07U10,U13 K2_GIG_K03	45	100	4	4	2,2	T/Z(w)	E		DN	2	S
12	W06GIG-SM3028G	Analytical technics in mineralogy and petrology GK	1		1			K2_GIG_W02,W08,W10 K2_GIG_U04,U10,U13 K2_GIG_U_K03	30	50	2	2	1,5	T/Z(w)	Z		DN	1	S
13	W06GIG-SM3052G	Geophysical measurements GK	2		1			K2_GIG_W02,W07,W08 K2_GIG_U08,U10,U13	45	100	4	4	2,2	T/Z(w)	E			2	S

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⁴University-wide subject / group of classes – enter O

⁵DN - number of ECTS points assigned to the classes related to the University's academic activity in the discipline/disciplines to which the main field of study is assigned

⁶Practical subject / group of classes – enter P. For the group of courses – in brackets enter the number of ECTS points assigned to practical courses

⁷KO – general education courses, PD – basic sciences courses, K – main field of study courses, S – specialization courses

14	W06GIG-SM3030G	Geological mapping GK	1		2	K2_GIG_U_K03 K2_GIG_W08,W10,W11 K2_GIG_U04,U10 K2_GIG_K03	45	100	4	4	2,4	T/Z(w)	E		DN	2	S
16	W06GIG-SM3053G	Historical geology GK	2		1	K2_GIG_W08,W10 K2_GIG_U10,U13 K2_GIG_K02,03	45	100	4	4	2,2	T/Z(w)	E			2	S
17	W06GIG-SM3054G	Geophysical exploration methods II GK	2		1	K2_GIG_W02,W08,W10 K2_GIG_U07,U10,U13 K2_GIG_K01,K03	45	100	4	4	2,2	T/Z(w)	E			2	S
18	GIG-SM0001AN	Free Elective	1				15	25	1		0,7		Z				S
19	W06GIG-SM3056P	Research in Innovative Exploration			6	K2_GIG_W01,W08,W10,W12 K2_GIG_U01,U07,U08,U10,U13 K2_GIG_K01,K02	90	175	7	4	3,9	T	Z		DN	7	S
Total			27	0	9	11	7	810	1700	68	60	39,5				39	

4.2.4.2 Diploma (e.g. diploma profile) block (21 ECTS points):

No	Subject / groups of classes code	Name of subject / groups of classes (denote group of courses with symbol GK)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form ² of course/group of courses	Way ³ of crediting	Subject / groups of classes			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN ⁵ classes	BU ¹ classes			University-wide ⁴	Concerning scientific activities ⁵	Practical ⁶	Type ⁷
1	W06GIG-SM3014S	Diploma Seminar					1	K2_GIG_W01 K2_GIG_U01,U13 K2_GIG_K03	15	25	1	1	0,8	T	Z		DN	P(1)	S
2	W06GIG-SM3015D	Master Thesis				1		K2_GIG_W01,W05,W10 K2_GIG_U01,U04, U08,U10,U13,U15 K2_GIG_K01,K03	15	500	20	20	1,8	T	Z		DN	P(20)	S
Total			0	0	0	1	1		30	525	21	21	2,6					21	

Altogether for specialization blocks:

Total number of hours					Total number of ZZU hours	Total number of CNPS hours	Total number of ECTS points	Total number of ECTS points for DN classes ⁵	Number of ECTS points for BU classes ¹
lec	cl	lab	pr	sem					
27	0	9	12	8	840	2225	89	81	42,1

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⁴University-wide subject /group of classes – enter O

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⁶Practical subject / group of classes – enter P. For the group of courses – in brackets enter the number of ECTS points assigned to practical courses

⁷KO – general education courses, PD – basic sciences courses, K – main field of study courses, S – specialization courses

4.3 Training block - concerning principles of training crediting – attachment no. ...

Opinion of the Advisory Faculty Council concerning the rules of crediting training block

Name of training			
Number of ECTS points	Number of ECTS points for BU ¹ classes	Training crediting mode	Code
Training duration		Training objective	
		Internship	

4.4 „Diploma dissertation” block (if it is foreseen at first level studies)

Type of diploma dissertation	Licencjat / inżynier / magister / magister inżynier*	
Number of diploma dissertation semesters	Number of ECTS points	Code
1	20	W06GIG-SM3015D
Character of diploma dissertation		
Literature survey, project, computer program, etc.		
Number of BU ¹ ECTS points	1,8	

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⁴University-wide subject /group of classes – enter O

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5. Ways of verifying assumed learning outcomes

Form of classes	Ways of verifying assumed learning outcomes
lecture	e.g. examination, progress/final test
class	e.g. progress/final test
laboratory	e.g. pretest, report from laboratory
project	e.g. project defence
seminar	e.g. participation in discussion, topic presentation, essay
training	e.g. report from training
diploma dissertation	prepared diploma dissertation

6. Range of diploma examination

1. Occupational risk assessment methods. Identification of harmful, dangerous and nuisance factors in the work environment.
2. Variogram and methods of its modelling
3. Kriging, its properties and types
4. Geophysical methods of exploration and identification of deposits.
5. Surface seismic methods. Reflective and refractive seismics.
6. Computer aided exploration and identification of deposits.
7. Optimisation techniques used in engineering.
8. Advances of technology & methods of future mining operations.
9. Aims, benefits, drawbacks of automation and industrial revolutions.
10. Applications of Interferometric Synthetic Aperture Radar.
11. Applications of map algebra and spatial statistics to determine surface deformation models
12. Perfectly elastic body vs linearly elastic body
13. Plate tectonic background of the geological processes
14. Magneto-, chemo-, seismic, sequence, and cycle stratigraphy
15. Surface geophysical methods
16. Geophysical methods used in boreholes
17. Classification of applied geophysical methods
18. Physical properties of rocks controlling the development of fractures, folds and other structural features

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²Traditional – enter T, remote – enter Z

³Exam – enter E, crediting – enter Z. For the group of classes – after the letter E or Z - enter in brackets the final subject form (lec, cl, lab, pr, sem)

⁴University-wide subject /group of classes – enter O

⁵DN - number of ECTS points assigned to the classes related to the University's academic activity in the discipline/disciplines to which the main field of study is assigned

⁶Practical subject / group of classes – enter P. For the group of courses – in brackets enter the number of ECTS points assigned to practical courses

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19. Ore forming geological processes which create different deposits
20. Genetic classification of deposits
21. Soil formation, soil classification methods
22. Hydrogeochemistry, transport processes
23. Analytical methods used in mineralogy and geology
24. Application of geophysical methods in different exploration phases
25. Different methods of stratigraphical correlation and their significance in raw material prospecting.
26. Rock mass age-determining methods
27. Geochemical aspects of the genesis of a chosen mineral
28. Principles of the distribution of chemical elements in the Earth
29. Applications of geo-informatics and GIS programs in mineral exploration
30. Modern measuring techniques in Geodesy
31. Sedimentary environments
32. Rock-forming processes
33. Characteristic of a selected minerals group
34. Plate tectonics and large scale structures
35. Water management issues
36. Sustainability and protection of groundwater
37. Vulnerability of groundwater
38. Laws and regulations related to exploration and exploitation of minerals / water
39. Mining legislation. Categorisation and classification of mineral reserves.
40. Groundwater chemistry and its impact on water use and legislation
41. Hydrogeological objects (wells, piezometers), construction and use.
42. Definitions of terms: ore mineral and industrial mineral. Classifications of industrial minerals.

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³Exam – enter E, crediting – enter Z. For the group of classes – after the letter E or Z - enter in brackets the final subject form (lec, cl, lab, pr, sem)

⁴University-wide subject /group of classes – enter O

⁵DN - number of ECTS points assigned to the classes related to the University's academic activity in the discipline/disciplines to which the main field of study is assigned

⁶Practical subject / group of classes – enter P. For the group of courses – in brackets enter the number of ECTS points assigned to practical courses

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7. Requirements concerning deadlines for crediting courses/groups of courses for all courses in particular blocks

No.	Subject / group of classes code	Name of subject / group of classes	Crediting by deadline of... (number of semester)
1	W06GIG-SM3017G	Physical Geology	1-4
2	W06GIG-SM3018G	Mineralogy and Geochemistry	1-4
3	W06GIG-SM3019G	Geophysical Exploration Methods I	1-4
4	W06GIG-SM3047G	Numerical methods and optimization GK	1-4
5	W06GIG-SM3048G	Engineering physics GK	1-4
6	W06GIG-SM3049G	Geodesy, spatial informatics GK	1-4
7	W06GIG-SM3050L	Computer science for engineers	1-4
8	W06GIG-SM3051G	Data and information processing GK	1-4
9	W06GIG-SM3031S	Graduate research seminar	1-4
10	W06GIG-SM3025G	Structural geology GK	2-4
11	W06GIG-SM3026G	Mineral Deposits GK	1-4
12	W06GIG-SM3027G	Engineering geology and hydrogeology GK	2-4
13	W06GIG-SM3028G	Analytical technics in mineralogy and petrology GK	2-4
14	W06GIG-SM3052G	Geophysical measurements GK	2-4
15	W06GIG-SM3030G	Geological mapping GK	2-4
16	W06GIG-SM3053G	Historical geology GK	2-4
17	W06GIG-SM3054G	Geophysical exploration methods II GK	2-4
18	W06GIG-SM3007	Principles and Application of InSAR and GIS in mining	3-4
19	W06GIG-SM3002	Computer Aided Geological Modelling & Geostatistics	3-4
20	W06GIG-SM3004	Engineering Geophysics	3-4
21	W06GIG-SM3005	Occupational Health and Safety	3-4
22	W06GIG-SM3000	Digital Mine	3-4
23	SJO-SM0003	Foreign language 1	3-4
24	SJO-SM0004	Foreign language 2	3-4
25	W06GIG-SM3055W	Geochemistry	3-4
26	GIG-SM0001AN	Free Elective	3-4

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27	W06GIG-SM3056P	Research in Innovative Exploration	3-4
28	W06GIG-SM3012G	Exploration Entrepreneurship	1-4
29	W06GIG-SM3013P	SOC Internship	1-4
30	W06GIG-SM3016P	Applied Field Exploration	1-4
31	W06GIG-SM3015D	Master Thesis	4
32	W06GIG-SM3014S	Diploma Seminar	4

8. Plan of studies (attachment no. 4)

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Approved by faculty student government legislative body:

POLITECHNIKA WROCLAWSKA
WYDZIAŁ GEOINŻYNIERII
GÓRNICWA I GEOLOGII
Samorząd Studencki Wydziału Geoinżynierii,
Górnictwa i Geologii
50-421 Wrocław, Na Grobli 15, pokój 370

Jakub Dobrzański

Jakub Dobrzański
Chairman of the Student Government
of the Faculty of Geoengineering, Mining and Geology

.....
name and surname, signature of student representative

28.09.23

.....
Date

DZIEKAN

prof. dr hab. inż. Radosław Zimroz

.....
Dean's signature

28.09.23

.....
Date

PLAN OF STUDIES

FACULTY: Geoengineering, Mining and Geology

MAIN FIELD OF STUDY: Mining and geology

EDUCATION LEVEL: second-level studies

FORM OF STUDIES: full-time studies

PROFILE: general academic

SPECIALIZATION: Mineral Resources Exploration - Track UM - WUST

LANGUAGE OF STUDY: English

In effect since academic year 2023/24

	Winter		Summer		Winter		Summer	
semester	1	ECTS	2	ECTS	3		4	ECTS
hours	UM		UM		WUST		WUST	
1	Physical Geology 20001 E W06GIG-SM3017G	4	Structural geology 10020 E W06GIG-SM3025G	4	Computer Aided Geological Modelling & Geostatistics 10300Z W06GIG- SM3002	5	Exploration entrepreneurship (EFG) 10012 Z W06GIG-SM3012G	4
2								
3								
4	Mineralogy and Geochemistry 20100 E W06GIG-SM3018G	4	Mineral Deposits 20100 E W06GIG-SM3026G	4	Engineering Geophysics 10010 Z W06GIG- SM3004	3	Diploma Seminar 00001Z W06GIG-SM3012G	1
5								
6								
7	Geophysical Exploration Methods I 20100E W06GIG-SM3019G	4	Engineering geology and hydrogeology 20001 E W06GIG-SM3027G	4	Principles and Application of InSAR and GIS in mining 20300E W06GIG- SM3007	5	Master Thesis 00010 Z W06GIG-SM3015D	20
8								
9								
10	Numerical methods and optimization 10100 Z W06GIG-SM3047G	2	Analytical technics in mineralogy and petrology 10100Z W06GIG-SM3028G	2	Digital Mine 10100 Z W06GIG- SM3006	2		
11								
12	Engineering physics 200001E W06GIG-SM3048G	4	Geophysical measurements 20100 E W06GIG-SM3052G	4	Geochemistry 20000Z W06GIG- SM3055W	2	SOC Internship 00020 Z W06GIG-SM3013P	2
13								
14								
15	Geodesy, spatial informatics 200001E W06GIG-SM3049G	4	Geological mapping 10020 E W06GIG-SM3030G	4	Foreign Language 2 01000 Z SJO-SM0004	1	Applied field exploration 00030 Z W06GIG-SM3013P	3
16								
17								
18	Computer science for engineers 00200 Z W06GIG-SM3050L	2	Historical geology 20001 E W06GIG-SM3053G	4	Research in innovative exploration 00060 Z W06GIG-SM3056P	7		
19								
20	Data and information processing 20001 Z W06GIG-SM3051G	4	Geophysical exploration methods II. 20001 E W06GIG-SM3054G	4	Free Elective 10000 GIG-SM0001AN	1		
21								
22	Graduate research seminar 00002 Z W06GIG-SM3031S	2			Occupational Health and Safety 100100Z W06GIG- SM3005	2		
23								
24								
25					Foreign Language 1 03000 Z SJO-SM0003	2		
26								
27								
Total ECTS		30		30		30		30

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1. Set of obligatory and optional subjects and groups of classes in semestral arrangement

Semester 1

Obligatory subjects / groups of classes (0 ECTS points)

No.	Subject / groups of classes code	Name of subject / groups of classes (denote group of courses with symbol GK)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form ² of course/group of courses	Way ³ of crediting	Subject / groups of classes			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN ⁵ classes	BU ¹ classes			University-wide ⁴	Concerning scientific activities ⁵	Practical ⁶	Type ⁷
1																			
Total																			

Optional subjects / groups of classes Number of ECTS points 30

No.	Subject / groups of classes code	Name of subject / groups of classes (denote group of courses with symbol GK)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form ² of course/group of courses	Way ³ of crediting	Subject / groups of classes			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN ⁵ classes	BU ¹ classes			University-wide ⁴	Concerning scientific activities ⁵	Practical ⁶	Type ⁷
1	W06GIG-SM3017G	Physical Geology GK	2			1		K2_GIG_W08,W10 K2_GIG_UU10,U13 K2_GIG_K02,03	45	100	4	4	2,4	T/Z(w)	E		DN	2	S
2	W06GIG-SM3018G	Mineralogy and Geochemistry GK	2		1			K2_GIG_W02,W08,W10 K2_GIG_U08,U10,U13 K2_GIG_K03	45	100	4	4	2,2	T/Z(w)	E		DN	2	S
3	W06GIG-SM3019G	Geophysical Exploration Methods I GK	2		1			K2_GIG_W02,W08,W10 K2_GIG_U07,U10,U13 K2_GIG_K01,K03	45	100	4	4	2,2	T/Z(w)	E		DN	2	S
4	W06GIG-SM3047G	Numerical methods and optimization GK	1		1			K2_GIG_W02,W09 K2_GIG_U04,U13,U14 K2_GIG_K01,K03	30	50	2	2	1,5	T/Z(w)	Z		DN	1	S
5	W06GIG-SM3048G	Engineering physics GK	2				1	K2_GIG_W02 K2_GIG_U01, U13 K2_GIG_K02	45	100	4		2,2	T/Z(w)	E			2	S
6	W06GIG-SM3049G	Geodesy, spatial informatics GK	2				1	K2_GIG_W02,W08,W15,W16 K2_GIG_U04,U10,U13 K2_GIG_K01,K03	45	100	4	4	2,2	T/Z(w)	E		DN	2	S
7	W06GIG-SM3050L	Computer science for engineers			2			K2_GIG_U04,U13 K2_GIG_K01,K03	30	50	2	2	1,4	T	Z		DN	2	S
8	W06GIG-SM3051G	Data and information processing GK	2				1	K2_GIG_W02,W15,W16 K2_GIG_U04,U13 K2_GIG_K01,K03	45	100	4	4	2,1	T/Z(w)	Z		DN	2	S

¹BU – number of ECTS points assigned to hours of classes requiring direct participation of academic teachers and other persons conducting classes

²Traditional – enter T, remote – enter Z

³Exam – enter E, crediting – enter Z. For the group of classes – after the letter E or Z - enter in brackets the final subject form (lec, cl, lab, pr, sem)

⁴University-wide subject /group of classes – enter O

⁵DN - number of ECTS points assigned to the classes related to the University's academic activity in the discipline/disciplines to which the main field of study is assigned

⁶Practical subject / group of classes – enter P. For the group of courses – in brackets enter the number of ECTS points assigned to practical courses

⁷KO – general education courses, PD – basic sciences courses, K – main field of study courses, S – specialization courses

9	W06GIG-SM3031S	Graduate research seminar				2	K2_GIG_W01,W07,W10 K2_GIG_U01,U08,U13 K2_GIG_K02	30	50	2	2	1,4	T/Z(w)	Z		DN	2	S
Total			13	5	1	5		360	750	30	24	17,6					17	

Altogether in semester

Total number of hours					Total number of ZZU hours	Total number of CNPS hours	Total number of ECTS points	Total number of ECTS points for DN classes ⁵	Number of ECTS points for BU classes ¹
lec	cl	lab	pr	sem					
13	0	5	1	5	360	750	30	24	17,6

Semester 2

Obligatory subjects / groups of classes (0 ECTS points)

No.	Subject / groups of classes code	Name of subject / groups of classes (denote group of courses with symbol GK)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form ² of course/group of courses	Way ³ of crediting	Subject / groups of classes			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN ⁵ classes	BU ¹ classes			University-wide ⁴	Concerning scientific activities ⁵	Practical ⁶	Type ⁷
1																			
		Total																	

¹BU – number of ECTS points assigned to hours of classes requiring direct participation of academic teachers and other persons conducting classes

²Traditional – enter T, remote – enter Z

³Exam – enter E, crediting – enter Z. For the group of classes – after the letter E or Z - enter in brackets the final subject form (lec, cl, lab, pr, sem)

⁴University-wide subject /group of classes – enter O

⁵DN - number of ECTS points assigned to the classes related to the University's academic activity in the discipline/disciplines to which the main field of study is assigned

⁶Practical subject / group of classes – enter P. For the group of courses – in brackets enter the number of ECTS points assigned to practical courses

⁷KO – general education courses, PD – basic sciences courses, K – main field of study courses, S – specialization courses

Optional subjects / groups of classes
Number of ECTS points 30

No	Subject / groups of classes code	Name of subject / groups of classes (denote group of courses with symbol GK)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form ² of course/group of courses	Way ³ of crediting	Subject / groups of classes			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN ⁵ classes	BU ¹ classes			University-wide ⁴	Concerning scientific activities ⁵	Practical ⁶	Type ⁷
1	W06GIG-SM3025G	Structural geology GK	1			2		K2_GIG_W02,W08,W10,W15 K2_GIG_U04,U07,U10,U13 K2_GIG_K03	45	100	4	4	2,4	T/Z(w)	E		DN	2	S
2	W06GIG-SM3026G	Mineral Deposits GK	2		1			K2_GIG_W08,W09,W10 K2_GIG_U01,U10,U13 K2_GIG_K03	45	100	4	4	2,2	T/Z(w)	E		DN	2	S
3	W06GIG-SM3027G	Engineering geology and hydrogeology GK	2		1			K2_GIG_W02,W08,W10,W14 K2_GIG_U04,U07U10,U13 K2_GIG_K03	45	100	4	4	2,2	T/Z(w)	E		DN	2	S
4	W06GIG-SM3028G	Analytical technics in mineralogy and petrology GK	1		1			K2_GIG_W02,W08,W10 K2_GIG_U04,U10,U13 K2_GIG_U_K03	30	50	2	2	1,5	T/Z(w)	Z		DN	1	S
5	W06GIG-SM3052G	Geophysical measurements GK	2		1			K2_GIG_W02,W07,W08 K2_GIG_U08,U10,U13 K2_GIG_U_K03	45	100	4	4	2,2	T/Z(w)	E			2	S
6	W06GIG-SM3030G	Geological mapping GK	1			2		K2_GIG_W08,W10,W11 K2_GIG_U04,U10 K2_GIG_K03	45	100	4	4	2,4	T/Z(w)	E		DN	2	S
7	W06GIG-SM3053G	Historical geology GK	2				1	K2_GIG_W08,W10 K2_GIG_U10,U13 K2_GIG_K02,03	45	100	4	4	2,2	T/Z(w)	E			2	S
8	W06GIG-SM3054G	Geophysical exploration methods II GK	2				1	K2_GIG_W02,W08,W10 K2_GIG_U07,U10,U13 K2_GIG_K01,K03	45	100	4	4	2,2	T/Z(w)	E			2	S
Total			13		4	4	2		345	750	30	30	17,3					15	

Altogether in semester

Total number of hours					Total number of ZZU hours	Total number of CNPS hours	Total number of ECTS points	Total number of ECTS points for DN classes ⁵	Number of ECTS points for BU classes ¹
lec	cl	lab	pr	sem					
13		4	4	2	345	750	30	30	17,3

¹BU – number of ECTS points assigned to hours of classes requiring direct participation of academic teachers and other persons conducting classes

²Traditional – enter T, remote – enter Z

³Exam – enter E, crediting – enter Z. For the group of classes – after the letter E or Z - enter in brackets the final subject form (lec, cl, lab, pr, sem)

⁴University-wide subject /group of classes – enter O

⁵DN - number of ECTS points assigned to the classes related to the University's academic activity in the discipline/disciplines to which the main field of study is assigned

⁶Practical subject / group of classes – enter P. For the group of courses – in brackets enter the number of ECTS points assigned to practical courses

⁷KO – general education courses, PD – basic sciences courses, K – main field of study courses, S – specialization courses

Semester 3

Obligatory subjects / groups of classes Number of ECTS points¹⁹

No.	Subject / groups of classes code	Name of subject / groups of classes (denote group of courses with symbol GK)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form ² of course/group of courses	Way ³ of crediting	Subject / groups of classes			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN ⁵ classes	BU ¹ classes			University-wide ⁴	Concerning scientific activities ⁵	Practical ⁶	Type ⁷
1	W06GIG-SM3002W	Computer Aided Geological Modelling & Geostatistics	1					K2_GIG_W06,W08,W15	15	50	2		0,8	T/Z	Z				PD/K
2	W06GIG-SM3002L	Computer Aided Geological Modelling & Geostatistics			3			K2_GIG_U04,U08,U14	45	75	3	2	1,9	T	Z		DN	3	PD/K
3	W06GIG-SM3004W	Engineering Geophysics	1					K2_GIG_W02,W08,W10	15	25	1	1	0,8	T/Z	Z		DN		PD
4	W06GIG-SM3004P	Engineering Geophysics				1		K2_GIG_U04,U13	15	50	2	2	0,9	T	Z		DN	2	PD
50	W06GIG-SM3007W	Principles and Application of InSAR and GIS in mining	2					K2_GIG_W15,W16,W18	30	50	2	2	1,4	T/Z(w)	E		DN		K
6	W06GIG-SM3007L	Principles and Application of InSAR and GIS in mining			3			K2_GIG_U04,U07,U08	45	75	3	3	2,0	T	Z		DN	3	K
7	W06GIG-SM3005W	Occupational Health and Safety	1					K2_GIG_W11,W12,W14,W17	15	25	1	1	0,7	T/Z(w)	Z		DN		K
8	W06GIG-SM3005P	Occupational Health and Safety				1		K2_GIG_U11, K2_GIG_K02, K03	15	25	1	1	0,8	T	Z		DN	1	K
9	W06GIG-SM3000W	Digital Mine	1					K2_GIG_W07,W12,W18,W19	15	25	1	1	0,8	T/Z(w)	Z		DN		K
10	W06GIG-SM3000L	Digital Mine			1			K2_GIG_U04,U07,U08	15	25	1	1	0,8	T	Z		DN	1	K
11	W06GIG-SM3055W	Geochemistry	2					K2_GIG_W02,W10 K2_GIG_K03	30	50	2	2	1,4	T/Z(w)	Z	O	DN		PD
Total			8		7	2			255	475	19	16	12,3					10	

¹BU – number of ECTS points assigned to hours of classes requiring direct participation of academic teachers and other persons conducting classes

²Traditional – enter T, remote – enter Z

³Exam – enter E, crediting – enter Z. For the group of classes – after the letter E or Z - enter in brackets the final subject form (lec, cl, lab, pr, sem)

⁴University-wide subject /group of classes – enter O

⁵DN - number of ECTS points assigned to the classes related to the University's academic activity in the discipline/disciplines to which the main field of study is assigned

⁶Practical subject / group of classes – enter P. For the group of courses – in brackets enter the number of ECTS points assigned to practical courses

⁷KO – general education courses, PD – basic sciences courses, K – main field of study courses, S – specialization courses

Optional subjects / groups of classes (11 ECTS points)

No.	Subject / groups of classes code	Name of subject / groups of classes (denote group of courses with symbol GK)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form ² of course/group of courses	Way ³ of crediting	Subject / groups of classes			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN ⁵ classes	BU ¹ classes			University-wide ⁴	Concerning scientific activities ⁵	Practical ⁶	Type ⁷
1	SJO-SM0003	Foreign Language 1		3				K2_GIG_U03	45	60	2		1,6	T	Z	O		2	KO
2	SJO-SM0004	Foreign Language 2		1				K2_GIG_U01,U02	15	30	1		0,6	T	Z	O		1	KO
3	GIG-SM0001AN	Free Elective	1						15	25	1		0,7	T /Z(w)	Z				S
4	W06GIG-SM3056P	Research in Innovative Exploration					6	K2_GIG_W01,W08,W10,W12 K2_GIG_U01,U07,U08,U10,U13 K2_GIG_K01,K02	90	175	7	4	3,9	T	Z		DN	7	S
Total			1	4	0	6			165	290	11	4	6,8					10	

Altogether in semester

Total number of hours					Total number of ZZU hours	Total number of CNPS hours	Total number of ECTS points	Total number of ECTS points for DN classes ⁵	Number of ECTS points for BU classes ¹
lec	cl	lab	pr	sem					
9	4	7	8	0	420	765	30	20	19,1

¹BU – number of ECTS points assigned to hours of classes requiring direct participation of academic teachers and other persons conducting classes

²Traditional – enter T, remote – enter Z

³Exam – enter E, crediting – enter Z. For the group of classes – after the letter E or Z - enter in brackets the final subject form (lec, cl, lab, pr, sem)

⁴University-wide subject /group of classes – enter O

⁵DN - number of ECTS points assigned to the classes related to the University's academic activity in the discipline/disciplines to which the main field of study is assigned

⁶Practical subject / group of classes – enter P. For the group of courses – in brackets enter the number of ECTS points assigned to practical courses

⁷KO – general education courses, PD – basic sciences courses, K – main field of study courses, S – specialization courses

Semester 4

Obligatory subjects / groups of classes

Number of ECTS points 9

No.	Subject / groups of classes code	Name of subject / groups of classes (denote group of courses with symbol GK)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form ² of course/group of courses	Way ³ of crediting	Subject / groups of classes			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN ⁵ classes	BU ¹ classes			University-wide ⁴	Concerning scientific activities ⁵	Practical ⁶	Type ⁷
1	W06GIG-SM3012G	Exploration Entrepreneurship GK	1			1	2	K2_GIG_W03,W05,W09 K2_GIG_U08,U09 K2_GIG_K01,K02,K03	60	100	4		3,0	Z	Z			P(3)	S
2	W06GIG-SM3013P	SOC Internship					2	K2_GIG_W05,W09 K2_GIG_U08,U09 K2_GIG_K01,K02,K03	30	50	2		1,5	T	Z			P(2)	S
3	W06GIG-SM3016P	Applied Field Exploration					3	K2_GIG_W08,W15 K2_GIG_U04,U09,U10,U13 K2_GIG_K02	45	75	3	1	2,1	T	Z		DN	P(3)	S
Total			1	0	0	6	2		135	225	9	1	6,6					8	

Optional subjects / groups of classes (21 ECTS points)

No.	Subject / groups of classes code	Name of subject / groups of classes (denote group of courses with symbol GK)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form ² of course/group of courses	Way ³ of crediting	Subject / groups of classes			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN ⁵ classes	BU ¹ classes			University-wide ⁴	Concerning scientific activities ⁵	Practical ⁶	Type ⁷
1	W06GIG-SM3014S	Diploma Seminar					1	K2_GIG_W01 K2_GIG_U01,U13 K2_GIG_K02,K03	15	25	1	1	0,8	T	Z		DN	P(1)	S
2	W06GIG-SM3015D	Master Thesis					1	K2_GIG_W01,W05,W10 K2_GIG_U01,U04,U08,U10,U13,U15 K2_GIG_K01,K02,K03	15	500	20	20	1,8	T	Z		DN	P(20)	S
Total			0	0	0	1	1		30	525	21	21	2,6					21	

Altogether in semester

Total number of hours					Total number of ZZU hours	Total number of CNPS hours	Total number of ECTS points	Total number of ECTS points for DN classes ⁵	Number of ECTS points for BU classes ¹
lec	cl	lab	pr	sem					
1	0	0	7	3	165	750	30	22	9,2

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²Traditional – enter T, remote – enter Z

³Exam – enter E, crediting – enter Z. For the group of classes – after the letter E or Z - enter in brackets the final subject form (lec, cl, lab, pr, sem)

⁴University-wide subject /group of classes – enter O

⁵DN - number of ECTS points assigned to the classes related to the University's academic activity in the discipline/disciplines to which the main field of study is assigned

⁶Practical subject / group of classes – enter P. For the group of courses – in brackets enter the number of ECTS points assigned to practical courses

⁷KO – general education courses, PD – basic sciences courses, K – main field of study courses, S – specialization courses

2. Set of examinations in semestral arrangement

Subject / groups of classes code	Names of subjects / groups of classes ending with examination	Semester
W06GIG-SM3017G	1. Physical Geology	1
W06GIG-SM3018G	2. Mineralogy and Geochemistry	1
W06GIG-SM3019G	3. Geophysical Exploration Methods I	1
W06GIG-SM3048G	4. Engineering physics	1
W06GIG-SM3049G	5. Geodesy, spatial informatics	1
W06GIG-SM3017G	1. Structural geology	2
W06GIG-SM3018G	2. Mineral Deposits	2
W06GIG-SM3019G	3. Engineering geology and hydrogeology	2
W06GIG-SM3030G	4. Geological mapping	2
W06GIG-SM3052G	5. Geophysical measurements	2
W06GIG-SM3053G	6. Historical geology	2
W06GIG-SM3054G	7. Geophysical exploration methods II	2
W06GIG-SM3007	1. Principles and Applications of InSAR in Mining	3
	Final diploma examination	4

3. Numbers of allowable deficit of ECTS points after particular semesters

Semester	Allowable deficit of ECTS points after semester
1	12
2	8
3	0

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Opinion of student government legislative body

POLITECHNIKA WROCLAWSKA
WYDZIAŁ GEOINŻYNIERII
GÓRNICTWA I GEOLOGII
Samorząd Studencki Wydziału Geoinżynierii,
Górnictwa i Geologii
50-421 Wrocław, Na Grebli 15, pokój 370

28.09.23

Jakub Dobrzański

Jakub Dobrzański
Chairman of the Student Government
of the Faculty of Geoengineering, Mining and Geology

Date

Name and surname, signature of student representative

28.09.23

DZIEKAN
RD
prof. dr hab. inż. Radosław Zimroz
(1)

Date

Dean's signature

FACULTY: **of Geoengineering, Mining and Geology**

MAIN FIELD OF STUDY: **Mining and Geology**

LANGUAGE OF STUDY: English

SPECIALIZATION: **Mineral Resources Exploration**

- Track -WUST - UNI MISKOLC

DESCRIPTION OF THE PROGRAM OF STUDIES

Main field of study MINING AND GEOLOGY**Profile** general academic**Level of studies** second level studies**Form of studies** full-time studies**1. General description**

<i>1.1 Number of semesters: 4</i>	<i>1.2 Total number of ECTS points necessary to complete studies at a given level: 120</i>
<i>1.3 Total number of hours: 1365</i>	<i>1.4 Prerequisites (particularly for second-level studies): Bachelor of Science in Engineering diploma, interview</i>
<i>1.5 Upon completion of studies graduate obtains professional degree of: magister inżynier - 2nd degree qualifications</i>	<p><i>1.6 Graduate profile, employability:</i></p> <p><i>The program will train T-shaped earth science specialists having a strong background in classical disciplines of geology and geophysics complemented with modern 3D modelling as well as data processing and interpretation skills, while the boundary-crossing competences will cover skills in innovative mineral exploration techniques and technologies used in the field, in laboratories, in an underground and underwater environment. Students will also be trained in sustainability, social responsibility and social licence to operate. T-shaped mineral explorers will use Industry 4.0-derived tools and methods for mineral resource exploration, mentored by experts.</i></p> <p><i>They will be prepared to work in enterprises, technical supervision institutions, public state and local administration, in research and development organisations, in Poland and</i></p>

	<p><i>abroad, will also be prepared to start own business or work as free lanced exploration geologists. The graduates will be able to use English freely and will be prepared to work in an international environment and intercultural groups during their professional career.</i></p>
<p><i>1.7 Possibility of continuing studies: eligibility to apply for admission to a doctoral school, non-degree postgraduate programmes</i></p>	<p><i>1.8 Indicate connection with University’s mission and its development strategy: The study programs of all specializations within the field of study Mining and Geology respond to the strategic goals of the University (Strategia Politechniki Wrocławskiej 2023–2030), by rising the level of correlation of the study offer with the needs of the market (C3), by enhancing the quality of education through didactic interdisciplinarity and by cooperation with industrial partners as well as increasing the level of entrepreneurship, creativity and involvement of students in research processes (C4, C2). Graduates of the faculty should be creative, professional, have theoretical background and practical abilities, as well as have interpersonal skills and cross-cultural experience (C5). The Faculty of Geoengineering, Mining and Geology, as one of the units of the Wrocław University of Science and Technology, educates in the field of engineering, broadened by knowledge in natural and economic sciences. The profile and quality of education are at the international level and are adapted to the needs of the national and global mineral industries.</i></p>

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³Exam – enter E, crediting – enter Z. For the group of classes – after the letter E or Z - enter in brackets the final subject form (lec, cl, lab, pr, sem)

⁴University-wide subject /group of classes – enter O

⁵DN - number of ECTS points assigned to the classes related to the University's academic activity in the discipline/disciplines to which the main field of study is assigned

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2. Detailed description

2.1 Total number of learning outcomes in the program of study: W (knowledge) = 19, U (skills) = 15, K (competences) = 3,
W + U + K = 37

~~2.2 For the main field of study assigned to more than one discipline – the number of learning outcomes assigned to the discipline:~~

~~_____ D1 (major) (this number must be greater than half the total number of learning outcomes)~~

~~_____ D2~~

~~_____ D3~~

~~_____ D4~~

~~2.3 For the main field of study assigned to more than one discipline – percentage share of the number of ECTS points for each discipline:~~

~~_____ D1% ECTS points~~

~~_____ D2% ECTS points~~

~~_____ D3% ECTS points~~

~~_____ D4% ECTS points~~

2.4a. For the general academic profile of the main field of study – the number of ECTS points assigned to the classes related to the University's academic activity in the discipline or disciplines to which the main field of study is assigned – DN (must be greater than 50% of the total number of ECTS points from 1.2) 95 ECTS

~~2.4b. For the practical profile of the main field of study – the number of ECTS points assigned to the classes shaping practical skills (must be greater than 50% of the total number of ECTS points from 1.2)~~

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³Exam – enter E, crediting – enter Z. For the group of classes – after the letter E or Z - enter in brackets the final subject form (lec, cl, lab, pr, sem)

⁴University-wide subject /group of classes – enter O

⁵DN - number of ECTS points assigned to the classes related to the University's academic activity in the discipline/disciplines to which the main field of study is assigned

⁶Practical subject / group of classes – enter P. For the group of courses – in brackets enter the number of ECTS points assigned to practical courses

⁷KO – general education courses, PD – basic sciences courses, K – main field of study courses, S – specialization courses

2.5 Concise analysis of compliance of the assumed learning outcomes with the needs of the labor market

The economic development of the country is closely dependent on natural resources, the ability to use them and having appropriate engineering workforce. The assumed learning outcomes correspond to the needs of practice in the field of the generally understood management of mineral resources - technologies and techniques for their identification, valuation, extraction, processing, revitalization of industrial areas, and the practice of managing an enterprise (especially mining) in the sense of managing information, environment and people, using the latest IT and marketing techniques and methods. This integration of economic needs and assumed educational effects favorably shape the labor market for the graduates of the Faculty. Additionally, a good command of English and experience of working in an international group will open up the possibility of working in foreign branches of Polish enterprises and in foreign companies.

2.6. The total number of ECTS points that a student must obtain in classes requiring direct participation of academic teachers or other persons conducting classes and students (enter the sum of ECTS points for courses / groups of courses marked with the BU¹ code) **67,5ECTS**

2.7. Total number of ECTS points, which student has to obtain from basic sciences classes

Number of ECTS points for obligatory subjects	6
Number of ECTS points for optional subjects	0
Total number of ECTS points	6

2.8. Total number of ECTS points, which student has to obtain from practical classes, including project and laboratory classes (enter total number of ECTS points for courses/group of courses denoted with code P)

Number of ECTS points for obligatory subjects	24
Number of ECTS points for optional subjects	58
Total number of ECTS points	82

¹BU – number of ECTS points assigned to hours of classes requiring direct participation of academic teachers and other persons conducting classes

²Traditional – enter T, remote – enter Z

³Exam – enter E, crediting – enter Z. For the group of classes – after the letter E or Z - enter in brackets the final subject form (lec, cl, lab, pr, sem)

⁴University-wide subject /group of classes – enter O

⁵DN - number of ECTS points assigned to the classes related to the University's academic activity in the discipline/disciplines to which the main field of study is assigned

⁶Practical subject / group of classes – enter P. For the group of courses – in brackets enter the number of ECTS points assigned to practical courses

⁷KO – general education courses, PD – basic sciences courses, K – main field of study courses, S – specialization courses

2.9. Minimum number of ECTS points, which student has to obtain doing education blocks offered as part of University-wide classes or other main field of study (enter number of ECTS points for courses/groups of courses denoted with code O)

3 ECTS points

2.10. Total number of ECTS points, which student may obtain doing optional blocks (min. 30% of total number of ECTS points)

84 ECTS points

3. Description of the process leading to learning outcomes acquisition:

1. Upon starting classes in each subject, the student has an appropriate level of knowledge and skills which constitute the prerequisites for a given course (it is verified by the teacher or the dean's office).
2. The student participates in classes organized at the university.
3. The student carries out the assigned work in class and at home (projects, computational tasks, analyzes, prepares presentations) and studies the literature and materials recommended by the teacher.
4. The student uses the appointed hours of the tutor's consultation, explaining his uncertainties and verifying the correct understanding of the course content.
5. The student participates in periodic tests of knowledge and skills, completes the tests available on the e-portal and is familiar with the correct answers, grades and comments from the teacher.
6. In some subjects, the student participates in group tasks, taking part in the organization of the group's work, assessment of the activities of individual participants and takes responsibility for the result of the group's work.
7. The student is encouraged to become involved in the work of research clubs, student organizations, discussion clubs, sports groups, participation in social life through work in public welfare organizations, voluntary work, thus gaining valuable interpersonal skills and social competences.
8. The student participates in meetings with companies from the industry, technical excursions, job fairs, tries to gain knowledge about the labor market and additional advantages when applying for a job
9. The student is encouraged to participate in an international student exchange, and through contact with foreigners at the faculty, he or she acquires additional interpersonal, cultural and language qualifications

¹BU – number of ECTS points assigned to hours of classes requiring direct participation of academic teachers and other persons conducting classes

²Traditional – enter T, remote – enter Z

³Exam – enter E, crediting – enter Z. For the group of classes – after the letter E or Z - enter in brackets the final subject form (lec, cl, lab, pr, sem)

⁴University-wide subject /group of classes – enter O

⁵DN - number of ECTS points assigned to the classes related to the University's academic activity in the discipline/disciplines to which the main field of study is assigned

⁶Practical subject / group of classes – enter P. For the group of courses – in brackets enter the number of ECTS points assigned to practical courses

⁷KO – general education courses, PD – basic sciences courses, K – main field of study courses, S – specialization courses

4. List of education blocks:

4.1. List of obligatory blocks:

4.1.1 List of general education blocks

4.1.1.1 Liberal-managerial subjects block (7 ECTS points):

No.	Subject/ group of classes code	Name of subject/group of classes (denote group of courses with symbol GK)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form ² of course/gr oup of courses	Way ³ of crediting	Subject/ group of classes			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN ⁵ classes	BU ¹ classes			University -wide ⁴	Concerni ng scientific activities ⁵	Practical ⁶	Type ⁷
1	W06GIG- SM3003G	Project Management, Appraisal and Risk Evaluation (GK)	1		2	1		K2_GIG_W03,W05,W11 K2_GIG_U04,U06,U08,U15 K2_GIG_K01	60	100	4	4	3,1	T/Z(w)	E(w), Z(l,p)		DN	P (3)	KO
2	W06GIG- SM3000W	Operations Research	1					K2_GIG_W06 K2_GIG_U10,U14 K2_GIG_K01	15	25	1	1	0,8	T/Z	Z		DN		KO
3	W06GIG- SM3000L	Operations Research			1			K2_GIG_U10,U14 K2_GIG_K01	15	50	2	2	0,7	T	Z		DN	P (2)	KO
Total			2	0	3	1	0		90	175	7	7	4,6					5	

Altogether for general education blocks

Total number of hours					Total number of ZZU hours	Total number of CNPS hours	Total number of ECTS points	Total number of ECTS points for DN classes ⁵	Number of ECTS points for BU classes ¹
lec	cl	lab	pr	sem					
2	0	3	1	0	90	175	7	7	4,6

¹BU – number of ECTS points assigned to hours of classes requiring direct participation of academic teachers and other persons conducting classes

²Traditional – enter T, remote – enter Z

³Exam – enter E, crediting – enter Z. For the group of classes – after the letter E or Z - enter in brackets the final subject form (lec, cl, lab, pr, sem)

⁴University-wide subject /group of classes – enter O

⁵DN - number of ECTS points assigned to the classes related to the University's academic activity in the discipline/disciplines to which the main field of study is assigned

⁶Practical subject / group of classes – enter P. For the group of courses – in brackets enter the number of ECTS points assigned to practical courses

⁷KO – general education courses, PD – basic sciences courses, K – main field of study courses, S – specialization courses

4.1.2 List of basic sciences blocks

4.1.2.1 Mathematics block

No.	Subject/ group of classes code	Name of subject/group of classes (denote group of courses with symbol GK)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form ² of course/gr oup of courses	Way ³ of crediting	Subject/ group of classes			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN ⁵ classes	BU ¹ classes			University -wide ⁴	Concerni ng scientific activities ⁵	Practical ⁶	Type ⁷
1	W06GIG- SM3002W	Computer Aided Geological Modelling & Geostatistics (część: Geostatistics)	1					K2_GIG_W06,W08,W15 K2_GIG_U04,U08,U14	15	50	2		0,8	T	Z				PD
2	W06GIG- SM3002L	Computer Aided Geological Modelling & Geostatistics (część: Geostatistics)			1				15	25	1		0,6	T	Z			P (1)	PD
Total			1	0	1	0	0		30	75	3		1,4					1	

4.1.2.3 Physics block

No.	Subject/ group of classes code	Name of subject/group of classes (denote group of courses with symbol GK)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form ² of course/gr oup of courses	Way ³ of crediting	Subject/group of classes			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN ⁵ classes	BU ¹ classes			University -wide ⁴	Concerni ng scientific activities ⁵	Practical ⁶	Type ⁷
1	W06GIG- SM3004W	Engineering Geophysics	1					K2_GIG_W02,W08,W10 K2_GIG_U04,U13	15	25	1	1	0,8	T/Z	Z		DN		PD
	W06GIG- SM3004P	Engineering Geophysics				1			15	50	2	2	0,9	T	Z		DN	P(2)	PD
Total			2	0	0	0	0		30	75	3	3	1,7					2	

Altogether for basic sciences blocks:

Total number of hours					Total number of ZZU hours	Total number of CNPS hours	Total number of ECTS points	Total number of ECTS points for DN classes ⁵	Number of ECTS points for BU classes ¹
lec	cl	lab	pr	sem					
3	0	1	0	0	60	150	6	3	3,1

¹BU – number of ECTS points assigned to hours of classes requiring direct participation of academic teachers and other persons conducting classes

²Traditional – enter T, remote – enter Z

³Exam – enter E, crediting – enter Z. For the group of classes – after the letter E or Z - enter in brackets the final subject form (lec, cl, lab, pr, sem)

⁴University-wide subject /group of classes – enter O

⁵DN - number of ECTS points assigned to the classes related to the University's academic activity in the discipline/disciplines to which the main field of study is assigned

⁶Practical subject / group of classes – enter P. For the group of courses – in brackets enter the number of ECTS points assigned to practical courses

⁷KO – general education courses, PD – basic sciences courses, K – main field of study courses, S – specialization courses

4.1.3 List of the main field of study blocks

4.1.3.1 Obligatory main field of study blocks

No.	Subject/ group of classes code	Name of subject/group of classes (denote group of courses with symbol GK)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form ² of course/gr oup of courses	Way ³ of crediting	Subject/group of classes			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN ⁵ clas ses	BU ¹ clas ses			Unive rsity- wide ⁴	Concerning scientific activities ⁵	Practical ⁶	Type ⁷
1	W06GIG- SM3002L	Computer Aided Geological Modelling & Geostatistics (Część: Computer Aided Geological Modelling)			2			K2_GIG_W06,W08,W15 K2_GIG_U04,U08,U14	30	50	2	2	1,3	T	Z		DN	P(2)	K
2	W06GIG- SM3006W	Digital Mine	1					K2_GIG_W07,W12,W18,W19 K2_GIG_U04,U07,U08	15	25	1	1	0,8	T/Z(w)	Z		DN		K
3	W06GIG- SM3006L	Digital Mine			1				15	25	1	1	0,8	T	Z		DN	P(1)	K
4	W06GIG- SM3005W	Occupational Health and Safety	1					K2_GIG_W11,W12,W14,W17 K2_GIG_U11, K2_GIG_K02, K03	15	25	1	1	0,7	T/Z(w)	Z		DN		K
5	W06GIG- SM3005P	Occupational Health and Safety				1			15	25	1	1	0,8	T	Z		DN	P(1)	K
6	W06GIG- SM3007W	Principles and Application of InSAR and GIS in mining	2					K2_GIG_W15,W16,W18 K2_GIG_U04,U07,U08	30	50	2	2	1,4	T/Z(w)	E		DN		K
7	W06GIG- SM3007L	Principles and Application of InSAR and GIS in mining			3				45	75	3	3	2,0	T	Z		DN	P(3)	K
8	W06GIG- SM3001W	Environmental Management	2					K2_GIG_W04,W12,W13,W18 K2_GIG_U05,U10,U11,U12 K2_GIG_K02,K03	30	50	2	2	1,3	T/Z(w)	Z		DN		K
9	W06GIG- SM3001S	Environmental Management					1		15	25	1	1	0,8	T	Z		DN	P(1)	K
10	W06GIG- SM3012G	Exploration Entrepreneurship GK	1			1	2	K2_GIG_W03,W05,W09 K2_GIG_U08,U09 K2_GIG_K01,K02,K03	60	100	4		3,0	Z	Z			P(3)	S
11	W06GIG- SM3013P	SOC Internship				2		K2_GIG_W05,W09 K2_GIG_U08,U09 K2_GIG_K01,K02,K03	30	50	2		1,5	T	Z			P(2)	S
12	W06GIG- SM3016P	Applied Field Exploration				3		K2_GIG_W08,W15 K2_GIG_U04,U09,U10,U13 K2_GIG_K02	45	75	3	1	2,1	T	Z		DN	P(3)	S
Total			7	0	6	7	3		345	575	23	15	16,5					16	

¹BU – number of ECTS points assigned to hours of classes requiring direct participation of academic teachers and other persons conducting classes

²Traditional – enter T, remote – enter Z

³Exam – enter E, crediting – enter Z. For the group of classes – after the letter E or Z - enter in brackets the final subject form (lec, cl, lab, pr, sem)

⁴University-wide subject /group of classes – enter O

⁵DN - number of ECTS points assigned to the classes related to the University's academic activity in the discipline/disciplines to which the main field of study is assigned

⁶Practical subject / group of classes – enter P. For the group of courses – in brackets enter the number of ECTS points assigned to practical courses

⁷KO – general education courses, PD – basic sciences courses, K – main field of study courses, S – specialization courses

Altogether (for main field of study blocks):

Total number of hours					Total number of ZZU hours	Total number of CNPS hours	Total number of ECTS points	Total number of ECTS points for DN classes ⁵	Number of ECTS points for BU classes ¹
lec	cl	lab	pr	sem					
7	0	6	7	3	345	575	23	15	16,5

4.2 List of optional blocks

4.2.1 List of general education blocks

4.2.1.2 Foreign languages block (min. 3 ECTS points):

No.	Subject/group of classes code	Name of subject/group of classes (denote group of courses with symbol GK)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form ² of course/group of courses	Way ³ of crediting	Subject/group of classes			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN ⁵ classes	BU ¹ classes			University-wide ⁴	Concerning scientific activities ⁵	Practical ⁶	Type ⁷
1	SJO-SM0003	Foreign Language 1		3				K2_GIG_U03	45	60	2		1,6	T	Z	O		P (2)	KO
2	SJO-SM0004	Foreign Language 2		1				K2_GIG_U01,U02	15	30	1		0,6	T	Z	O		P(1)	KO
Total			0	4	0	0	0		60	90	3		2,2					3	

Altogether for general education blocks:

Total number of hours					Total number of ZZU hours	Total number of CNPS hours	Total number of ECTS points	Total number of ECTS points for DN classes ⁵	Number of ECTS points for BU classes ¹
lec	cl	lab	pr	sem					
0	4	0	0	0	60	90	3	0	2,2

¹BU – number of ECTS points assigned to hours of classes requiring direct participation of academic teachers and other persons conducting classes

²Traditional – enter T, remote – enter Z

³Exam – enter E, crediting – enter Z. For the group of classes – after the letter E or Z - enter in brackets the final subject form (lec, cl, lab, pr, sem)

⁴University-wide subject /group of classes – enter O

⁵DN - number of ECTS points assigned to the classes related to the University's academic activity in the discipline/disciplines to which the main field of study is assigned

⁶Practical subject / group of classes – enter P. For the group of courses – in brackets enter the number of ECTS points assigned to practical courses

⁷KO – general education courses, PD – basic sciences courses, K – main field of study courses, S – specialization courses

4.2.4 List of specialization blocks

4.2.4.1 Specialization subjects (e.g. whole specialization) blocks (60 ECTS points):

No.	Subject/ group of classes code	Name of subject/group of classes (denote group of courses with symbol GK)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form ² of course/gr oup of courses	Way ³ of crediting	Subject/group of classes			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN ⁵ classes	BU ¹ classes			Universi ty-wide ⁴	Concerni ng scientific activities ⁵	Practical ⁶	Type ⁷
1	W06GIG- SM3017G	Physical Geology GK	2			1		K2_GIG_W08,W10 K2_GIG_UU10,U13 K2_GIG_K02,03	45	100	4	4	2,4	T/Z(w)	E		DN	2	S
2	W06GIG- SM3018G	Mineralogy and Geochemistry GK	2		1			K2_GIG_W02,W08,W10 K2_GIG_U08,U10,U13 K2_GIG_K03	45	100	4	4	2,2	T/Z(w)	E		DN	2	S
3	W06GIG- SM3019G	Geophysical Exploration Methods I GK	2		1			K2_GIG_W02,W08,W10 K2_GIG_U07,U10,U13 K2_GIG_K01,K03	45	100	4	4	2,2	T/Z(w)	E		DN	2	S
4	W06GIG- SM3020G	Geological Interpretation and Prospecting GK	2			2		K2_GIG_W02,W08,W10 K2_GIG_U04,U06,U09,U10,U13 K2_GIG_K01	60	100	4	2	3,0	T/Z(w)	E		DN	2	S
5	W06GIG- SM3021G	Geophysical Interpretation and Prospecting GK	2			2		K2_GIG_W02,W08,W09,W11,W15 K2_GIG_U04,U10,U13 K2_GIG_K02	60	100	4	3	3,0	T/Z(w)	E		DN	2	S
6	W06GIG- SM3022G	Geoelectric lectureship GK	2			2		K2_GIG_W02,W08,W10 K2_GIG_U04,U10 K2_GIG_K03	60	100	4		3,0	T/Z(w)	Z			2	S
7	W06GIG- SM3023G	Global environmental geophysics GK	1				1	K2_GIG_W02, W10,W12 K2_GIG_U01,U05,U08 K2_GIG_K03	30	50	2		1,7	T/Z(w)	Z			1	S
8	W06GIG- SM3024G	Non-metallic industrial minerals GK	2		2			K2_GIG_W02,W08,W10, K2_GIG_U07,U10 K2_GIG_K01	60	100	4	4	2,7	T/Z(w)	Z		DN	2	S
9	W06GIG- SM3025G	Structural geology GK	1			2		K2_GIG_W02,W08,W10,W15 K2_GIG_U04,U07,U10,U13 K2_GIG_K03	45	100	4	4	2,4	T/Z(w)	E		DN	2	S
10	W06GIG- SM3026G	Mineral Deposits GK	2		1			K2_GIG_W08,W09,W10 K2_GIG_U01,U10,U13 K2_GIG_K03	45	100	4	4	2,2	T/Z(w)	E		DN	2	S
11	W06GIG- SM3027G	Engineering geology and hydrogeology GK	2		1			K2_GIG_W02,W08,W10,W14 K2_GIG_U04,U07U10,U13 K2_GIG_K03	45	100	4	4	2,2	T/Z(w)	E		DN	2	S
12	W06GIG- SM3028G	Analytical technics in mineralogy and petrology GK	1		1			K2_GIG_W02,W08,W10 K2_GIG_U04,U10,U13 K2_GIG_U_K03	30	50	2	2	1,5	T/Z(w)	Z		DN	1	S
13	W06GIG- SM3029G	Geochemical prospecting methods GK	1			2		K2_GIG_W02,W08,W10 K2_GIG_U04,U10,U13 K2_GIG_K02	45	100	4	4	2,3	T/Z(w)	Z		DN	2	S
14	W06GIG- SM3030G	Geological mapping GK	1			2		K2_GIG_W08,W10,W11 K2_GIG_U04,U10 K2_GIG_K03	45	100	4	4	2,4	T/Z(w)	E		DN	2	S

¹BU – number of ECTS points assigned to hours of classes requiring direct participation of academic teachers and other persons conducting classes

²Traditional – enter T, remote – enter Z

³Exam – enter E, crediting – enter Z. For the group of classes – after the letter E or Z - enter in brackets the final subject form (lec, cl, lab, pr, sem)

⁴University-wide subject /group of classes – enter O

⁵DN - number of ECTS points assigned to the classes related to the University's academic activity in the discipline/disciplines to which the main field of study is assigned

⁶Practical subject / group of classes – enter P. For the group of courses – in brackets enter the number of ECTS points assigned to practical courses

⁷KO – general education courses, PD – basic sciences courses, K – main field of study courses, S – specialization courses

15	W06GIG-SM3031S	Graduate research seminar					2	K2_GIG_W01,W07,W10 K2_GIG_U01,U08,U13 K2_GIG_K02	30	50	2	2	1,4	T/Z(w)	Z		DN	2	S
16	W06GIG-SM3032P	Student research project				6		K2_GIG_W01,W08,W10,W12 K2_GIG_U01,U07,U08,U10,U13 K2_GIG_K01,K02	90	150	6	4	3,9	T/Z(w)	Z		DN	6	S
Total			23	0	7	19	3		780	1500	60	49	38,5					34	

4.2.4.2 Diploma (e.g. diploma profile) block (21 ECTS points):

No.	Subject/group of classes code	Name of subject/group of classes (denote group of courses with symbol GK)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form ² of course/group of courses	Way ³ of crediting	Subject/group of classes			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN ⁵ classes	BU ¹ classes			University-wide ⁴	Concerning scientific activities ⁵	Practical ⁶	Type ⁷
1	W06GIG-SM3014S	Diploma Seminar					1	K2_GIG_W01 K2_GIG_U01,U13 K2_GIG_K03	15	25	1	1	0,8	T	Z		DN	P(1)	S
2	W06GIG-SM3015D	Master Thesis				1		K2_GIG_W01,W05,W10 K2_GIG_U01,U04, U08,U10,U13,U15 K2_GIG_K01,K03	15	500	20	20	1,8	T	Z		DN	P(20)	S
Total			0	0	0	1	1		30	525	21	21	2,6					21	

Altogether for specialization blocks:

Total number of hours					Total number of ZZU hours	Total number of CNPS hours	Total number of ECTS points	Total number of ECTS points for DN classes ⁵	Number of ECTS points for BU classes ¹
lec	cl	lab	pr	sem					
23	0	7	20	4	810	2025	81	70	41,1

¹BU – number of ECTS points assigned to hours of classes requiring direct participation of academic teachers and other persons conducting classes

²Traditional – enter T, remote – enter Z

³Exam – enter E, crediting – enter Z. For the group of classes – after the letter E or Z - enter in brackets the final subject form (lec, cl, lab, pr, sem)

⁴University-wide subject / group of classes – enter O

⁵DN - number of ECTS points assigned to the classes related to the University's academic activity in the discipline/disciplines to which the main field of study is assigned

⁶Practical subject / group of classes – enter P. For the group of courses – in brackets enter the number of ECTS points assigned to practical courses

⁷KO – general education courses, PD – basic sciences courses, K – main field of study courses, S – specialization courses

4.3 Training block - concerning principles of training crediting – attachment no. ...

Opinion of the Advisory Faculty Council concerning the rules of crediting training block

Name of training			
Number of ECTS points	Number of ECTS points for BU ¹ classes	Training crediting mode	Code
Training duration		Training objective	
		Internship	

4.4 „Diploma dissertation” block (if it is foreseen at first level studies)

Type of diploma dissertation	Licencjat / inżynier / magister / magister inżynier*	
Number of diploma dissertation semesters	Number of ECTS points	Code
1	20	W06GIG-SM3015D
Character of diploma dissertation		
Literature survey, project, computer program, etc.		
Number of BU ¹ ECTS points	1,8	

¹BU – number of ECTS points assigned to hours of classes requiring direct participation of academic teachers and other persons conducting classes

²Traditional – enter T, remote – enter Z

³Exam – enter E, crediting – enter Z. For the group of classes – after the letter E or Z - enter in brackets the final subject form (lec, cl, lab, pr, sem)

⁴University-wide subject /group of classes – enter O

⁵DN - number of ECTS points assigned to the classes related to the University's academic activity in the discipline/disciplines to which the main field of study is assigned

⁶Practical subject / group of classes – enter P. For the group of courses – in brackets enter the number of ECTS points assigned to practical courses

⁷KO – general education courses, PD – basic sciences courses, K – main field of study courses, S – specialization courses

5. Ways of verifying assumed learning outcomes

Form of classes	Ways of verifying assumed learning outcomes
lecture	e.g. examination, progress/final test
class	e.g. progress/final test
laboratory	e.g. pretest, report from laboratory
project	e.g. project defence
seminar	e.g. participation in discussion, topic presentation, essay
training	e.g. report from training
diploma dissertation	prepared diploma dissertation

6. Range of diploma examination

1. Occupational risk assessment methods. Identification of harmful, dangerous and nuisance factors in the work environment.
2. Costs as the subject of cost accounting. Variable and fixed costs. Break even point.
3. Capital budgeting, evaluation of different methods
4. Liquidity vs profitability of a company. Ways of their evaluation
5. Environmental management systems
6. Characteristics of hazards for the natural environment resulting from human activities
7. Variogram and methods of its modelling
8. Kriging, its properties and types
9. Geophysical methods of exploration and identification of deposits.
10. Surface seismic methods. Reflective and refractive seismics.
11. Computer aided exploration and identification of deposits.
12. Decision models used in management.
13. Advances of technology & methods of future mining operations.
14. Aims, benefits, drawbacks of automation and industrial revolutions.
15. Applications of Interferometric Synthetic Aperture Radar.
16. Applications of map algebra and spatial statistics to determine surface deformation models
17. Plate tectonic background of the geological processes

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²Traditional – enter T, remote – enter Z

³Exam – enter E, crediting – enter Z. For the group of classes – after the letter E or Z - enter in brackets the final subject form (lec, cl, lab, pr, sem)

⁴University-wide subject /group of classes – enter O

⁵DN - number of ECTS points assigned to the classes related to the University's academic activity in the discipline/disciplines to which the main field of study is assigned

⁶Practical subject / group of classes – enter P. For the group of courses – in brackets enter the number of ECTS points assigned to practical courses

⁷KO – general education courses, PD – basic sciences courses, K – main field of study courses, S – specialization courses

18. Magneto-, chemo-, seismic, sequence, and cycle stratigraphy
19. Surface geophysical methods
20. Geophysical methods used in boreholes
21. Classification of applied geophysical methods
22. Physical properties of rocks controlling the development of fractures, folds and other structural features
23. Ore forming geological processes which create the different deposits
24. Genetic classification of deposits
25. Mineral exploration methods, quality control and quality assurance
26. Soil formation, soil classification methods
27. Hydrogeochemistry, transport processes
28. Analytical methods used in mineralogy and geology
29. Basic methods of resource estimation
30. Water exploration by geophysical methods
31. The most important well logging methods
32. Geophysical methods in geothermal exploration
33. Composition of the Earth' interior based on seismic tomography, the most significant boundaries
34. Physical basics of direct current (DC) geoelectric methods
35. Physical basics of alternating current (AC) electromagnetic methods
36. Main geochemical mineral exploration methods
37. Geological characteristics of deposits of two chosen non-metallic minerals
38. Sedimentary environments
39. Rock-forming processes
40. Characteristic of a selected minerals group
41. Plate tectonics and large scale structures
42. Water management issues
43. Sustainability and protection of groundwater
44. Vulnerability of groundwater
45. Laws and regulations related to exploration and exploitation of minerals / water

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²Traditional – enter T, remote – enter Z

³Exam – enter E, crediting – enter Z. For the group of classes – after the letter E or Z - enter in brackets the final subject form (lec, cl, lab, pr, sem)

⁴University-wide subject /group of classes – enter O

⁵DN - number of ECTS points assigned to the classes related to the University's academic activity in the discipline/disciplines to which the main field of study is assigned

⁶Practical subject / group of classes – enter P. For the group of courses – in brackets enter the number of ECTS points assigned to practical courses

⁷KO – general education courses, PD – basic sciences courses, K – main field of study courses, S – specialization courses

7. Requirements concerning deadlines for crediting courses/groups of courses for all courses in particular blocks

No.	Subject / group of classes code	Name of subject / group of classes	Crediting by deadline of.. (number of semester)
1	W06GIG-SM3007	Principles and Application of InSAR and GIS in mining	1-4
2	W06GIG-SM3002	Computer Aided Geological Modelling & Geostatistics	1-4
3	W06GIG-SM3003G	Project Management, Appraisal and Risk Evaluation	1-4
4	W06GIG-SM3004	Engineering Geophysics	1-4
5	W06GIG-SM3001	Environmental Management	1-4
6	W06GIG-SM3005	Occupational Health and Safety	1-4
7	SJO-SM0003	Foreign language 1	1-4
8	SJO-SM0004	Foreign language 2	1-4
9	W06GIG-SM3006	Digital Mine	1-4
10	W06GIG-SM3000	Operations Research	1-4
11	W06GIG-SM3017G	Physical Geology	2-4
12	W06GIG-SM3018G	Mineralogy and Geochemistry	2-4
13	W06GIG-SM3019G	Geophysical Exploration Methods I	2-4
14	W06GIG-SM3020G	Geological Interpretation and Prospecting	2-4
15	W06GIG-SM3021G	Geophysical Interpretation and Prospecting	2-4
16	W06GIG-SM3022G	Geoelectric lectureship	2-4
17	W06GIG-SM3023G	Global environmental geophysics	2-4
18	W06GIG-SM3024G	Non-metallic industrial minerals	2-4
19	W06GIG-SM3025G	Structural geology GK	2-4
20	W06GIG-SM3026G	Mineral Deposits GK	2-4
21	W06GIG-SM3027G	Engineering geology and hydrogeology GK	2-4
22	W06GIG-SM3028G	Analytical technics in mineralogy and petrology GK	2-4
23	W06GIG-SM3029G	Geochemical prospecting methods GK	2-4
24	W06GIG-SM3030G	Geological mapping GK	2-4
25	W06GIG-SM3031S	Graduate research seminar	2-4
26	W06GIG-SM3032P	Student research project	2-4

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⁴University-wide subject /group of classes – enter O

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27	W06GIG-SM3012G	Exploration Entrepreneurship	1-4
28	W06GIG-SM3013P	SOC Internship	1-4
29	W06GIG-SM3016P	Applied Field Exploration	1-4
30	W06GIG-SM3014S	Master Thesis	4
31	W06GIG-SM3015D	Diploma Seminar	4

8. Plan of studies (attachment no. 4)

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⁴University-wide subject /group of classes – enter O

⁵DN - number of ECTS points assigned to the classes related to the University's academic activity in the discipline/disciplines to which the main field of study is assigned

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Approved by faculty student government legislative body:

POLITECHNIKA WROCLAWSKA
WYDZIAŁ GEOINŻYNIERII
GÓRNICWA I GEOLOGII
Samorząd Studencki Wydziału Geoinżynierii,
Górnictwa i Geologii
50-421 Wrocław, Na Grobli 15, pokój 370

Jakub Dobrzański

Jakub Dobrzański
Chairman of the Student Government
of the Faculty of Geoengineering, Mining and Geology

.....
name and surname, signature of student representative

28.09.23

.....
Date

DZIEKAN

prof. dr hab. inż. Radosław Zimroz

.....
Dean's signature

28.09.23

.....
Date

PLAN OF STUDIES

FACULTY: Geoengineering, Mining and Geology

MAIN FIELD OF STUDY: Mining and geology

EDUCATION LEVEL: second-level studies

FORM OF STUDIES: full-time studies

PROFILE: general academic

SPECIALIZATION: Mineral Resources Exploration - Track WUST - UM

LANGUAGE OF STUDY: English

In effect since academic year 2023/24

	Summer		Winter		Summer		Winter	
semester	1	ECTS	2	ECTS	3	ECTS	4	ECTS
hours	WUST		UM		UM		WUST	
1	Operations Research 10100Z W06GIG- SM3000	3	Physical Geology 20010 E W06GIG-SM3017G	4	Structural geology 10020 E W06GIG-SM3025G	4	Exploration entrepreneurship (EFG) 10012 Z W06GIG-SM3012G	4
2								
3								
4	Environmental Management 20001Z W06GIG-SM3001	3	Mineralogy and Geochemistry 20100 E W06GIG-SM3018G	4	Mineral Deposits 20100 E W06GIG-SM3026G	4	Diploma Seminar 00001Z W06GIG-SM3014S	1
5								
6	Computer Aided Geological Modelling & Geostatistics 10300Z W06GIG-SM3002	5	Geophysical Exploration Methods I 20100E W06GIG-SM3019G	4	Engineering geology and hydrogeology 20100 E W06GIG-SM3027G	4	Master Thesis W06GIG-SM3015D	20
7								
8								
9	Project Management, Appraisal and Risk Evaluation 10210E W06GIG-SM3003G	4	Geological Interpretation and Prospecting 20020E W06GIG-SM3020G	4	Analytical technics in mineralogy and petrology 10100Z W06GIG-SM3028G	2	SOC Internship 00020Z W06GIG-SM3013P	2
10								
11								
12								
13	Engineering Geophysics 10010 Z W06GIG- SM3004	3	Geophysical Interpretation and Prospecting 20020E W06GIG-SM3021G	4	Geochemical prospecting methods 10020 z W06GIG-SM3029G	4	Applied field exploration 00030Z W06GIG-SM3016P	3
14								
15	Occupational Health and Safety 100100Z W06GIG- SM3005	2			Geological mapping 10000 1 E W06GIG-SM3030G	4		
16								
17	Foreign Language 1 03000 Z SJO- SM0003	2	Goelectric lectureship 20020Z W06GIG-SM3022G	4	Graduate research seminar 00002Z W06GIG-SM3031S	2		
18								
19								
20	Digital Mine 10100 Z W06GIG-SM3006	2	Global environmental geophysics 10001Z W06GIG-SM3023G	2	Student research project 00060Z W06GIG-SM3032P	6		
21								
22	Principles and Application of InSAR and GIS in mining 20300E W06GIG- SM3007	5	Non-metallic industrial minerals 20200Z W06GIG-SM3024G	4				
23								
24								
25	Foreign Language 2 01000 Z SJO-SM0004	1						
26								
27								
28								
Total ECTS		30		30		30		30

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1. Set of obligatory and optional subjects and groups of classes in semestral arrangement

Semester 1

Obligatory subjects / groups of classes Number of ECTS points 27

No.	Subject / groups of classes code	Name of subject / groups of classes (denote group of courses with symbol GK)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form ² of course/g group of courses	Way ³ of crediting	Subject / groups of classes			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN ⁵ classes	BU ¹ classes			University-wide ⁴	Concerning scientific activities ⁵	Practical ⁶	Type ⁷
1	W06GIG-SM3000W	Operations Research	1					K2_GIG_W06	15	25	1	1	0,8	T /Z	Z		DN		KO
2	W06GIG-SM3000L	Operations Research			1			K2_GIG_U10,U14 K2_GIG_K01	15	50	2	2	0,7	T	Z		DN	P (2)	KO
3	W06GIG-SM3002W	Computer Aided Geological Modelling & Geostatistics	1					K2_GIG_W06,W08,W15	15	50	2		0,8	T /Z	Z		DN		PD/K
4	W06GIG-SM3002L	Computer Aided Geological Modelling & Geostatistics			3			K2_GIG_U04,U08,U14	45	75	3	2	1,9	T	Z		DN	P (3)	PD/K
5	W06GIG-SM3003G	Project Management, Appraisal and Risk Evaluation (GK)	1		2	1		K2_GIG_W03,W05,W11 K2_GIG_U04,U06,U08,U15 K2_GIG_K01	60	100	4	4	3,1	T/Z(w)	E(w), Z(l,p)		DN	P (3)	KO
6	W06GIG-SM3001W	Environmental Management	2					K2_GIG_W04,W12,W13,W18	30	50	2	2	1,3	T /Z(w)	Z		DN		K
7	W06GIG-SM3001S	Environmental Management					1	K2_GIG_U05,U10,U11,U12 K2_GIG_K02,K03	15	25	1	1	0,8	T	Z		DN	P(1)	K
8	W06GIG-SM3004W	Engineering Geophysics	1					K2_GIG_W02,W08,W10	15	25	1	1	0,8	T /Z	Z		DN		PD
9	W06GIG-SM3004P	Engineering Geophysics				1		K2_GIG_U04,U13	15	50	2	2	0,9	T	Z		DN	P(2)	PD
10	W06GIG-SM3007W	Principles and Application of InSAR and GIS in mining	2					K2_GIG_W15,W16,W18	30	50	2	2	1,4	T/Z(w)	E		DN		K
11	W06GIG-SM3007L	Principles and Application of InSAR and GIS in mining			3			K2_GIG_U04,U07,U08	45	75	3	3	2,0	T	Z		DN	P(3)	K
12	W06GIG-SM3005W	Occupational Health and Safety	1					K2_GIG_W11,W12,W14,W17	15	25	1	1	0,7	T /Z(w)	Z		DN		K
13	W06GIG-SM3005P	Occupational Health and Safety				1		K2_GIG_U11, K2_GIG_K02, K03	15	25	1	1	0,8	T	Z		DN	P(1)	K
14	W06GIG-SM3000W	Digital Mine	1					K2_GIG_W07,W12,W18,W19	15	25	1	1	0,8	T /Z(w)	Z		DN		K
15	W06GIG-SM3000L	Digital Mine			1			K2_GIG_U04,U07,U08	15	25	1	1	0,8	T	Z		DN	P(1)	K
Total			10	0	10	3	1		360	675	27	24	17,6					16	

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Optional subjects / groups of classes (3 ECTS points)

No.	Subject / groups of classes code	Name of subject / groups of classes (denote group of courses with symbol GK)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form ² of course/group of courses	Way ³ of crediting	Subject / groups of classes			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN ⁵ classes	BU ¹ classes			University-wide ⁴	Concerning scientific activities ⁵	Practical ⁶	Type ⁷
1	SJO-SM0003	Foreign Language 1		3				K2_GIG_U03	45	60	2		1,6	T	Z	O		P(2)	KO
2	SJO-SM0004	Foreign Language 2		1				K2_GIG_U01,U02	15	30	1		0,6	T	Z	O		P(1)	KO
Total			0	4	0	0			60	90	3	0	2,2					3	

Altogether in semester

Total number of hours					Total number of ZZU hours	Total number of CNPS hours	Total number of ECTS points	Total number of ECTS points for DN classes ⁵	Number of ECTS points for BU classes ¹
lec	cl	lab	pr	sem					
10	4	10	3	1	420	765	30	24	19,8

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³Exam – enter E, crediting – enter Z. For the group of classes – after the letter E or Z - enter in brackets the final subject form (lec, cl, lab, pr, sem)

⁴University-wide subject /group of classes – enter O

⁵DN - number of ECTS points assigned to the classes related to the University's academic activity in the discipline/disciplines to which the main field of study is assigned

⁶Practical subject / group of classes – enter P. For the group of courses – in brackets enter the number of ECTS points assigned to practical courses

⁷KO – general education courses, PD – basic sciences courses, K – main field of study courses, S – specialization courses

Semester 2

Obligatory subjects / groups of classes (0 ECTS points)

No.	Subject / groups of classes code	Name of subject / groups of classes (denote group of courses with symbol GK)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form ² of course/group of courses	Way ³ of crediting	Subject / groups of classes			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN ⁵ classes	BU ¹ classes			University-wide ⁴	Concerning scientific activities ⁵	Practical ⁶	Type ⁷
1																			
Total																			

Optional subjects / groups of classes

Number of ECTS points 30

No.	Subject / groups of classes code	Name of subject / groups of classes (denote group of courses with symbol GK)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form ² of course/group of courses	Way ³ of crediting	Subject / groups of classes			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN ⁵ classes	BU ¹ classes			University-wide ⁴	Concerning scientific activities ⁵	Practical ⁶	Type ⁷
1	W06GIG-SM3017G	Physical Geology GK	2			1		K2_GIG_W08,W10 K2_GIG_UU10,U13 K2_GIG_K02,03	45	100	4	4	2,4	T/Z(w)	E		DN	2	S
2	W06GIG-SM3018G	Mineralogy and Geochemistry GK	2		1			K2_GIG_W02,W08,W10 K2_GIG_U08,U10,U13 K2_GIG_K03	45	100	4	4	2,2	T/Z(w)	E		DN	2	S
3	W06GIG-SM3019G	Geophysical Exploration Methods I GK	2		1			K2_GIG_W02,W08,W10 K2_GIG_U07,U10,U13 K2_GIG_K01,K03	45	100	4	4	2,2	T/Z(w)	E		DN	2	S
4	W06GIG-SM3020G	Geological Interpretation and Prospecting GK	2			2		K2_GIG_W02,W08,W10 K2_GIG_U04,U06,U09,U10,U13 K2_GIG_K01	60	100	4	2	3,0	T/Z(w)	E		DN	2	S
5	W06GIG-SM3021G	Geophysical Interpretation and Prospecting GK	2			2		K2_GIG_W02,W08,W09,W11,W15 K2_GIG_U04,U10,U13 K2_GIG_K02	60	100	4	3	3,0	T/Z(w)	E		DN	2	S
6	W06GIG-SM3022G	Geoelectric lectureship GK	2			2		K2_GIG_W02,W08,W10 K2_GIG_U04,U10 K2_GIG_K03	60	100	4		3,0	T/Z(w)	Z			2	S
7	W06GIG-SM3023G	Global environmental geophysics GK	1				1	K2_GIG_W02, W10,W12 K2_GIG_U01,U05,U08 K2_GIG_K03	30	50	2		1,7	T/Z(w)	Z			1	S
8	W06GIG-SM3024G	Non-metallic industrial minerals GK	2		2			K2_GIG_W02,W08,W10, K2_GIG_U07,U10 K2_GIG_K01	60	100	4	4	2,7	T/Z(w)	Z		DN	2	S
Total			15	4	7	1			405	750	30		20,2					15	

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³Exam – enter E, crediting – enter Z. For the group of classes – after the letter E or Z - enter in brackets the final subject form (lec, cl, lab, pr, sem)

⁴University-wide subject /group of classes – enter O

⁵DN - number of ECTS points assigned to the classes related to the University's academic activity in the discipline/disciplines to which the main field of study is assigned

⁶Practical subject / group of classes – enter P. For the group of courses – in brackets enter the number of ECTS points assigned to practical courses

⁷KO – general education courses, PD – basic sciences courses, K – main field of study courses, S – specialization courses

Altogether in semester

Total number of hours					Total number of ZZU hours	Total number of CNPS hours	Total number of ECTS points	Total number of ECTS points for DN classes ⁵	Number of ECTS points for BU classes ¹
lec	cl	lab	pr	sem					
15		4	7	1	405	750	30		20,3

Semester 3

Obligatory subjects / groups of classes (0 ECTS points)

No.	Subject / groups of classes code	Name of subject / groups of classes (denote group of courses with symbol GK)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form ² of course/group of courses	Way ³ of crediting	Subject / groups of classes			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN ⁵ classes	BU ¹ classes			University-wide ⁴	Concerning scientific activities ⁵	Practical ⁶	Type ⁷
1																			
		Total																	

¹BU – number of ECTS points assigned to hours of classes requiring direct participation of academic teachers and other persons conducting classes

²Traditional – enter T, remote – enter Z

³Exam – enter E, crediting – enter Z. For the group of classes – after the letter E or Z - enter in brackets the final subject form (lec, cl, lab, pr, sem)

⁴University-wide subject /group of classes – enter O

⁵DN - number of ECTS points assigned to the classes related to the University's academic activity in the discipline/disciplines to which the main field of study is assigned

⁶Practical subject / group of classes – enter P. For the group of courses – in brackets enter the number of ECTS points assigned to practical courses

⁷KO – general education courses, PD – basic sciences courses, K – main field of study courses, S – specialization courses

Optional subjects / groups of classes
Number of ECTS points 30

No	Subject / groups of classes code	Name of subject / groups of classes (denote group of courses with symbol GK)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form ² of course/group of courses	Way ³ of crediting	Subject / groups of classes			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN ⁵ classes	BU ¹ classes			University-wide ⁴	Concerning scientific activities ⁵	Practical ⁶	Type ⁷
1	W06GIG-SM3025G	Structural geology GK	1			2		K2_GIG_W02,W08,W10,W15 K2_GIG_U04,U07,U10,U13 K2_GIG_K03	45	100	4	4	2,4	T/Z(w)	E		DN	2	S
2	W06GIG-SM3026G	Mineral Deposits GK	2		1			K2_GIG_W08,W09,W10 K2_GIG_U01,U10,U13 K2_GIG_K03	45	100	4	4	2,2	T/Z(w)	E		DN	2	S
3	W06GIG-SM3027G	Engineering geology and hydrogeology GK	2		1			K2_GIG_W02,W08,W10,W14 K2_GIG_U04,U07U10,U13 K2_GIG_K03	45	100	4	4	2,2	T/Z(w)	E		DN	2	S
4	W06GIG-SM3028G	Analytical technics in mineralogy and petrology GK	1		1			K2_GIG_W02,W08,W10 K2_GIG_U04,U10,U13 K2_GIG_U_K03	30	50	2	2	1,5	T/Z(w)	Z		DN	1	S
5	W06GIG-SM3029G	Geochemical prospecting methods GK	1			2		K2_GIG_W02,W08,W10 K2_GIG_U04,U10,U13 K2_GIG_K02	45	100	4	4	2,3	T/Z(w)	Z		DN	2	S
6	W06GIG-SM3030G	Geological mapping GK	1			2		K2_GIG_W08,W10,W11 K2_GIG_U04,U10 K2_GIG_K03	45	100	4	4	2,4	T/Z(w)	E		DN	2	S
7	W06GIG-SM3031S	Graduate research seminar					2	K2_GIG_W01,W07,W10 K2_GIG_U01,U08,U13 K2_GIG_K02	30	50	2	2	1,4	T/Z(w)	Z		DN	2	S
8	W06GIG-SM3032P	Student research project				6		K2_GIG_W01,W08,W10,W12 K2_GIG_U01,U07,U08,U10,U13 K2_GIG_K01,K02	90	150	6	4	3,9	T/Z(w)	Z		DN	6	S
Total			8	2	12	3			375	750	30		18,3					19	

Altogether in semester

Total number of hours					Total number of ZZU hours	Total number of CNPS hours	Total number of ECTS points	Total number of ECTS points for DN classes ⁵	Number of ECTS points for BU classes ¹
lec	cl	lab	pr	sem					
8		2	12	3	375	750	30		18,3

¹BU – number of ECTS points assigned to hours of classes requiring direct participation of academic teachers and other persons conducting classes

²Traditional – enter T, remote – enter Z

³Exam – enter E, crediting – enter Z. For the group of classes – after the letter E or Z - enter in brackets the final subject form (lec, cl, lab, pr, sem)

⁴University-wide subject /group of classes – enter O

⁵DN - number of ECTS points assigned to the classes related to the University's academic activity in the discipline/disciplines to which the main field of study is assigned

⁶Practical subject / group of classes – enter P. For the group of courses – in brackets enter the number of ECTS points assigned to practical courses

⁷KO – general education courses, PD – basic sciences courses, K – main field of study courses, S – specialization courses

Semester 4

Obligatory subjects / groups of classes Number of ECTS points 9

No.	Subject / groups of classes code	Name of subject / groups of classes (denote group of courses with symbol GK)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form ² of course/group of courses	Way ³ of crediting	Subject / groups of classes				
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN ⁵ classes	BU ¹ classes			University-wide ⁴	Concerning scientific activities ⁵	Practical ⁶	Type ⁷	
1	W06GIG-SM3012G	Exploration Entrepreneurship GK	1				1	2	K2_GIG_W03,W05,W09 K2_GIG_U08,U09 K2_GIG_K01,K02,K03	60	100	4		3,0	Z	Z			P(3)	S
2	W06GIG-SM3013P	SOC Internship					2		K2_GIG_W05,W09 K2_GIG_U08,U09 K2_GIG_K01,K02,K03	30	50	2		1,5	T	Z			P(2)	S
3	W06GIG-SM3016P	Applied Field Exploration					3		K2_GIG_W08,W15 K2_GIG_U04,U09,U10,U13 K2_GIG_K02	45	75	3	1	2,1	T	Z		DN	P(3)	S
Total			1	0	0	6	2		135	225	9	1	6,6					8		

Optional subjects / groups of classes (21 ECTS points)

No.	Subject / groups of classes code	Name of subject / groups of classes (denote group of courses with symbol GK)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form ² of course/group of courses	Way ³ of crediting	Subject / groups of classes				
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN ⁵ classes	BU ¹ classes			University-wide ⁴	Concerning scientific activities ⁵	Practical ⁶	Type ⁷	
1	W06GIG-SM3014S	Diploma Seminar					1		K2_GIG_W01 K2_GIG_U01,U13 K2_GIG_K02,K03	15	25	1	1	0,8	T	Z		DN	P(1)	S
2	W06GIG-SM3015D	Master Thesis					1		K2_GIG_W01,W05,W10 K2_GIG_U01,U04,U08,U10,U13,U15 K2_GIG_K01,K02,K03	15	500	20	20	1,8	T	Z		DN	P(20)	S
Total			0	0	0	1	1		30	525	21	21	2,6					21		

Altogether in semester

Total number of hours					Total number of ZZU hours	Total number of CNPS hours	Total number of ECTS points	Total number of ECTS points for DN classes ⁵	Number of ECTS points for BU classes ¹
lec	cl	lab	pr	sem					
1	0	0	7	3	165	750	30	22	9,2

¹BU – number of ECTS points assigned to hours of classes requiring direct participation of academic teachers and other persons conducting classes

²Traditional – enter T, remote – enter Z

³Exam – enter E, crediting – enter Z. For the group of classes – after the letter E or Z - enter in brackets the final subject form (lec, cl, lab, pr, sem)

⁴University-wide subject /group of classes – enter O

⁵DN - number of ECTS points assigned to the classes related to the University's academic activity in the discipline/disciplines to which the main field of study is assigned

⁶Practical subject / group of classes – enter P. For the group of courses – in brackets enter the number of ECTS points assigned to practical courses

⁷KO – general education courses, PD – basic sciences courses, K – main field of study courses, S – specialization courses

2. Set of examinations in semestral arrangement

Course / group of courses code	Names of courses / groups of courses ending with examination	Semester
W06GIG-SM3003G W06GIG-SM3007	1. Project Management, Appraisal and Risk Evaluation 2. Principles and Applications of InSAR in Mining	1 1
W06GIG-SM3017G W06GIG-SM3018G W06GIG-SM3019G W06GIG-SM3020G W06GIG-SM3021G	1. Physical Geology 2. Mineralogy and Geochemistry 3. Geophysical Exploration Methods I 4. Geological Interpretation and Prospecting 5. Geophysical Interpretation and Prospecting	2 2 2 2 2
W06GIG-SM3025G W06GIG-SM3026G W06GIG-SM3027G W06GIG-SM3030G	1. Structural geology 2. Mineral Deposits 3. Engineering geology and hydrogeology 4. Geological mapping	3 3 3 3
	Final diploma examination	4

3. Numbers of allowable deficit of ECTS points after particular semesters

Semester	Allowable deficit of ECTS points after semester
1	12
2	8
3	0

¹BU – number of ECTS points assigned to hours of classes requiring direct participation of academic teachers and other persons conducting classes

²Traditional – enter T, remote – enter Z

³Exam – enter E, crediting – enter Z. For the group of classes – after the letter E or Z - enter in brackets the final subject form (lec, cl, lab, pr, sem)

⁴University-wide subject /group of classes – enter O

⁵DN - number of ECTS points assigned to the classes related to the University's academic activity in the discipline/disciplines to which the main field of study is assigned

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⁷KO – general education courses, PD – basic sciences courses, K – main field of study courses, S – specialization courses

Opinion of student government legislative body

POLITECHNIKA WROCLAWSKA
WYDZIAŁ GEOINŻYNIERII
GÓRNICICTWA I GEOLOGII
Samorząd Studencki Wydziału Geoinżynierii,
Górnictwa i Geologii
50-421 Wrocław, Na Grebli 15, pokój 370

28.09.23

Jakub Dobrzański

Jakub Dobrzański
Chairman of the Student Government
of the Faculty of Geoengineering, Mining and Geology

Date

Name and surname, signature of student representative

28.09.23

DZIEKAN
RD
prof. dr hab. inż. Radosław Zimroz
(1)

Date

Dean's signature

FACULTY: **of Geoengineering, Mining and Geology**

MAIN FIELD OF STUDY: **Mining and Geology**

LANGUAGE OF STUDY: English

SPECIALIZATION: **Mineral Resources Exploration**

- Track: UNI ZAGREB -WUST

DESCRIPTION OF THE PROGRAM OF STUDIES

Main field of study MINING AND GEOLOGY**Profile** general academic**Level of studies** second level studies**Form of studies** full-time studies**1. General description**

<i>1.1 Number of semesters: 4</i>	<i>1.2 Total number of ECTS points necessary to complete studies at a given level: 120</i>
<i>1.3 Total number of hours: 1395</i>	<i>1.4 Prerequisites (particularly for second-level studies): Bachelor of Science in Engineering diploma, interview</i>
<i>1.5 Upon completion of studies graduate obtains professional degree of: magister inżynier - 2nd degree qualifications</i>	<p><i>1.6 Graduate profile, employability:</i></p> <p><i>The program will train T-shaped earth science specialists having a strong background in classical disciplines of geology and geophysics complemented with modern 3D modelling as well as data processing and interpretation skills, while the boundary-crossing competences will cover skills in innovative mineral exploration techniques and technologies used in the field, in laboratories, in an underground and underwater environment. Students will also be trained in sustainability, social responsibility and social licence to operate. T-shaped mineral explorers will use Industry 4.0-derived tools and methods for mineral resource exploration, mentored by experts.</i></p> <p><i>They will be prepared to work in enterprises, technical supervision institutions, public state and local administration, in research and development organisations, in Poland and</i></p>

	<p><i>abroad, will also be prepared to start own business or work as free lanced exploration geologists. The graduates will be able to use English freely and will be prepared to work in an international environment and intercultural groups during their professional career.</i></p>
<p><i>1.7 Possibility of continuing studies: eligibility to apply for admission to a doctoral school, non-degree postgraduate programmes</i></p>	<p><i>1.8 Indicate connection with University’s mission and its development strategy: The study programs of all specializations within the field of study Mining and Geology respond to the strategic goals of the University (Strategia Politechniki Wrocławskiej 2023–2030), by rising the level of correlation of the study offer with the needs of the market (C3), by enhancing the quality of education through didactic interdisciplinarity and by cooperation with industrial partners as well as increasing the level of entrepreneurship, creativity and involvement of students in research processes (C4, C2). Graduates of the faculty should be creative, professional, have theoretical background and practical abilities, as well as have interpersonal skills and cross-cultural experience (C5). The Faculty of Geoengineering, Mining and Geology, as one of the units of the Wrocław University of Science and Technology, educates in the field of engineering, broadened by knowledge in natural and economic sciences. The profile and quality of education are at the international level and are adapted to the needs of the national and global mineral industries.</i></p>

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³Exam – enter E, crediting – enter Z. For the group of classes – after the letter E or Z - enter in brackets the final subject form (lec, cl, lab, pr, sem)

⁴University-wide subject /group of classes – enter O

⁵DN - number of ECTS points assigned to the classes related to the University's academic activity in the discipline/disciplines to which the main field of study is assigned

⁶Practical subject / group of classes – enter P. For the group of courses – in brackets enter the number of ECTS points assigned to practical courses

⁷KO – general education courses, PD – basic sciences courses, K – main field of study courses, S – specialization courses

2. Detailed description

2.1 Total number of learning outcomes in the program of study: W (knowledge) = 19, U (skills) = 15, K (competences) = 3,

$$W + U + K = 37$$

2.2 ~~For the main field of study assigned to more than one discipline – the number of learning outcomes assigned to the discipline:~~

~~_____ D1 (major) (this number must be greater than half the total number of learning outcomes)~~

~~_____ D2~~

~~_____ D3~~

~~_____ D4~~

2.3 ~~For the main field of study assigned to more than one discipline – percentage share of the number of ECTS points for each discipline:~~

~~— D1% ECTS points~~

~~— D2% ECTS points~~

~~— D3% ECTS points~~

~~— D4% ECTS points~~

2.4a. For the general academic profile of the main field of study – the number of ECTS points assigned to the classes related to the University's academic activity in the discipline or disciplines to which the main field of study is assigned – DN (must be greater than 50% of the total number of ECTS points from 1.2) 89 ECTS

2.4b. ~~For the practical profile of the main field of study – the number of ECTS points assigned to the classes shaping practical skills (must be greater than 50% of the total number of ECTS points from 1.2)~~

¹BU – number of ECTS points assigned to hours of classes requiring direct participation of academic teachers and other persons conducting classes

²Traditional – enter T, remote – enter Z

³Exam – enter E, crediting – enter Z. For the group of classes – after the letter E or Z - enter in brackets the final subject form (lec, cl, lab, pr, sem)

⁴University-wide subject /group of classes – enter O

⁵DN - number of ECTS points assigned to the classes related to the University's academic activity in the discipline/disciplines to which the main field of study is assigned

⁶Practical subject / group of classes – enter P. For the group of courses – in brackets enter the number of ECTS points assigned to practical courses

⁷KO – general education courses, PD – basic sciences courses, K – main field of study courses, S – specialization courses

2.5 Concise analysis of compliance of the assumed learning outcomes with the needs of the labor market

The economic development of the country is closely dependent on natural resources, the ability to use them and having appropriate engineering workforce. The assumed learning outcomes correspond to the needs of practice in the field of the generally understood management of mineral resources - technologies and techniques for their identification, valuation, extraction, processing, revitalization of industrial areas, and the practice of managing an enterprise (especially mining) in the sense of managing information, environment and people, using the latest IT and marketing techniques and methods. This integration of economic needs and assumed educational effects favorably shape the labor market for the graduates of the Faculty. Additionally, a good command of English and experience of working in an international group will open up the possibility of working in foreign branches of Polish enterprises and in foreign companies.

2.6. The total number of ECTS points that a student must obtain in classes requiring direct participation of academic teachers or other persons conducting classes and students (enter the sum of ECTS points for courses / groups of courses marked with the BU¹ code) **67,6 ECTS**

2.7. Total number of ECTS points, which student has to obtain from basic sciences classes

Number of ECTS points for obligatory subjects	5
Number of ECTS points for optional subjects	0
Total number of ECTS points	5

2.8. Total number of ECTS points, which student has to obtain from practical classes, including project and laboratory classes (enter total number of ECTS points for courses/group of courses denoted with code P)

Number of ECTS points for obligatory subjects	24
Number of ECTS points for optional subjects	60
Total number of ECTS points	84

¹BU – number of ECTS points assigned to hours of classes requiring direct participation of academic teachers and other persons conducting classes

²Traditional – enter T, remote – enter Z

³Exam – enter E, crediting – enter Z. For the group of classes – after the letter E or Z - enter in brackets the final subject form (lec, cl, lab, pr, sem)

⁴University-wide subject /group of classes – enter O

⁵DN - number of ECTS points assigned to the classes related to the University's academic activity in the discipline/disciplines to which the main field of study is assigned

⁶Practical subject / group of classes – enter P. For the group of courses – in brackets enter the number of ECTS points assigned to practical courses

⁷KO – general education courses, PD – basic sciences courses, K – main field of study courses, S – specialization courses

2.9. Minimum number of ECTS points, which student has to obtain doing education blocks offered as part of University-wide classes or other main field of study (enter number of ECTS points for courses/groups of courses denoted with code O)

3 ECTS points

2.10. Total number of ECTS points, which student may obtain doing optional blocks (min. 30% of total number of ECTS points)

84 ECTS points

3. Description of the process leading to learning outcomes acquisition:

1. Upon starting classes in each subject, the student has an appropriate level of knowledge and skills which constitute the prerequisites for a given course (it is verified by the teacher or the dean's office).
2. The student participates in classes organized at the university.
3. The student carries out the assigned work in class and at home (projects, computational tasks, analyzes, prepares presentations) and studies the literature and materials recommended by the teacher.
4. The student uses the appointed hours of the tutor's consultation, explaining his uncertainties and verifying the correct understanding of the course content.
5. The student participates in periodic tests of knowledge and skills, completes the tests available on the e-portal and is familiar with the correct answers, grades and comments from the teacher.
6. In some subjects, the student participates in group tasks, taking part in the organization of the group's work, assessment of the activities of individual participants and takes responsibility for the result of the group's work.
7. The student is encouraged to become involved in the work of research clubs, student organizations, discussion clubs, sports groups, participation in social life through work in public welfare organizations, voluntary work, thus gaining valuable interpersonal skills and social competences.
8. The student participates in meetings with companies from the industry, technical excursions, job fairs, tries to gain knowledge about the labor market and additional advantages when applying for a job
9. The student is encouraged to participate in an international student exchange, and through contact with foreigners at the faculty, he or she acquires additional interpersonal, cultural and language qualifications

¹BU – number of ECTS points assigned to hours of classes requiring direct participation of academic teachers and other persons conducting classes

²Traditional – enter T, remote – enter Z

³Exam – enter E, crediting – enter Z. For the group of classes – after the letter E or Z - enter in brackets the final subject form (lec, cl, lab, pr, sem)

⁴University-wide subject /group of classes – enter O

⁵DN - number of ECTS points assigned to the classes related to the University's academic activity in the discipline/disciplines to which the main field of study is assigned

⁶Practical subject / group of classes – enter P. For the group of courses – in brackets enter the number of ECTS points assigned to practical courses

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4. List of education blocks:

4.1. List of obligatory blocks:

4.1.1 List of general education blocks

4.1.1.1 Liberal-managerial subjects block (7 ECTS points):

No.	Subject / groups of classescode	Name of subject / groups of classes (denote group of courses with symbol GK)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form ² of course/group of courses	Way ³ of crediting	Subject / groups of classes			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN ⁵ classes	BU ¹ classes			University-wide ⁴	Concerning scientific activities ⁵	Practical ⁶	Type ⁷
1	W06GIG-SM3003G	Project Management, Appraisal and Risk Evaluation (GK)	1		2	1		K2_GIG_W03,W05,W11 K2_GIG_U04,U06,U08,U15 K2_GIG_K01	60	100	4	4	3,1	T/Z(w)	E(w), Z(L,p)		DN	P (3)	KO
2	W06GIG-SM3000W	Operations Research w	1					K2_GIG_W06 K2_GIG_U10,U14 K2_GIG_K01	15	25	1	1	0,8	T/Z	Z		DN		KO
3	W06GIG-SM3000L	Operations Research l			1			K2_GIG_U10,U14 K2_GIG_K01	15	50	2	2	0,7	T	Z		DN	P (2)	KO
Total			2	0	3	1	0		90	175	7	7	4,6					5	

Altogether for general education blocks

Total number of hours					Total number of ZZU hours	Total number of CNPS hours	Total number of ECTS points	Total number of ECTS points for DN classes ⁵	Number of ECTS points for BU classes ¹
lec	cl	lab	pr	sem					
2	0	3	1	0	90	175	7	7	4,6

¹BU – number of ECTS points assigned to hours of classes requiring direct participation of academic teachers and other persons conducting classes

²Traditional – enter T, remote – enter Z

³Exam – enter E, crediting – enter Z. For the group of classes – after the letter E or Z - enter in brackets the final subject form (lec, cl, lab, pr, sem)

⁴University-wide subject/group of classes – enter O

⁵DN - number of ECTS points assigned to the classes related to the University's academic activity in the discipline/disciplines to which the main field of study is assigned

⁶Practical subject / group of classes – enter P. For the group of courses – in brackets enter the number of ECTS points assigned to practical courses

⁷KO – general education courses, PD – basic sciences courses, K – main field of study courses, S – specialization courses

4.1.2 List of basic sciences blocks

4.1.2.1 Mathematics block

No.	Subject / groups of classes code	Name of subject / groups of classes (denote group of courses with symbol GK)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form ² of course/group of courses	Way ³ of crediting	Subject / groups of classes			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN ⁵ classes	BU ¹ classes			University-wide ⁴	Concerning scientific activities ⁵	Practical ⁶	Type ⁷
1	W06GIG-SM3002W	Computer Aided Geological Modelling & Geostatistics (część: Geostatistics) w	1					K2_GIG_W06,W08,W15 K2_GIG_U04,U08,U14	15	50	2		0,8	T	Z				PD
2	W06GIG-SM3002L	Computer Aided Geological Modelling & Geostatistics (część: Geostatistics) l			1				15	25	1		0,6	T	Z			P (1)	PD
Total			1	0	1	0	0		30	75	3		1,4					1	

4.1.2.3 Physics block

No.	Subject / groups of classes code	Name of subject / groups of classes (denote group of courses with symbol GK)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form ² of course/group of courses	Way ³ of crediting	Subject / groups of classes			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN ⁵ classes	BU ¹ classes			University-wide ⁴	Concerning scientific activities ⁵	Practical ⁶	Type ⁷
1	W06GIG-SM3004W	Engineering Geophysics w	1					K2_GIG_W02,W08,W10 K2_GIG_U04,U13	15	25	1	1	0,8	T/Z	Z		DN		PD
2	W06GIG-SM3004P	Engineering Geophysics p				1			15	50	2	2	0,9	T	Z		DN	P(2)	PD
Total			2	0	0	0	0		30	75	3	3	1,7					2	

Altogether for basic sciences blocks:

Total number of hours					Total number of ZZU hours	Total number of CNPS hours	Total number of ECTS points	Total number of ECTS points for DN classes ⁵	Number of ECTS points for BU classes ¹
lec	cl	lab	pr	sem					
3	0	1	0	0	60	150	6	3	3,1

¹BU – number of ECTS points assigned to hours of classes requiring direct participation of academic teachers and other persons conducting classes

²Traditional – enter T, remote – enter Z

³Exam – enter E, crediting – enter Z. For the group of classes – after the letter E or Z - enter in brackets the final subject form (lec, cl, lab, pr, sem)

⁴University-wide subject / group of classes – enter O

⁵DN - number of ECTS points assigned to the classes related to the University's academic activity in the discipline/disciplines to which the main field of study is assigned

⁶Practical subject / group of classes – enter P. For the group of courses – in brackets enter the number of ECTS points assigned to practical courses

⁷KO – general education courses, PD – basic sciences courses, K – main field of study courses, S – specialization courses

4.1.3 List of the main field of study blocks

4.1.3.1 Obligatory main field of study blocks

No.	Subject / groups of classes code	Name of subject / groups of classes (denote group of courses with symbol GK)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form ² of course/group of courses	Way ³ of crediting	Subject / groups of classes			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN ⁵ classes	BU ¹ classes			Unive ⁴ rsity-wide ⁴	Concerning scientific activities ⁵	Practical ⁶	Type ⁷
1	W06GIG-SM3002L	Computer Aided Geological Modelling & Geostatistics (Część: Computer Aided Geological Modelling)			2			K2_GIG_W06,W08,W15 K2_GIG_U04,U08,U14	30	50	2	2	1,3	T	Z		DN	P(2)	K
2	W06GIG-SM3006W	Digital Mine w	1					K2_GIG_W07,W12,W18,W19 K2_GIG_U04,U07,U08	15	25	1	1	0,8	T/Z(w)	Z		DN		K
3	W06GIG-SM3006L	Digital Mine l			1				15	25	1	1	0,8	T	Z		DN	P(1)	K
4	W06GIG-SM3005W	Occupational Health and Safety w	1					K2_GIG_W11,W12,W14,W17 K2_GIG_U11, K2_GIG_K02, K03	15	25	1	1	0,7	T/Z(w)	Z		DN		K
5	W06GIG-SM3005P	Occupational Health and Safety p				1			15	25	1	1	0,8	T	Z		DN	P(1)	K
6	W06GIG-SM3007W	Principles and Application of InSAR and GIS in mining w	2					K2_GIG_W15,W16,W18 K2_GIG_U04,U07,U08	30	50	2	2	1,4	T/Z(w)	E		DN		K
7	W06GIG-SM3007L	Principles and Application of InSAR and GIS in mining l			3				45	75	3	3	2,0	T	Z		DN	P(3)	K
8	W06GIG-SM3001W	Environmental Management w	2					K2_GIG_W04,W12,W13,W18 K2_GIG_U05,U10,U11 K2_GIG_K02,K03	30	50	2	2	1,3	T/Z(w)	Z		DN		K
9	W06GIG-SM3001S	Environmental Management s				1			15	25	1	1	0,8	T	Z		DN	P(1)	K
10	W06GIG-SM3012G	Exploration Entrepreneurship GK	1			1	2	K2_GIG_W03,W05,W09 K2_GIG_U08,U09 K2_GIG_K01,K02,K03	60	100	4		3,0	Z	Z			P(3)	S
11	W06GIG-SM3013P	SOC Internship				2		K2_GIG_W05,W09 K2_GIG_U08,U09 K2_GIG_K01,K02,K03	30	50	2		1,5	T	Z			P(2)	S
12	W06GIG-SM3016P	Applied Field Exploration				3		K2_GIG_W08,W15 K2_GIG_U04,U09,U10,U13 K2_GIG_K02	45	75	3	1	2,1	T	Z		DN	P(3)	S
Total			7	0	6	7	3		345	575	23	15	16,5					16	

¹BU – number of ECTS points assigned to hours of classes requiring direct participation of academic teachers and other persons conducting classes

²Traditional – enter T, remote – enter Z

³Exam – enter E, crediting – enter Z. For the group of classes – after the letter E or Z - enter in brackets the final subject form (lec, cl, lab, pr, sem)

⁴University-wide subject /group of classes – enter O

⁵DN - number of ECTS points assigned to the classes related to the University's academic activity in the discipline/disciplines to which the main field of study is assigned

⁶Practical subject / group of classes – enter P. For the group of courses – in brackets enter the number of ECTS points assigned to practical courses

⁷KO – general education courses, PD – basic sciences courses, K – main field of study courses, S – specialization courses

Altogether (for main field of study blocks):

Total number of hours					Total number of ZZU hours	Total number of CNPS hours	Total number of ECTS points	Total number of ECTS points for DN classes ⁵	Number of ECTS points for BU classes ¹
lec	cl	lab	pr	sem					
7	0	6	7	3	345	575	24	16	16,5

4.2 List of optional blocks

4.2.1 List of general education blocks

4.2.1.2 Foreign languages block (min. 3 ECTS points):

No.	Subject / groups of classes code	Name of subject / groups of classes (denote group of courses with symbol GK)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form ² of course/group of courses	Way ³ of crediting	Subject / groups of classes			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN ⁵ classes	BU ¹ classes			University-wide ⁴	Concerning scientific activities ⁵	Practical ⁶	Type ⁷
1	SJO-SM0003	Foreign Language 1		3				K2_GIG_U03	45	60	2		1,6	T	Z	O		P (2)	KO
2	SJO-SM0004	Foreign Language 2		1				K2_GIG_U01,U02	15	30	1		0,6	T	Z	O		P(1)	KO
Total			0	4	0	0	0		60	90	3		2,2					3	

Altogether for general education blocks:

Total number of hours					Total number of ZZU hours	Total number of CNPS hours	Total number of ECTS points	Total number of ECTS points for DN classes ⁵	Number of ECTS points for BU classes ¹
lec	cl	lab	pr	sem					
0	4	0	0	0	60	90	3	0	2,2

¹BU – number of ECTS points assigned to hours of classes requiring direct participation of academic teachers and other persons conducting classes

²Traditional – enter T, remote – enter Z

³Exam – enter E, crediting – enter Z. For the group of classes – after the letter E or Z - enter in brackets the final subject form (lec, cl, lab, pr, sem)

⁴University-wide subject / group of classes – enter O

⁵DN - number of ECTS points assigned to the classes related to the University's academic activity in the discipline/disciplines to which the main field of study is assigned

⁶Practical subject / group of classes – enter P. For the group of courses – in brackets enter the number of ECTS points assigned to practical courses

⁷KO – general education courses, PD – basic sciences courses, K – main field of study courses, S – specialization courses

4.2.4 List of specialization blocks

4.2.4.1 Specialization subjects (e.g. whole specialization) blocks (60 ECTS points):

No.	Subject / groups of classes code	Name of subject / groups of classes (denote group of courses with symbol GK)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form ² of course/group of courses	Way ³ of crediting	Subject / groups of classes			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN ⁵ classes	BU ¹ classes			University-wide ⁴	Concerning scientific activities ⁵	Practical ⁶	Type ⁷
1	W06GIG-SM3033G	Sedimentology GK	2			3		K2_GIG_W01,W02 K2_GIG_U01,U13 K2_GIG_K02	75	125	5	3	3,6	T/Z(w)	E		DN	3	S
2	W06GIG-SM3034G	Mineral deposits exploration GK	2			3		K2_GIG_W01, W08,W11,W15, K2_GIG_U01,U13 K2_GIG_K03	75	125	5	3	3,6	T/Z(w)	E		DN	3	S
3	W06GIG-SM3035G	Petroleum geology GK	2			3		K2_GIG_W01,W2,W08, W11, K2_GIG_U01,U4,U10,U13 K2_GIG_K03	75	125	5		3,6	T/Z(w)	E			3	S
4	W06GIG-SM3036G	Engineering geological investigations GK	2			2		K2_GIG_W2,W07, W10, K2_GIG_U01,U04,U10 K2_GIG_K03	60	125	5	3	3,0	T/Z(w)	E		DN	3	S
5	W06GIG-SM3037G	Exploration geochemistry GK	2			1		K2_GIG_W01,W02,W18 K2_GIG_U01,U04,U09,U10,U13 K2_GIG_K02	45	100	4	3	2,3	T/Z(w)	Z		DN	2	S
6	W06GIG-SM3038G	Remote sensing of mineral resources GK	1		1			K2_GIG_W01,W02,W08,W15 K2_GIG_U01,U04,U13,U15 K2_GIG_K03	30	75	3	3	1,5	T/Z(w)	E		DN	2	S
7	W06GIG-SM3039G	GIS in exploration of mineral resources GK	1		1			K2_GIG_W01,W02,W08,W14,W15 K2_GIG_U01,U04,U13,U15 K2_GIG_K01	30	75	3	3	1,5	T/Z(w)	Z		DN	2	S
8	W06GIG-SM3040G	Regional hydrogeology GK	2			2		K2_GIG_W01,W2,W10, W15 K2_GIG_U01,U4,U13 K2_GIG_K03	60	100	4	4	2,9	T/Z(w)	E		DN	2	S
9	W06GIG-SM3041G	Seismotectonics GK	2			1		K2_GIG_W2,W10, W14 K2_GIG_U01,U4,U10,U13 K2_GIG_K01	45	100	4	4	2,4	T/Z(w)	E		DN	2	S
10	W06GIG-SM3042G	Industrial mineral deposits and applications GK	2				2	K2_GIG_W1,W07, W12 K2_GIG_U01,U10,U13 K2_GIG_K01,K02	60	125	5	5	2,8	T/Z	E		DN	3	S
11	W06GIG-SM3043G	Analytical methods in ore deposits GK	2		2			K2_GIG_W1,W02, W10 K2_GIG_U02,U07,U13 K2_GIG_K01	60	125	5	4	2,8	T/Z(w)	E		DN	3	S
12	W06GIG-SM3044W	Geophysical exploration and mineral resources	2					K2_GIG_W1,W02, W08,W10 K2_GIG_K01	30	75	3	3	1,4	T/Z	E		DN		S
13	W06GIG-SM3045G	Analyses of mineral paragenesis GK	1		2			K2_GIG_W1,W02 K2_GIG_U01,U13 K2_GIG_K01	45	75	3		2,2	T/Z(w)	E			2	S
14	W06GIG-SM3046P	Field and laboratory practicum				8		K2_GIG_U01,U04,U13 K2_GIG_K02,K03	120	150	6	4	5,0	T	Z		DN	6	S
Total			23	0	6	23	2		810	1500	60	42	38,6					36	

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²Traditional – enter T, remote – enter Z

³Exam – enter E, crediting – enter Z. For the group of classes – after the letter E or Z - enter in brackets the final subject form (lec, cl, lab, pr, sem)

⁴University-wide subject /group of classes – enter O

⁵DN - number of ECTS points assigned to the classes related to the University's academic activity in the discipline/disciplines to which the main field of study is assigned

⁶Practical subject / group of classes – enter P. For the group of courses – in brackets enter the number of ECTS points assigned to practical courses

⁷KO – general education courses, PD – basic sciences courses, K – main field of study courses, S – specialization courses

4.2.4.2 Diploma (e.g. diploma profile) block (21 ECTS points):

No.	Subject / groups of classes code	Name of subject / groups of classes (denote group of courses with symbol GK)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form ² of course/group of courses	Way ³ of crediting	Subject / groups of classes			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN ⁵ classes	BU ¹ classes			University-wide ⁴	Concerning scientific activities ⁵	Practical ⁶	Type ⁷
1	W06GIG-SM3014S	Diploma Seminar					1	K2_GIG_W01 K2_GIG_U01,U13 K2_GIG_K03	15	25	1	1	0,8	T	Z		DN	P(1)	S
2	W06GIG-SM3015D	Master Thesis					1	K2_GIG_W01,W05,W10 K2_GIG_U01,U04,U08,U10,U13,U15 K2_GIG_K01,K03	15	500	20	20	1,8	T	Z		DN	P(20)	S
Total			0	0	0	1	1		30	525	21	21	2,6					21	

Altogether for specialization blocks:

Total number of hours					Total number of ZZU hours	Total number of CNPS hours	Total number of ECTS points	Total number of ECTS points for DN classes ⁵	Number of ECTS points for BU classes ¹
lec	cl	lab	pr	sem					
23	0	6	24	3	840	2025	81	63	41,2

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⁴University-wide subject/group of classes – enter O

⁵DN - number of ECTS points assigned to the classes related to the University's academic activity in the discipline/disciplines to which the main field of study is assigned

⁶Practical subject / group of classes – enter P. For the group of courses – in brackets enter the number of ECTS points assigned to practical courses

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4.3 Training block - concerning principles of training crediting – attachment no. ...

Opinion of the Advisory Faculty Council concerning the rules of crediting training block

Name of training			
Number of ECTS points	Number of ECTS points for BU ¹ classes	Training crediting mode	Code
Training duration		Training objective	
		Internship	

4.4 „Diploma dissertation” block (if it is foreseen at first level studies)

Type of diploma dissertation	Licencjat / inżynier / magister / magister inżynier*	
Number of diploma dissertation semesters	Number of ECTS points	Code
1	20	
Character of diploma dissertation		
Literature survey, project, computer program, etc.		
Number of BU ¹ ECTS points	1,8	

5. Ways of verifying assumed learning outcomes

Form of classes	Ways of verifying assumed learning outcomes
lecture	e.g. examination, progress/final test
class	e.g. progress/final test
laboratory	e.g. pretest, report from laboratory
project	e.g. project defence
seminar	e.g. participation in discussion, topic presentation, essay
training	e.g. report from training
diploma dissertation	prepared diploma dissertation

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⁴University-wide subject /group of classes – enter O

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6. Range of diploma examination

1. Occupational risk assessment methods. Identification of harmful, dangerous and nuisance factors in the work environment.
2. Costs as the subject of cost accounting. Variable and fixed costs. Break even point.
3. Capital budgeting, evaluation of different methods
4. Liquidity vs profitability of a company. Ways of their evaluation
5. Environmental management systems
6. Characteristics of hazards for the natural environment resulting from human activities
7. Variogram and methods of its modelling
8. Kriging, its properties and types
9. Geophysical methods of exploration and identification of deposits.
10. Surface seismic methods. Reflective and refractive seismics.
11. Computer aided exploration and identification of deposits.
12. Decision models used in management.
13. Advances of technology & methods of future mining operations.
14. Aims, benefits, drawbacks of automation and industrial revolutions.
15. Applications of Interferometric Synthetic Aperture Radar.
16. Applications of map algebra and spatial statistics to determine surface deformation models
17. Facies cycles and sedimentary sequences
18. Basic features of modern and paleo - depositional environments
19. Geological methods of exploring mineral deposits.
20. Geological criteria in the exploration of mineral deposits
21. Calculation of mineral reserves
22. Examples of appropriate level of site investigations for the purpose of different types of studies and projects in geotechnical engineering.
23. Examples of potential geotechnical problems in different rock types in geotechnical engineering.
24. Basic principles of geochemical prospecting
25. Instrumental analytical methods of geochemical prospecting
26. Application of remote sensing in mineral exploration
27. Characteristics of electromagnetic radiation for the purposes of remote sensing of mineral resources
28. Applications of GIS software in mineral exploration
29. Stress types and distribution in Earth's crust in respect to tectonic plate boundary types
30. Basic properties of global and local seismicity
31. Definition of the concept of scale in hydrogeology and its effect related to permeability properties
32. Basic concept of the Earth's thermal regime
33. Physicochemical and geological conditions for the formation of deposits of chosen industrial minerals

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³Exam – enter E, crediting – enter Z. For the group of classes – after the letter E or Z - enter in brackets the final subject form (lec, cl, lab, pr, sem)

⁴University-wide subject /group of classes – enter O

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⁶Practical subject / group of classes – enter P. For the group of courses – in brackets enter the number of ECTS points assigned to practical courses

⁷KO – general education courses, PD – basic sciences courses, K – main field of study courses, S – specialization courses

34. Types of deposits of industrial minerals
35. The most important analytical methods applied in mineral deposits investigation
36. Special geophysical methods of measurement and interpretation applied in the exploration of construction materials deposits and solid mineral raw materials
37. Mineral paragenesis of magmatic and metamorphic rocks and its interpretation
38. The ways of the origin of primary and secondary mineral parageneses in magmatic rocks.
39. Mining legislation. Categorisation and classification of mineral reserves.
40. Groundwater chemistry and its impact on water use and legislation
41. Hydrogeological objects (wells, piezometers), construction and use.
42. Definitions of terms: ore mineral and industrial mineral. Classifications of industrial minerals.

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7. Requirements concerning deadlines for crediting subject/groups of subject for all courses in particular blocks

No.	Course / group of courses code	Name of course / group of courses	Crediting by deadline of... (number of semester)
1	W06GIG-SM3033G	Sedimentology GK	1-4
2	W06GIG-SM3034G	Mineral deposits exploration GK	1-4
3	W06GIG-SM3035G	Petroleum geology GK	1-4
4	W06GIG-SM3036G	Engineering geological investigations GK	1-4
5	W06GIG-SM3037G	Exploration geochemistry GK	1-4
6	W06GIG-SM3038G	Remote sensing of mineral resources GK	1-4
7	W06GIG-SM3039G	GIS in exploration of mineral resources GK	1-4
8	W06GIG-SM3040G	Regional hydrogeology GK	2-4
9	W06GIG-SM3041G	Seismotectonics GK	2-4
10	W06GIG-SM3042G	Industrial mineral deposits and applications GK	2-4
11	W06GIG-SM3043G	Analytical methods in ore deposits GK	2-4
12	W06GIG-SM3044W	Geophysical exploration and mineral resources	2-4
13	W06GIG-SM3045G	Analyses of mineral paragenesis GK	2-4
14	W06GIG-SM3046P	Field and laboratory practicum	2-4
15	W06GIG-SM3007	Principles and Application of InSAR and GIS in mining	3-4
16	W06GIG-SM3002	Computer Aided Geological Modelling & Geostatistics	3-4
17	W06GIG-SM3003G	Project Management, Appraisal and Risk Evaluation	3-4
18	W06GIG-SM3004	Engineering Geophysics	3-4
19	W06GIG-SM3001	Environmental Management	3-4
20	W06GIG-SM3005	Occupational Health and Safety	3-4
21	SJO-SM0003	Foreign language 1	3-4
22	SJO-SM0004	Foreign language 2	3-4
23	W06GIG-SM3006	Digital Mine	3-4
24	W06GIG-SM3000	Operations Research	3-4
27	W06GIG-SM3012G	Exploration Entrepreneurship	1-4
28	W06GIG-SM3013P	SOC Internship	1-4
29	W06GIG-SM3016P	Applied Field Exploration	1-4
30	W06GIG-SM3014S	Master Thesis	4
31	W06GIG-SM3015D	Diploma Seminar	4

8. Plan of studies (attachment no. 4)

¹BU – number of ECTS points assigned to hours of classes requiring direct participation of academic teachers and other persons conducting classes

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⁵DN - number of ECTS points assigned to the classes related to the University's academic activity in the discipline/disciplines to which the main field of study is assigned

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Approved by faculty student government legislative body:

POLITECHNIKA WROCLAWSKA
WYDZIAŁ GEOINŻYNIERII
GÓRNICICTWA I GEOLOGII
Samorząd Studencki Wydziału Geoinżynierii,
Górnictwa i Geologii
50-421 Wrocław, Na Grobli 15, pokój 370

Jakub Dobrzański

Jakub Dobrzański
Chairman of the Student Government
of the Faculty of Geoengineering, Mining and Geology

.....
name and surname, signature of student representative

28.09.23

.....
Date

DZIEKAN

prof. dr hab. inż. Radosław Zimroz

.....
Dean's signature

28.09.23

.....
Date

PLAN OF STUDIES

FACULTY: Geoengineering, Mining and Geology

MAIN FIELD OF STUDY: Mining and geology

EDUCATION LEVEL: second-level studies

FORM OF STUDIES: full-time studies

PROFILE: general academic

SPECIALIZATION: Mineral Resources Exploration - Track UNI ZAGREB-WUST

LANGUAGE OF STUDY: English

In effect since academic year 2023/24

	Winter		Summer		Winter		Summer													
semester	1	ECTS	2	ECTS	3	ECTS	4	ECTS												
hours	UNIZG		UNIZG		WUST		WUST													
1	Sedimentology 20030 E W06GIG-SM3033G	5	Regional Hydrogeology 20020E W06GIG-SM3040G	4	Operations Research 10100Z W06GIG- SM3000	3	Exploration entrepreneurship (EFG) 10012 Z W06GIG-SM3012G	4												
2					Environmental Management 20001Z W06GIG- SM3001				3											
3										Seismotectonics 20100E W06GIG-SM3041G	4	Diploma Seminar 00002Z SM3014S	1							
4														Computer Aided Geological Modelling & Geostatistics 10300Z W06GIG- SM3002	5	Master Thesis 00010Z W06GIG-SM3015D	20			
5	Industrial Mineral Deposits and Applications 20002E W06GIG-SM3042G	5	Project Management, Appraisal and Risk Evaluation 10210E W06GIG- SM3003G	4																
6					Mineral Deposits Exploration 20030E W06GIG-SM3034G	5	Analytical Methods in Ore Deposits 20200E W06GIG-SM3043G	5	SOC Internship 00020 Z W06GIG-SM3013P	2										
7											Petroleum Geology 20030E W06GIG-SM3035G	5	Engineering Geophysics 10010 Z W06GIG- SM3004					3		
8																			Geophysical Exploration of Mineral Resources 20000E W06GIG-SM3044W	3
9	Analyses of mineral paragenesis 10200E W06GIG-SM3045G	3	Foreign Language 1 03000 Z SJO- SM0003	2																
10														Field and laboratory practicum 00080 Z W06GIG-SM3046P	6	Principles and Application of InSAR and GIS in mining 20300E W06GIG- SM3007	5			
11	Exploration Geochemistry 20010Z W06GIG-SM3037G	4	Digital Mine 10100 Z W06GIG- SM3006	2																
12					Remote sensing of mineral resources 10100E W06GIG-SM3038G	3	Foreign Language 2 01000 Z SJO- SM0004	1												
13									GIS in Exploration of Mineral Resources 10100Z W06GIG-SM3039G	3										
14																				
15																				
16	Engineering Geological Investigations 20020E W06GIG-SM3036G	5																		
17	Exploration Geochemistry 20010Z W06GIG-SM3037G	4																		
18	Remote sensing of mineral resources 10100E W06GIG-SM3038G	3																		
19	GIS in Exploration of Mineral Resources 10100Z W06GIG-SM3039G	3																		
20																				
21																				
22																				
23																				
24																				
25																				
26																				
27																				
28																				
Total ECTS		30		30		30		30												

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⁴University-wide subject /group of classes – enter O

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1. Set of obligatory and optional subjects and groups of classes in semestral arrangement

Semester 1

Obligatory subjects / groups of classes (0 ECTS points)

No.	Subject / groups of classescode	Name of subject / groups of classes (denote group of courses with symbol GK)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form ² of course/group of courses	Way ³ of crediting	Subject / groups of classes			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN ⁵ classes	BU ¹ classes			University-wide ⁴	Concerning scientific activities ⁵	Practical ⁶	Type ⁷
1																			
Total																			

Optional subjects / groups of classes Number of ECTS points 30

No.	Subject / groups of classescode	Name of subject / groups of classes (denote group of courses with symbol GK)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form ² of course/group of courses	Way ³ of crediting	Subject / groups of classes			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN ⁵ classes	BU ¹ classes			University-wide ⁴	Concerning scientific activities ⁵	Practical ⁶	Type ⁷
1	W06GIG-M3033G	Sedimentology GK	2			3		K2_GIG_W01,W02 K2_GIG_U01,U13 K2_GIG_K02	75	125	5	3	3,6	T/Z(w)	E		DN	3	S
2	W06GIG-SM3034G	Mineral deposits exploration GK	2			3		K2_GIG_W01, W08,W11,W15, K2_GIG_U01,U13 K2_GIG_K03	75	125	5	3	3,6	T/Z(w)	E		DN	3	S
3	W06GIG-SM3035G	Petroleum geology GK	2			3		K2_GIG_W01,W2,W08, W11, K2_GIG_U01,U4,U10,U13 K2_GIG_K03	75	125	5		3,6	T/Z(w)	E			3	S
4	W06GIG-SM3036G	Engineering geological investigations GK	2			2		K2_GIG_W2,W07, W10, K2_GIG_U01,U04,U10 K2_GIG_K03	60	125	5	3	3,0	T/Z(w)	E		DN	3	S
5	W06GIG-SM3037G	Exploration geochemistry GK	2			1		K2_GIG_W01,W02,W18 K2_GIG_U01,U04,U09,U10,U13 K2_GIG_K02	45	100	4	3	2,3	T/Z(w)	Z		DN	2	S
6	W06GIG-SM3038G	Remote sensing of mineral resources GK	1		1			K2_GIG_W01,W02,W08,W15 K2_GIG_U01,U04,U13,U15 K2_GIG_K03	30	75	3	3	1,5	T/Z(w)	E		DN	2	S
7	W06GIG-SM3039G	GIS in exploration of mineral resources GK	1		1			K2_GIG_W01,W02,W08,W14,W15 K2_GIG_U01,U04,U13,U15 K2_GIG_K01	30	75	3	3	1,5	T/Z(w)	Z		DN	2	S
Total			12		2	12			390	750	30	18	19,1					18	

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⁶Practical subject / group of classes – enter P. For the group of courses – in brackets enter the number of ECTS points assigned to practical courses

⁷KO – general education courses, PD – basic sciences courses, K – main field of study courses, S – specialization courses

Altogether in semester

Total number of hours					Total number of ZZU hours	Total number of CNPS hours	Total number of ECTS points	Total number of ECTS points for DN classes ⁵	Number of ECTS points for BU classes ¹
lec	cl	lab	pr	sem					
12		2	12		390	750	30	18	19,1

Semester 2

Obligatory subjects / groups of classes (0 ECTS points)

No.	Subject / groups of classescode	Name of subject / groups of classes (denote group of courses with symbol GK)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form ² of course/group of courses	Way ³ of crediting	Subject / groups of classes			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN ⁵ classes	BU ¹ classes			University-wide ⁴	Concerning scientific activities ⁵	Practical ⁶	Type ⁷
1																			
		Total																	

Optional subjects / groups of classes Number of ECTS points 30

No.	Subject / groups of classescode	Name of subject / groups of classes (denote group of courses with symbol GK)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form ² of course/group of courses	Way ³ of crediting	Subject / groups of classes			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN ⁵ classes	BU ¹ classes			University-wide ⁴	Concerning scientific activities ⁵	Practical ⁶	Type ⁷
1	W06GIG-SM3040G	Regional hydrogeology GK	2			2		K2_GIG_W01,W2,W10, W15 K2_GIG_U01,U4,U13 K2_GIG_K03	60	100	4	4	2,9	T/Z(w)	E		DN	2	S
2	W06GIG-SM3041G	Seismotectonics GK	2			1		K2_GIG_W2,W10, W14 K2_GIG_U01,U4,U10,U13 K2_GIG_K01	45	100	4	4	2,4	T/Z(w)	E		DN	2	S
3	W06GIG-SM3042G	Industrial mineral deposits and applications GK	2				2	K2_GIG_W1,W07, W12 K2_GIG_U01,U10,U13 K2_GIG_K01,K02	60	125	5	5	2,8	T/Z	E		DN	3	S
4	W06GIG-SM3043G	Analytical methods in ore deposits GK	2		2			K2_GIG_W1,W02, W10 K2_GIG_U02,U07,U13 K2_GIG_K01	60	125	5	4	2,8	T/Z(w)	E		DN	3	S
5	W06GIG-SM3044W	Geophysical exploration and mineral resources	2					K2_GIG_W1,W02, W08,W10 K2_GIG_K01	30	75	3	3	1,4	T/Z	E		DN		S
6	W06GIG-SM3045G	Analyses of mineral paragenesis GK	1		2			K2_GIG_W1,W02 K2_GIG_U01,U13 K2_GIG_K01	45	75	3		2,2	T/Z(w)	E			2	S
7	W06GIG-SM3046P	Field and laboratory practicum				8		K2_GIG_U01,U04,U13 K2_GIG_K02,K03	120	150	6	4	5,0	T	Z		DN	6	S
		Total	11		4	11	2		420	750	30	24	19,5					18	

¹BU – number of ECTS points assigned to hours of classes requiring direct participation of academic teachers and other persons conducting classes

²Traditional – enter T, remote – enter Z

³Exam – enter E, crediting – enter Z. For the group of classes – after the letter E or Z - enter in brackets the final subject form (lec, cl, lab, pr, sem)

⁴University-wide subject /group of classes – enter O

⁵DN - number of ECTS points assigned to the classes related to the University's academic activity in the discipline/disciplines to which the main field of study is assigned

⁶Practical subject / group of classes – enter P. For the group of courses – in brackets enter the number of ECTS points assigned to practical courses

⁷KO – general education courses, PD – basic sciences courses, K – main field of study courses, S – specialization courses

Altogether in semester

Total number of hours					Total number of ZZU hours	Total number of CNPS hours	Total number of ECTS points	Total number of ECTS points for DN classes ⁵	Number of ECTS points for BU classes ¹
lec	cl	lab	pr	sem					
11		4	11	2	420	750	30	24	19,5

Semester 3

Obligatory subjects / groups of classes Number of ECTS points 27

No.	Subject / groups of classescode	Name of subject / groups of classes (denote group of courses with symbol GK)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form ² of course/g roup of courses	Way ³ of crediting	Subject / groups of classes			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN ⁵ classes	BU ¹ classes			University-wide ⁴	Concerning scientific activities ⁵	Practical ⁶	Type ⁷
1	W06GIG-SM3000W	Operations Research	1					K2_GIG_W06	15	25	1	1	0,8	T/Z	Z		DN		KO
2	W06GIG-SM3000L	Operations Research			1			K2_GIG_U10,U14 K2_GIG_K01	15	50	2	2	0,7	T	Z		DN	P (2)	KO
3	W06GIG-SM3002W	Computer Aided Geological Modelling & Geostatistics	1					K2_GIG_W06,W08,W15	15	50	2		0,8	T/Z	Z		DN		PD/K
4	W06GIG-SM3002L	Computer Aided Geological Modelling & Geostatistics			3			K2_GIG_U04,U08,U14	45	75	3	2	1,9	T	Z		DN	P (3)	PD/K
5	W06GIG-SM3003G	Project Management, Appraisal and Risk Evaluation (GK)	1		2	1		K2_GIG_W03,W05,W11 K2_GIG_U04,U06,U08,U15 K2_GIG_K01	60	100	4	4	3,1	T/Z(w)	E(w), Z(l,p)		DN	P (3)	KO
6	W06GIG-SM3001W	Environmental Management	2					K2_GIG_W04,W12,W13,W18	30	50	2	2	1,3	T/Z(w)	Z		DN		K
7	W06GIG-SM3001S	Environmental Management				1		K2_GIG_U05,U10,U11 K2_GIG_K02,K03	15	25	1	1	0,8	T	Z		DN	P(1)	K
8	W06GIG-SM3004W	Engineering Geophysics	1					K2_GIG_W02,W08,W10	15	25	1	1	0,8	T/Z	Z		DN		PD
9	W06GIG-SM3004P	Engineering Geophysics				1		K2_GIG_U04,U13	15	50	2	2	0,9	T	Z		DN	P(2)	PD
10	W06GIG-SM3007W	Principles and Application of InSAR and GIS in mining	2					K2_GIG_W15,W16,W18	30	50	2	2	1,4	T/Z(w)	E		DN		K
11	W06GIG-SM3007L	Principles and Application of InSAR and GIS in mining			3			K2_GIG_U04,U07,U08	45	75	3	3	2,0	T	Z		DN	P(3)	K
12	W06GIG-SM3005W	Occupational Health and Safety	1					K2_GIG_W11,W12,W14,W17	15	25	1	1	0,7	T/Z(w)	Z		DN		K
13	W06GIG-SM3005P	Occupational Health and Safety				1		K2_GIG_U11, K2_GIG_K02, K03	15	25	1	1	0,8	T	Z		DN	P(1)	K
14	W06GIG-SM3006W	Digital Mine	1					K2_GIG_W07,W12,W18,W19	15	25	1	1	0,8	T/Z(w)	Z		DN		K
15	W06GIG-SM3006L	Digital Mine			1			K2_GIG_U04,U07,U08	15	25	1	1	0,8	T	Z		DN	P(1)	K
Total			10	0	10	3	1		360	675	27	24	17,6					16	

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²Traditional – enter T, remote – enter Z

³Exam – enter E, crediting – enter Z. For the group of classes – after the letter E or Z - enter in brackets the final subject form (lec, cl, lab, pr, sem)

⁴University-wide subject /group of classes – enter O

⁵DN - number of ECTS points assigned to the classes related to the University's academic activity in the discipline/disciplines to which the main field of study is assigned

⁶Practical subject / group of classes – enter P. For the group of courses – in brackets enter the number of ECTS points assigned to practical courses

⁷KO – general education courses, PD – basic sciences courses, K – main field of study courses, S – specialization courses

Optional subjects / groups of classes (3 ECTS points)

No.	Subject / groups of classescode	Name of subject / groups of classes (denote group of courses with symbol GK)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form ² of course/g roup of courses	Way ³ of crediting	Course/group of courses			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN ⁵ classes	BU ¹ classes			University -wide ⁴	Concerni ng scientific activities ⁵	Practical ⁶	Type ⁷
1	SJO-SM0003	Foreign Language 1		3				K2_GIG_U03	45	60	2		1,6	T	Z	O		P(2)	KO
2	SJO-SM0004	Foreign Language 2		1				K2_GIG_U01,U02	15	30	1		0,6	T	Z	O		P(1)	KO
Total			0	4	0	0			60	90	3	0	2,2					3	

Altogether in semester

Total number of hours					Total number of ZZU hours	Total number of CNPS hours	Total number of ECTS points	Total number of ECTS points for DN classes ⁵	Number of ECTS points for BU classes ¹
lec	cl	lab	pr	sem					
10	4	10	3	1	420	765	30	24	19,8

Semester 4

Obligatory subjects / groups of classes Number of ECTS points 9

No.	Subject / groups of classescode	Name of subject / groups of classes (denote group of courses with symbol GK)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form ² of course/g roup of courses	Way ³ of crediting	Course/group of courses			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN ⁵ classes	BU ¹ classes			University -wide ⁴	Concerni ng scientific activities ⁵	Practical ⁶	Type ⁷
1	W06GIG-SM3012G	Exploration Entrepreneurship GK	1			1	2	K2_GIG_W03,W05,W09 K2_GIG_U08,U09 K2_GIG_K01,K02,K03	60	100	4		3,0	Z	Z			P(3)	S
2	W06GIG-SM3013P	SOC Internship				2		K2_GIG_W05,W09 K2_GIG_U08,U09 K2_GIG_K01,K02,K03	30	50	2		1,5	T	Z			P(2)	S
3	W06GIG-SM3016P	Applied Field Exploration				3		K2_GIG_W08,W15 K2_GIG_U04,U09,U10,U13 K2_GIG_K02	45	75	3	1	2,1	T	Z		DN	P(3)	S
Total			1	0	0	6	2		135	225	9	1	6,6					8	

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²Traditional – enter T, remote – enter Z

³Exam – enter E, crediting – enter Z. For the group of classes – after the letter E or Z - enter in brackets the final subject form (lec, cl, lab, pr, sem)

⁴University-wide subject /group of classes – enter O

⁵DN - number of ECTS points assigned to the classes related to the University's academic activity in the discipline/disciplines to which the main field of study is assigned

⁶Practical subject / group of classes – enter P. For the group of courses – in brackets enter the number of ECTS points assigned to practical courses

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Optional subjects / groups of classes (21 ECTS points)

No.	Subject / groups of classescode	Name of subject / groups of classes (denote group of courses with symbol GK)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form ² of course/group of courses	Way ³ of crediting	Course/group of courses			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN ⁵ classes	BU ¹ classes			University-wide ⁴	Concernin g scientific activities ⁵	Practical ⁶	Type ⁷
1	W06GIG-SM3014S	Diploma Seminar					1	K2_GIG_W01 K2_GIG_U01,U13 K2_GIG_K02,K03	15	25	1	1	0,8	T	Z		DN	P(1)	S
2	W06GIG-SM3015D	Master Thesis					1	K2_GIG_W01,W05,W10 K2_GIG_U01,U04,U08,U10,U13,U15 K2_GIG_K01,K02,K03	15	500	20	20	1,8	T	Z		DN	P(20)	S
Total			0	0	0	1	1		30	525	21	21	2,6					21	

Altogether in semester

Total number of hours					Total number of ZZU hours	Total number of CNPS hours	Total number of ECTS points	Total number of ECTS points for DN classes ⁵	Number of ECTS points for BU classes ¹
lec	cl	lab	pr	sem					
1	0	0	7	3	165	750	30	22	9,2

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²Traditional – enter T, remote – enter Z

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⁴University-wide subject /group of classes – enter O

⁵DN - number of ECTS points assigned to the classes related to the University's academic activity in the discipline/disciplines to which the main field of study is assigned

⁶Practical subject / group of classes – enter P. For the group of courses – in brackets enter the number of ECTS points assigned to practical courses

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2. Set of examinations in semestral arrangement

Course / group of courses code	Names of subjects / groups of classes ending with examination	Semester
W06GIG-SM3033G	1. Sedimentology	1
W06GIG-SM3034G	2. Mineral deposits exploration	1
W06GIG-SM3035G	3. Petroleum geology	1
W06GIG-SM3036G	4. Engineering geological investigations	1
W06GIG-SM3038G	5. Remote sensing of mineral resources	1
W06GIG-SM3040G	1. Regional hydrogeology	2
W06GIG-SM3041G	2. Seismotectonics	2
W06GIG-SM3042G	3. Industrial mineral deposits and applications	2
W06GIG-SM3043G	4. Analytical methods in ore deposits	2
W06GIG-SM3044W	5. Geophysical exploration and mineral resources	2
W06GIG-SM3045G	6. Analyses of mineral paragenesis	2
W06GIG-SM3003G	1. Project Management, Appraisal and Risk Evaluation	3
W06GIG-SM3007	2. Principles and Application of InSAR and GIS in mining	3
	Final diploma examination	4

3. Numbers of allowable deficit of ECTS points after particular semesters

Semester	Allowable deficit of ECTS points after semester
1	12
2	8
3	0

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⁴University-wide subject /group of classes – enter O

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Opinion of student government legislative body

POLITECHNIKA WROCLAWSKA
WYDZIAŁ GEOINŻYNIERII
GÓRNICICTWA I GEOLOGII
Samorząd Studencki Wydziału Geoinżynierii,
Górnictwa i Geologii
50-421 Wrocław, Na Grebli 15, pokój 370

28.09.23

Jakub Dobrzański

Jakub Dobrzański
Chairman of the Student Government
of the Faculty of Geoengineering, Mining and Geology

Date

Name and surname, signature of student representative

28.09.23

DZIEKAN
RD
prof. dr hab. inż. Radosław Zimroz
(1)

Date

Dean's signature

FACULTY: **of Geoengineering, Mining and Geology**

MAIN FIELD OF STUDY: **Mining and Geology**

LANGUAGE OF STUDY: English

SPECIALIZATION: **Mineral Resources Exploration**

- Track: WUST - UNI ZAGREB

DESCRIPTION OF THE PROGRAM OF STUDIES

Main field of study MINING AND GEOLOGY**Profile** general academic**Level of studies** second level studies**Form of studies** full-time studies**1. General description**

<i>1.1 Number of semesters: 4</i>	<i>1.2 Total number of ECTS points necessary to complete studies at a given level: 120</i>
<i>1.3 Total number of hours: 1395</i>	<i>1.4 Prerequisites (particularly for second-level studies): Bachelor of Science in Engineering diploma, interview</i>
<i>1.5 Upon completion of studies graduate obtains professional degree of: magister inżynier - 2nd degree qualifications</i>	<p><i>1.6 Graduate profile, employability:</i></p> <p><i>The program will train T-shaped earth science specialists having a strong background in classical disciplines of geology and geophysics complemented with modern 3D modelling as well as data processing and interpretation skills, while the boundary-crossing competences will cover skills in innovative mineral exploration techniques and technologies used in the field, in laboratories, in an underground and underwater environment. Students will also be trained in sustainability, social responsibility and social licence to operate. T-shaped mineral explorers will use Industry 4.0-derived tools and methods for mineral resource exploration, mentored by experts.</i></p> <p><i>They will be prepared to work in enterprises, technical supervision institutions, public state and local administration, in research and development organisations, in Poland and</i></p>

	<p><i>abroad, will also be prepared to start own business or work as free lanced exploration geologists. The graduates will be able to use English freely and will be prepared to work in an international environment and intercultural groups during their professional career.</i></p>
<p><i>1.7 Possibility of continuing studies: eligibility to apply for admission to a doctoral school, non-degree postgraduate programmes</i></p>	<p><i>1.8 Indicate connection with University's mission and its development strategy: The study programs of all specializations within the field of study Mining and Geology respond to the strategic goals of the University (Strategia Politechniki Wrocławskiej 2023–2030), by rising the level of correlation of the study offer with the needs of the market (C3), by enhancing the quality of education through didactic interdisciplinarity and by cooperation with industrial partners as well as increasing the level of entrepreneurship, creativity and involvement of students in research processes (C4, C2). Graduates of the faculty should be creative, professional, have theoretical background and practical abilities, as well as have interpersonal skills and cross-cultural experience (C5). The Faculty of Geoengineering, Mining and Geology, as one of the units of the Wrocław University of Science and Technology, educates in the field of engineering, broadened by knowledge in natural and economic sciences. The profile and quality of education are at the international level and are adapted to the needs of the national and global mineral industries.</i></p>

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⁴University-wide subject /group of classes – enter O

⁵DN - number of ECTS points assigned to the classes related to the University's academic activity in the discipline/disciplines to which the main field of study is assigned

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⁷KO – general education courses, PD – basic sciences courses, K – main field of study courses, S – specialization courses

2. Detailed description

2.1 Total number of learning outcomes in the program of study: W (knowledge) = 19, U (skills) = 15, K (competences) = 3,
W + U + K = 37

~~2.2 For the main field of study assigned to more than one discipline – the number of learning outcomes assigned to the discipline:~~

~~_____ D1 (major) (this number must be greater than half the total number of learning outcomes)~~

~~_____ D2~~

~~_____ D3~~

~~_____ D4~~

~~2.3 For the main field of study assigned to more than one discipline – percentage share of the number of ECTS points for each discipline:~~

~~_____ D1% ECTS points~~

~~_____ D2% ECTS points~~

~~_____ D3% ECTS points~~

~~_____ D4% ECTS points~~

2.4a. For the general academic profile of the main field of study – the number of ECTS points assigned to the classes related to the University's academic activity in the discipline or disciplines to which the main field of study is assigned – DN (must be greater than 50% of the total number of ECTS points from 1.2) 88 ECTS

2.4b. For the practical profile of the main field of study – the number of ECTS points assigned to the classes shaping practical skills (must be greater than 50% of the total number of ECTS points from 1.2)

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⁴University-wide subject /group of classes – enter O

⁵DN - number of ECTS points assigned to the classes related to the University's academic activity in the discipline/disciplines to which the main field of study is assigned

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2.5 Concise analysis of compliance of the assumed learning outcomes with the needs of the labor market

The economic development of the country is closely dependent on natural resources, the ability to use them and having appropriate engineering workforce. The assumed learning outcomes correspond to the needs of practice in the field of the generally understood management of mineral resources - technologies and techniques for their identification, valuation, extraction, processing, revitalization of industrial areas, and the practice of managing an enterprise (especially mining) in the sense of managing information, environment and people, using the latest IT and marketing techniques and methods. This integration of economic needs and assumed educational effects favorably shape the labor market for the graduates of the Faculty. Additionally, a good command of English and experience of working in an international group will open up the possibility of working in foreign branches of Polish enterprises and in foreign companies.

2.6. The total number of ECTS points that a student must obtain in classes requiring direct participation of academic teachers or other persons conducting classes and students (enter the sum of ECTS points for courses / groups of courses marked with the BU¹ code) 67,6 ECTS

2.7. Total number of ECTS points, which student has to obtain from basic sciences classes

Number of ECTS points for obligatory subjects	6
Number of ECTS points for optional subjects	0
Total number of ECTS points	6

2.8. Total number of ECTS points, which student has to obtain from practical classes, including project and laboratory classes (enter total number of ECTS points for courses/group of courses denoted with code P)

Number of ECTS points for obligatory subjects	24
Number of ECTS points for optional subjects	60
Total number of ECTS points	84

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²Traditional – enter T, remote – enter Z

³Exam – enter E, crediting – enter Z. For the group of classes – after the letter E or Z - enter in brackets the final subject form (lec, cl, lab, pr, sem)

⁴University-wide subject /group of classes – enter O

⁵DN - number of ECTS points assigned to the classes related to the University's academic activity in the discipline/disciplines to which the main field of study is assigned

⁶Practical subject / group of classes – enter P. For the group of courses – in brackets enter the number of ECTS points assigned to practical courses

⁷KO – general education courses, PD – basic sciences courses, K – main field of study courses, S – specialization courses

2.9. Minimum number of ECTS points, which student has to obtain doing education blocks offered as part of University-wide classes or other main field of study (enter number of ECTS points for courses/groups of courses denoted with code O)

3 ECTS points

2.10. Total number of ECTS points, which student may obtain doing optional blocks (min. 30% of total number of ECTS points)

84 ECTS points

3. Description of the process leading to learning outcomes acquisition:

1. Upon starting classes in each subject, the student has an appropriate level of knowledge and skills which constitute the prerequisites for a given course (it is verified by the teacher or the dean's office).
2. The student participates in classes organized at the university.
3. The student carries out the assigned work in class and at home (projects, computational tasks, analyzes, prepares presentations) and studies the literature and materials recommended by the teacher.
4. The student uses the appointed hours of the tutor's consultation, explaining his uncertainties and verifying the correct understanding of the course content.
5. The student participates in periodic tests of knowledge and skills, completes the tests available on the e-portal and is familiar with the correct answers, grades and comments from the teacher.
6. In some subjects, the student participates in group tasks, taking part in the organization of the group's work, assessment of the activities of individual participants and takes responsibility for the result of the group's work.
7. The student is encouraged to become involved in the work of research clubs, student organizations, discussion clubs, sports groups, participation in social life through work in public welfare organizations, voluntary work, thus gaining valuable interpersonal skills and social competences.
8. The student participates in meetings with companies from the industry, technical excursions, job fairs, tries to gain knowledge about the labor market and additional advantages when applying for a job
9. The student is encouraged to participate in an international student exchange, and through contact with foreigners at the faculty, he or she acquires additional interpersonal, cultural and language qualifications

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³Exam – enter E, crediting – enter Z. For the group of classes – after the letter E or Z - enter in brackets the final subject form (lec, cl, lab, pr, sem)

⁴University-wide subject /group of classes – enter O

⁵DN - number of ECTS points assigned to the classes related to the University's academic activity in the discipline/disciplines to which the main field of study is assigned

⁶Practical subject / group of classes – enter P. For the group of courses – in brackets enter the number of ECTS points assigned to practical courses

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4. List of education blocks:

4.1. List of obligatory blocks:

4.1.1 List of general education blocks

4.1.1.1 Liberal-managerial subjects block (7 ECTS points):

No.	Subject/ group of classes code	Name of subject/group of classes (denote group of courses with symbol GK)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form ² of course/gr oup of courses	Way ³ of crediting	Subject/group of classes			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN ⁵ classes	BU ¹ classes			University -wide ⁴	Concerni ng scientific activities ⁵	Practical ⁶	Type ⁷
1	W06GIG- SM3003G	Project Management, Appraisal and Risk Evaluation (GK)	1		2	1		K2_GIG_W03,W05,W11 K2_GIG_U04,U06,U08,U15 K2_GIG_K01	60	100	4	4	3,1	T/Z(w)	E(w), Z(l,p)		DN	P (3)	KO
2	W06GIG- SM3000W	Operations Research	1					K2_GIG_W06 K2_GIG_U10,U14 K2_GIG_K01	15	25	1	1	0,8	T/Z	Z		DN		KO
3	W06GIG- SM3000L	Operations Research			1				15	50	2	2	0,7	T	Z		DN	P (2)	KO
Total			2	0	3	1	0		90	175	7	7	4,6					5	

Altogether for general education blocks

Total number of hours					Total number of ZZU hours	Total number of CNPS hours	Total number of ECTS points	Total number of ECTS points for DN classes ⁵	Number of ECTS points for BU classes ¹
lec	cl	lab	pr	sem					
2	0	3	1	0	90	175	7	7	4,6

¹BU – number of ECTS points assigned to hours of classes requiring direct participation of academic teachers and other persons conducting classes

²Traditional – enter T, remote – enter Z

³Exam – enter E, crediting – enter Z. For the group of classes – after the letter E or Z - enter in brackets the final subject form (lec, cl, lab, pr, sem)

⁴University-wide subject /group of classes – enter O

⁵DN - number of ECTS points assigned to the classes related to the University's academic activity in the discipline/disciplines to which the main field of study is assigned

⁶Practical subject / group of classes – enter P. For the group of courses – in brackets enter the number of ECTS points assigned to practical courses

⁷KO – general education courses, PD – basic sciences courses, K – main field of study courses, S – specialization courses

4.1.2 List of basic sciences blocks

4.1.2.1 Mathematics block

No.	Subject/ group of classes code	Name of subject/group of classes (denote group of courses with symbol GK)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form ² of course/gr oup of courses	Way ³ of crediting	Subject/group of classes			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN ⁵ classes	BU ¹ classes			University -wide ⁴	Concerni ng scientific activities ⁵	Practical ⁶	Type ⁷
1	W06GIG- SM3003G	Computer Aided Geological Modelling & Geostatistics (część: Geostatistics)	1					K2_GIG_W06,W08,W15 K2_GIG_U04,U08,U14	15	50	2		0,8	T	Z				PD
2	W06GIG- SM3000W	Computer Aided Geological Modelling & Geostatistics (część: Geostatistics)			1				15	25	1		0,6	T	Z			P (1)	PD
Total			1	0	1	0	0		30	75	3		1,4					1	

4.1.2.3 Physics block

No.	Subject/ group of classes code	Name of subject/group of classes (denote group of courses with symbol GK)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form ² of course/gr oup of courses	Way ³ of crediting	Subject/group of classes			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN ⁵ classes	BU ¹ classes			University -wide ⁴	Concerni ng scientific activities ⁵	Practical ⁶	Type ⁷
1	W06GIG- SM3004W	Engineering Geophysics	1					K2_GIG_W02,W08,W10 K2_GIG_U04,U13	15	25	1	1	0,8	T/Z	Z		DN		PD
	W06GIG- SM3004P	Engineering Geophysics				1			15	50	2	2	0,9	T	Z		DN	P(2)	PD
Total			2	0	0	0	0		30	75	3	3	1,7					2	

Altogether for basic sciences blocks:

Total number of hours					Total number of ZZU hours	Total number of CNPS hours	Total number of ECTS points	Total number of ECTS points for DN classes ⁵	Number of ECTS points for BU classes ¹
lec	cl	lab	pr	sem					
3	0	1	0	0	60	150	6	3	3,1

¹BU – number of ECTS points assigned to hours of classes requiring direct participation of academic teachers and other persons conducting classes

²Traditional – enter T, remote – enter Z

³Exam – enter E, crediting – enter Z. For the group of classes – after the letter E or Z - enter in brackets the final subject form (lec, cl, lab, pr, sem)

⁴University-wide subject /group of classes – enter O

⁵DN - number of ECTS points assigned to the classes related to the University's academic activity in the discipline/disciplines to which the main field of study is assigned

⁶Practical subject / group of classes – enter P. For the group of courses – in brackets enter the number of ECTS points assigned to practical courses

⁷KO – general education courses, PD – basic sciences courses, K – main field of study courses, S – specialization courses

4.1.3 List of the main field of study blocks

4.1.3.1 *Obligatory main field of study blocks*

No.	Subject/ group of classes code	Name of subject/group of classes (denote group of courses with symbol GK)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form ² of course/gr oup of courses	Way ³ of crediting	Subject/group of classes			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN ⁵ clas ses	BU ¹ clas ses			Unive rsity- wide ⁴	Concerning scientific activities ⁵	Practical ⁶	Type ⁷
1	W06GIG- SM3002L	Computer Aided Geological Modelling & Geostatistics (Część: Computer Aided Geological Modelling)			2			K2_GIG_W06,W08,W15 K2_GIG_U04,U08,U14	30	50	2	2	1,3	T	Z		DN	P(2)	K
2	W06GIG- SM3006W	Digital Mine	1					K2_GIG_W07,W12,W18,W19 K2_GIG_U04,U07,U08	15	25	1	1	0,8	T/Z(w)	Z		DN		K
3	W06GIG- SM3006L	Digital Mine			1				15	25	1	1	0,8	T	Z		DN	P(1)	K
4	W06GIG- SM3005W	Occupational Health and Safety	1					K2_GIG_W11,W12,W14,W17 K2_GIG_U11, K2_GIG_K02, K03	15	25	1	1	0,7	T/Z(w)	Z		DN		K
5	W06GIG- SM3005P	Occupational Health and Safety				1			15	25	1	1	0,8	T	Z		DN	P(1)	K
6	W06GIG- SM3007W	Principles and Application of InSAR and GIS in mining	2					K2_GIG_W15,W16,W18 K2_GIG_U04,U07,U08	30	50	2	2	1,4	T/Z(w)	E		DN		K
7	W06GIG- SM3007L	Principles and Application of InSAR and GIS in mining			3				45	75	3	3	2,0	T	Z		DN	P(3)	K
8	W06GIG- SM3001W	Environmental Management	2					K2_GIG_W04,W12,W13,W18 K2_GIG_U05,U10,U11,U12 K2_GIG_K02,K03	30	50	2	2	1,3	T/Z(w)	Z		DN		K
9	W06GIG- SM3001S	Environmental Management				1			15	25	1	1	0,8	T	Z		DN	P(1)	K
10	W06GIG- SM3012G	Exploration Entrepreneurship GK	1			1	2	K2_GIG_W03,W05,W09 K2_GIG_U08,U09 K2_GIG_K01,K02,K03	60	100	4		3,0	Z	Z			P(3)	S
11	W06GIG- SM3013P	SOC Internship				2		K2_GIG_W05,W09 K2_GIG_U08,U09 K2_GIG_K01,K02,K03	30	50	2		1,5	T	Z			P(2)	S
12	W06GIG- SM3016P	Applied Field Exploration				3		K2_GIG_W08,W15 K2_GIG_U04,U09,U10,U13 K2_GIG_K02	45	75	3	1	2,1	T	Z		DN	P(3)	S
Total			7	0	6	7	3		345	575	23	15	16,5					16	

¹BU – number of ECTS points assigned to hours of classes requiring direct participation of academic teachers and other persons conducting classes

²Traditional – enter T, remote – enter Z

³Exam – enter E, crediting – enter Z. For the group of classes – after the letter E or Z - enter in brackets the final subject form (lec, cl, lab, pr, sem)

⁴University-wide subject /group of classes – enter O

⁵DN - number of ECTS points assigned to the classes related to the University's academic activity in the discipline/disciplines to which the main field of study is assigned

⁶Practical subject / group of classes – enter P. For the group of courses – in brackets enter the number of ECTS points assigned to practical courses

⁷KO – general education courses, PD – basic sciences courses, K – main field of study courses, S – specialization courses

Altogether (for main field of study blocks):

Total number of hours					Total number of ZZU hours	Total number of CNPS hours	Total number of ECTS points	Total number of ECTS points for DN classes ⁵	Number of ECTS points for BU classes ¹
lec	cl	lab	pr	sem					
7	0	6	7	3	345	575	23	15	16,5

4.2 List of optional blocks

4.2.1 List of general education blocks

4.2.1.2 Foreign languages block (min. 3 ECTS points):

No.	Subject/group of classes code	Name of subject/group of classes (denote group of courses with symbol GK)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form ² of course/group of courses	Way ³ of crediting	Subject/group of classes			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN ⁵ classes	BU ¹ classes			University-wide ⁴	Concerning scientific activities ⁵	Practical ⁶	Type ⁷
1	SJO-SM0003	Foreign Language 1		3				K2_GIG_U03	45	60	2		1,6	T	Z	O		P (2)	KO
2	SJO-SM0004	Foreign Language 2		1				K2_GIG_U01,U02	15	30	1		0,6	T	Z	O		P(1)	KO
Total			0	4	0	0	0		60	90	3		2,2					3	

Altogether for general education blocks:

Total number of hours					Total number of ZZU hours	Total number of CNPS hours	Total number of ECTS points	Total number of ECTS points for DN classes ⁵	Number of ECTS points for BU classes ¹
lec	cl	lab	pr	sem					
0	4	0	0	0	60	90	3	0	2,2

¹BU – number of ECTS points assigned to hours of classes requiring direct participation of academic teachers and other persons conducting classes

²Traditional – enter T, remote – enter Z

³Exam – enter E, crediting – enter Z. For the group of classes – after the letter E or Z - enter in brackets the final subject form (lec, cl, lab, pr, sem)

⁴University-wide subject / group of classes – enter O

⁵DN - number of ECTS points assigned to the classes related to the University's academic activity in the discipline/disciplines to which the main field of study is assigned

⁶Practical subject / group of classes – enter P. For the group of courses – in brackets enter the number of ECTS points assigned to practical courses

⁷KO – general education courses, PD – basic sciences courses, K – main field of study courses, S – specialization courses

4.2.4 List of specialization blocks

4.2.4.1 Specialization subjects (e.g. whole specialization) blocks (60 ECTS points):

No.	Subject/ group of classes code	Name of subject/group of classes (denote group of courses with symbol GK)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form ² of course/gr oup of courses	Way ³ of crediting	Subject/group of classes			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN ⁵ classes	BU ¹ classes			Univer sity-wide ⁴	Concerni ng scientific activities ⁵	Practical ⁶	Type ⁷
1	W06GIG- SM3033G	Sedimentology GK	2			3		K2_GIG_W01,W02 K2_GIG_U01,U13 K2_GIG_K02	75	125	5	3	3,6	T/Z(w)	E		DN	3	S
2	W06GIG- SM3034G	Mineral deposits exploration GK	2			3		K2_GIG_W01, W08,W11,W15, K2_GIG_U01,U13 K2_GIG_K03	75	125	5	3	3,6	T/Z(w)	E		DN	3	S
3	W06GIG- SM3035G	Petroleum geology GK	2			3		K2_GIG_W01,W2,W08, W11, K2_GIG_U01,U4,U10,U13 K2_GIG_K03	75	125	5		3,6	T/Z(w)	E			3	S
4	W06GIG- SM3036G	Engineering geological investigations GK	2			2		K2_GIG_W2,W07, W10, K2_GIG_U01,U04,U10 K2_GIG_K03	60	125	5	3	3,0	T/Z(w)	E		DN	3	S
5	W06GIG- SM3037G	Exploration geochemistry GK	2			1		K2_GIG_W01,W02,W18 K2_GIG_U01,U04,U09,U10,U13 K2_GIG_K02	45	100	4	3	2,3	T/Z(w)	Z		DN	2	S
6	W06GIG- SM3038G	Remote sensing of mineral resources GK	1		1			K2_GIG_W01,W02,W08,W15 K2_GIG_U01,U04,U13,U15 K2_GIG_K03	30	75	3	3	1,5	T/Z(w)	E		DN	2	S
7	W06GIG- SM3039G	GIS in exploration of mineral resources GK	1		1			K2_GIG_W01,W02,W08,W14,W15 K2_GIG_U01,U04,U13,U15 K2_GIG_K01	30	75	3	3	1,5	T/Z(w)	Z		DN	2	S
8	W06GIG- SM3040G	Regional hydrogeology GK	2			2		K2_GIG_W01,W2,W10, W15 K2_GIG_U01,U4,U13 K2_GIG_K03	60	100	4	4	2,9	T/Z(w)	E		DN	2	S
9	W06GIG- SM3041G	Seismotectonics GK	2			1		K2_GIG_W2,W10, W14 K2_GIG_U01,U4,U10,U13 K2_GIG_K01	45	100	4	4	2,4	T/Z(w)	E		DN	2	S
10	W06GIG- SM3042G	Industrial mineral deposits and applications GK	2			2		K2_GIG_W1,W07, W12 K2_GIG_U01,U10,U13 K2_GIG_K01,K02	60	125	5	5	2,8	T/Z	E		DN	3	S
11	W06GIG- SM3043G	Analytical methods in ore deposits GK	2		2			K2_GIG_W1,W02, W10 K2_GIG_U02,U07,U13 K2_GIG_K01	60	125	5	4	2,8	T/Z(w)	E		DN	3	S
12	W06GIG- SM3044W	Geophysical exploration and mineral resources	2					K2_GIG_W1,W02, W08,W10 K2_GIG_K01	30	75	3	3	1,4	T/Z	E		DN		S
13	W06GIG- SM3045G	Analyses of mineral paragenesis GK	1		2			K2_GIG_W1,W02 K2_GIG_U01,U13 K2_GIG_K01	45	75	3		2,2	T/Z(w)	E			2	S
14	W06GIG- SM3046P	Field and laboratory practicum				8		K2_GIG_U01,U04,U13 K2_GIG_K02,K03	120	150	6	4	5,0	T	Z		DN	6	S
Total			23	0	6	23	2		810	1500	60	42	38,6					36	

¹BU – number of ECTS points assigned to hours of classes requiring direct participation of academic teachers and other persons conducting classes

²Traditional – enter T, remote – enter Z

³Exam – enter E, crediting – enter Z. For the group of classes – after the letter E or Z - enter in brackets the final subject form (lec, cl, lab, pr, sem)

⁴University-wide subject /group of classes – enter O

⁵DN - number of ECTS points assigned to the classes related to the University's academic activity in the discipline/disciplines to which the main field of study is assigned

⁶Practical subject / group of classes – enter P. For the group of courses – in brackets enter the number of ECTS points assigned to practical courses

⁷KO – general education courses, PD – basic sciences courses, K – main field of study courses, S – specialization courses

4.2.4.2 Diploma (e.g. diploma profile) block (21 ECTS points):

No.	Subject/ group of classes code	Name of subject/group of classes (denote group of courses with symbol GK)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form ² of course/g roup of courses	Way ³ of crediting	Subject/group of classes			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN ⁵ classes	BU ¹ classes			University -wide ⁴	Concerni ng scientific activities ⁵	Practical ⁶	Type ⁷
1	W06GIG- SM3014S	Diploma Seminar					1	K2_GIG_W01 K2_GIG_U01,U13 K2_GIG_K03	15	25	1	1	0,8	T	Z		DN	P(1)	S
2	W06GIG- SM3015D	Master Thesis					1	K2_GIG_W01,W05,W10 K2_GIG_U01,U04,U08,U10,U13,U15 K2_GIG_K01,K03	15	500	20	20	1,8	T	Z		DN	P(20)	S
Total			0	0	0	1	1		30	525	21	21	2,6					21	

Altogether for specialization blocks:

Total number of hours					Total number of ZZU hours	Total number of CNPS hours	Total number of ECTS points	Total number of ECTS points for DN classes ⁵	Number of ECTS points for BU classes ¹
lec	cl	lab	pr	sem					
23	0	6	24	3	840	2025	81	63	41,2

¹BU – number of ECTS points assigned to hours of classes requiring direct participation of academic teachers and other persons conducting classes

²Traditional – enter T, remote – enter Z

³Exam – enter E, crediting – enter Z. For the group of classes – after the letter E or Z - enter in brackets the final subject form (lec, cl, lab, pr, sem)

⁴University-wide subject /group of classes – enter O

⁵DN - number of ECTS points assigned to the classes related to the University's academic activity in the discipline/disciplines to which the main field of study is assigned

⁶Practical subject / group of classes – enter P. For the group of courses – in brackets enter the number of ECTS points assigned to practical courses

⁷KO – general education courses, PD – basic sciences courses, K – main field of study courses, S – specialization courses

4.3 Training block - concerning principles of training crediting – attachment no. ...

Opinion of the Advisory Faculty Council concerning the rules of crediting training block

Name of training			
Number of ECTS points	Number of ECTS points for BU ¹ classes	Training crediting mode	Code
Training duration	Training objective		
	Internship		

4.4 „Diploma dissertation” block (if it is foreseen at first level studies)

Type of diploma dissertation	Licencjat / inżynier / magister / magister inżynier*	
Number of diploma dissertation semesters	Number of ECTS points	Code
1	20	W06GIG-SM3015D
Character of diploma dissertation		
Literature survey, project, computer program, etc.		
Number of BU ¹ ECTS points	1,8	

5. Ways of verifying assumed learning outcomes

Form of classes	Ways of verifying assumed learning outcomes
lecture	e.g. examination, progress/final test
class	e.g. progress/final test
laboratory	e.g. pretest, report from laboratory
project	e.g. project defence
seminar	e.g. participation in discussion, topic presentation, essay
training	e.g. report from training
diploma dissertation	prepared diploma dissertation

¹BU – number of ECTS points assigned to hours of classes requiring direct participation of academic teachers and other persons conducting classes

²Traditional – enter T, remote – enter Z

³Exam – enter E, crediting – enter Z. For the group of classes – after the letter E or Z - enter in brackets the final subject form (lec, cl, lab, pr, sem)

⁴University-wide subject /group of classes – enter O

⁵DN - number of ECTS points assigned to the classes related to the University's academic activity in the discipline/disciplines to which the main field of study is assigned

⁶Practical subject / group of classes – enter P. For the group of courses – in brackets enter the number of ECTS points assigned to practical courses

⁷KO – general education courses, PD – basic sciences courses, K – main field of study courses, S – specialization courses

6. Range of diploma examination

1. Occupational risk assessment methods. Identification of harmful, dangerous and nuisance factors in the work environment.
2. Costs as the subject of cost accounting. Variable and fixed costs. Break even point.
3. Capital budgeting, evaluation of different methods
4. Liquidity vs profitability of a company. Ways of their evaluation
5. Environmental management systems
6. Characteristics of hazards for the natural environment resulting from human activities
7. Variogram and methods of its modelling
8. Kriging, its properties and types
9. Geophysical methods of exploration and identification of deposits.
10. Surface seismic methods. Reflective and refractive seismics.
11. Computer aided exploration and identification of deposits.
12. Decision models used in management.
13. Advances of technology & methods of future mining operations.
14. Aims, benefits, drawbacks of automation and industrial revolutions.
15. Applications of Interferometric Synthetic Aperture Radar.
16. Applications of map algebra and spatial statistics to determine surface deformation models
17. Facies cycles and sedimentary sequences
18. Basic features of modern and paleo - depositional environments
19. Geological methods of exploring mineral deposits.
20. Geological criteria in the exploration of mineral deposits
21. Calculation of mineral reserves
22. Examples of appropriate level of site investigations for the purpose of different types of studies and projects in geotechnical engineering.
23. Examples of potential geotechnical problems in different rock types in geotechnical engineering.
24. Basic principles of geochemical prospecting
25. Instrumental analytical methods of geochemical prospecting
26. Application of remote sensing in mineral exploration
27. Characteristics of electromagnetic radiation for the purposes of remote sensing of mineral resources
28. Applications of GIS software in mineral exploration
29. Stress types and distribution in Earth's crust in respect to tectonic plate boundary types
30. Basic properties of global and local seismicity
31. Definition of the concept of scale in hydrogeology and its effect related to permeability properties
32. Basic concept of the Earth's thermal regime
33. Physicochemical and geological conditions for the formation of deposits of chosen industrial minerals

¹BU – number of ECTS points assigned to hours of classes requiring direct participation of academic teachers and other persons conducting classes

²Traditional – enter T, remote – enter Z

³Exam – enter E, crediting – enter Z. For the group of classes – after the letter E or Z - enter in brackets the final subject form (lec, cl, lab, pr, sem)

⁴University-wide subject /group of classes – enter O

⁵DN - number of ECTS points assigned to the classes related to the University's academic activity in the discipline/disciplines to which the main field of study is assigned

⁶Practical subject / group of classes – enter P. For the group of courses – in brackets enter the number of ECTS points assigned to practical courses

⁷KO – general education courses, PD – basic sciences courses, K – main field of study courses, S – specialization courses

34. Types of deposits of industrial minerals
35. The most important analytical methods applied in mineral deposits investigation
36. Special geophysical methods of measurement and interpretation applied in the exploration of construction materials deposits and solid mineral raw materials
37. Mineral paragenesis of magmatic and metamorphic rocks and its interpretation
38. The ways of the origin of primary and secondary mineral parageneses in magmatic rocks.
39. Mining legislation. Categorisation and classification of mineral reserves.
40. Groundwater chemistry and its impact on water use and legislation
41. Hydrogeological objects (wells, piezometers), construction and use.
42. Definitions of terms: ore mineral and industrial mineral. Classifications of industrial minerals.

¹BU – number of ECTS points assigned to hours of classes requiring direct participation of academic teachers and other persons conducting classes

²Traditional – enter T, remote – enter Z

³Exam – enter E, crediting – enter Z. For the group of classes – after the letter E or Z - enter in brackets the final subject form (lec, cl, lab, pr, sem)

⁴University-wide subject /group of classes – enter O

⁵DN - number of ECTS points assigned to the classes related to the University's academic activity in the discipline/disciplines to which the main field of study is assigned

⁶Practical subject / group of classes – enter P. For the group of courses – in brackets enter the number of ECTS points assigned to practical courses

⁷KO – general education courses, PD – basic sciences courses, K – main field of study courses, S – specialization courses

7. Requirements concerning deadlines for crediting courses/groups of courses for all courses in particular blocks

No.	Subject / group of classes code	Name of subject / group of classes	Crediting by deadline of... (number of semester)
1	W06GIG-SM3007	Principles and Application of InSAR and GIS in mining	1-4
2	W06GIG-SM3002	Computer Aided Geological Modelling & Geostatistics	1-4
3	W06GIG-SM3003G	Project Management, Appraisal and Risk Evaluation	1-4
4	W06GIG-SM3004	Engineering Geophysics	1-4
5	W06GIG-SM3001	Environmental Management	1-4
6	W06GIG-SM3005	Occupational Health and Safety	1-4
7	SJO-SM0003	Foreign language 1	1-4
8	SJO-SM0004	Foreign language 2	1-4
9	W06GIG-SM3006	Digital Mine	1-4
10	W06GIG-SM3000	Operations Research	1-4
11	W06GIG-SM3033G	Sedimentology GK	2-4
12	W06GIG-SM3034G	Mineral deposits exploration GK	2-4
13	W06GIG-SM3035G	Petroleum geology GK	2-4
14	W06GIG-SM3036G	Engineering geological investigations GK	2-4
15	W06GIG-SM3037G	Exploration geochemistry GK	2-4
16	W06GIG-SM3038G	Remote sensing of mineral resources GK	2-4
17	W06GIG-SM3039G	GIS in exploration of mineral resources GK	2-4
18	W06GIG-SM3040G	Regional hydrogeology GK	2-4
19	W06GIG-SM3041G	Seismotectonics GK	2-4
20	W06GIG-SM3042G	Industrial mineral deposits and applications GK	2-4
21	W06GIG-SM3043G	Analytical methods in ore deposits GK	2-4
22	W06GIG-SM3044W	Geophysical exploration and mineral resources	2-4
23	W06GIG-SM3045G	Analyses of mineral paragenesis GK	2-4
24	W06GIG-SM3046P	Field and laboratory practicum	2-4
27	W06GIG-SM3012G	Exploration Entrepreneurship	1-4
28	W06GIG-SM3013P	SOC Internship	1-4
29	W06GIG-SM3016P	Applied Field Exploration	1-4
30	W06GIG-SM3014S	Master Thesis	4
31	W06GIG-SM3015D	Diploma Seminar	4

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²Traditional – enter T, remote – enter Z

³Exam – enter E, crediting – enter Z. For the group of classes – after the letter E or Z - enter in brackets the final subject form (lec, cl, lab, pr, sem)

⁴University-wide subject /group of classes – enter O

⁵DN - number of ECTS points assigned to the classes related to the University's academic activity in the discipline/disciplines to which the main field of study is assigned

⁶Practical subject / group of classes – enter P. For the group of courses – in brackets enter the number of ECTS points assigned to practical courses

⁷KO – general education courses, PD – basic sciences courses, K – main field of study courses, S – specialization courses

8. Plan of studies (attachment no. 4)

¹BU – number of ECTS points assigned to hours of classes requiring direct participation of academic teachers and other persons conducting classes

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Approved by faculty student government legislative body:

POLITECHNIKA WROCLAWSKA
WYDZIAŁ GEOINŻYNIERII
GÓRNICWA I GEOLOGII
Samorząd Studencki Wydziału Geoinżynierii,
Górnictwa i Geologii
50-421 Wrocław, Na Grobli 15, pokój 370

Jakub Dobrzański

Jakub Dobrzański
Chairman of the Student Government
of the Faculty of Geoen지니어ing, Mining and Geology

.....
name and surname, signature of student representative

28.09.23

.....
Date

DZIEKAN

prof. dr hab. inż. Radosław Zimroz

.....
Dean's signature

28.09.23

.....
Date

PLAN OF STUDIES

FACULTY: Geoengineering, Mining and Geology

MAIN FIELD OF STUDY: Mining and geology

EDUCATION LEVEL: second-level studies

FORM OF STUDIES: full-time studies

PROFILE: general academic

SPECIALIZATION: Mineral Resources Exploration - Track WUST-UNI ZAGREB

LANGUAGE OF STUDY: English

In effect since academic year 2023/24

	Summer		Winter		Summer		Winter			
semester	1	ECTS	2	ECTS	3	ECTS	4	ECTS		
hours	WUST		UNIZG		UNIZG		WUST			
1	Operations Research 10100Z	3	Sedimentology 20030 E W06GIG-SM3033G	5	Regional Hydrogeology 20020E W06GIG-SM3040G	4	Exploration entrepreneurship (EFG) 10012 Z W06GIG-SM3012G	4		
2	W06GIG-SM3002									
3	Environmental Management 20001Z W06GIG-SM3001	3			Seismotectonics 20100E W06GIG-SM3041G	4			Diploma Seminar 00001Z W06GIG-SM3014S	1
4										
5										
6	Computer Aided Geological Modelling & Geostatistics 10300Z W06GIG-SM3002	5	Mineral Deposits Exploration 20030E W06GIG-SM3034G	5	Industrial Mineral Deposits and Applications 20002E W06GIG-SM3042G	5	Master Thesis 00010Z W06GIG-SM3015D	20		
7										
8										
9										
10	Project Management, Appraisal and Risk Evaluation 10210E W06GIG-SM3003G	4	Petroleum Geology 20030E W06GIG-SM3035G	5	Analytical Methods in Ore Deposits 20200E W06GIG-SM3043G	5	SOC Internship 00020 Z W06GIG-SM3013P	2		
11										
12										
13	Engineering Geophysics 10010 Z W06GIG-SM3004	3	Engineering Geological Investigations 20020E W06GIG-SM3036G	5	Geophysical Exploration of Mineral Resources 20000E W06GIG-SM3044W	3	Applied field exploration 00030Z W06GIG-SM3016P	3		
14										
15	Occupational Health and Safety 100100Z W06GIG-SM3005	2	Exploration Geochemistry 20010Z W06GIG-SM3037G	4	Analyses of mineral paragenesis 10200E W06GIG-SM3045G	3				
16										
17										
18	Foreign Language 1 03000 Z SJO-SM0003	2	Remote sensing of mineral resources 10100E W06GIG-SM3038G	3	Field and laboratory practicum 00080 Z W06GIG-SM3046P	6				
19										
20	Digital Mine 10100 Z W06GIG-SM3006	2	GIS in Exploration of Mineral Resources 10100Z W06GIG-SM3039G	3						
21										
22	Principles and Application of InSAR and GIS in mining 20300E W06GIG-SM3007	5								
23										
24										
25	Foreign Language 2 01000Z SJO-SM0004	1								
26										
27										
28										
Total ECTS		30		30		30		30		

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1. Set of obligatory and optional subjects and groups of classes in semestral arrangement

Semester 1

Obligatory subjects / groups of classes Number of ECTS points 27

No.	Subject / groups of classes code	Name of subject / groups of classes (denote group of courses with symbol GK)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form ² of course/g group of courses	Way ³ of crediting	Subject / groups of classes			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN ⁵ classes	BU ¹ classes			University-wide ⁴	Concerning scientific activities ⁵	Practical ⁶	Type ⁷
1	W06GIG-SM3000W	Operations Research	1					K2_GIG_W06	15	25	1	1	0,8	T/Z	Z		DN		KO
2	W06GIG-SM3000L	Operations Research			1			K2_GIG_U10,U14 K2_GIG_K01	15	50	2	2	0,7	T	Z		DN	P (2)	KO
3	W06GIG-SM3002W	Computer Aided Geological Modelling & Geostatistics	1					K2_GIG_W06,W08,W15	15	50	2		0,8	T/Z	Z				PD/K
4	W06GIG-SM3002L	Computer Aided Geological Modelling & Geostatistics			3			K2_GIG_U04,U08,U14	45	75	3	2	1,9	T	Z		DN	P (3)	PD/K
5	W06GIG-SM3003G	Project Management, Appraisal and Risk Evaluation (GK)	1		2	1		K2_GIG_W03,W05,W11 K2_GIG_U04,U06,U08,U15 K2_GIG_K01	60	100	4	4	3,1	T/Z(w)	E(w), Z(l,p)		DN	P (3)	KO
6	W06GIG-SM3001W	Environmental Management	2					K2_GIG_W04,W12,W13,W18	30	50	2	2	1,3	T/Z(w)	Z		DN		K
7	W06GIG-SM3001S	Environmental Management					1	K2_GIG_U05,U10,U11,U12 K2_GIG_K02,K03	15	25	1	1	0,8	T	Z		DN	P(1)	K
8	W06GIG-SM3004W	Engineering Geophysics	1					K2_GIG_W02,W08,W10	15	25	1	1	0,8	T/Z	Z		DN		PD
9	W06GIG-SM3004P	Engineering Geophysics				1		K2_GIG_U04,U13	15	50	2	2	0,9	T	Z		DN	P(2)	PD
10	W06GIG-SM3007W	Principles and Application of InSAR and GIS in mining	2					K2_GIG_W15,W16,W18	30	50	2	2	1,4	T/Z(w)	E		DN		K
11	W06GIG-SM3007L	Principles and Application of InSAR and GIS in mining			3			K2_GIG_U04,U07,U08	45	75	3	3	2,0	T	Z		DN	P(3)	K
12	W06GIG-SM3005W	Occupational Health and Safety	1					K2_GIG_W11,W12,W14,W17	15	25	1	1	0,7	T/Z(w)	Z		DN		K
13	W06GIG-SM3005P	Occupational Health and Safety				1		K2_GIG_U11, K2_GIG_K02, K03	15	25	1	1	0,8	T	Z		DN	P(1)	K
14	W06GIG-SM3006W	Digital Mine	1					K2_GIG_W07,W12,W18,W19	15	25	1	1	0,8	T/Z(w)	Z		DN		K
15	W06GIG-SM3006L	Digital Mine			1			K2_GIG_U04,U07,U08	15	25	1	1	0,8	T	Z		DN	P(1)	K
Total			10	0	10	3	1		360	675	27	24	17,6					16	

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Optional subjects / groups of classes (3 ECTS points)

No.	Subject / groups of classes code	Name of subject / groups of classes (denote group of courses with symbol GK)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form ² of course/group of courses	Way ³ of crediting	Subject / groups of classes			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN ⁵ classes	BU ¹ classes			University-wide ⁴	Concerning scientific activities ⁵	Practical ⁶	Type ⁷
1	SJO-SM0003	Foreign Language 1		3				K2_GIG_U03	45	60	2		1,6	T	Z	O		P(2)	KO
2	SJO-SM0004	Foreign Language 2		1				K2_GIG_U01,U02	15	30	1		0,6	T	Z	O		P(1)	KO
Total			0	4	0	0			60	90	3	0	2,2					3	

Altogether in semester

Total number of hours					Total number of ZZU hours	Total number of CNPS hours	Total number of ECTS points	Total number of ECTS points for DN classes ⁵	Number of ECTS points for BU classes ¹
lec	cl	lab	pr	sem					
10	4	10	3	1	420	765	30	24	19,8

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⁴University-wide subject /group of classes – enter O

⁵DN - number of ECTS points assigned to the classes related to the University's academic activity in the discipline/disciplines to which the main field of study is assigned

⁶Practical subject / group of classes – enter P. For the group of courses – in brackets enter the number of ECTS points assigned to practical courses

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Semester 2

Obligatory subjects / groups of classes (0 ECTS points)

No.	Subject / groups of classes code	Name of subject / groups of classes (denote group of courses with symbol GK)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form ² of course/group of courses	Way ³ of crediting	Subject / groups of classes			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN ⁵ classes	BU ¹ classes			University-wide ⁴	Concerning scientific activities ⁵	Practical ⁶	Type ⁷
1																			
		Total																	

Optional subjects / groups of classes

Number of ECTS points 30

No.	Subject / groups of classes code	Name of subject / groups of classes (denote group of courses with symbol GK)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form ² of course/group of courses	Way ³ of crediting	Subject / groups of classes			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN ⁵ classes	BU ¹ classes			University-wide ⁴	Concerning scientific activities ⁵	Practical ⁶	Type ⁷
1	W06GIG-SM3033G	Sedimentology GK	2			3		K2_GIG_W01,W02 K2_GIG_U01,U13 K2_GIG_K02	75	125	5	3	3,6	T/Z(w)	E		DN	3	S
2	W06GIG-SM3034G	Mineral deposits exploration GK	2			3		K2_GIG_W01, W08,W11,W15, K2_GIG_U01,U13 K2_GIG_K03	75	125	5	3	3,6	T/Z(w)	E		DN	3	S
3	W06GIG-SM3035G	Petroleum geology GK	2			3		K2_GIG_W01,W2,W08, W11, K2_GIG_U01,U4,U10,U13 K2_GIG_K03	75	125	5		3,6	T/Z(w)	E			3	S
4	W06GIG-SM3036G	Engineering geological investigations GK	2			2		K2_GIG_W2,W07, W10, K2_GIG_U01,U04,U10 K2_GIG_K03	60	125	5	3	3,0	T/Z(w)	E		DN	3	S
5	W06GIG-SM3037G	Exploration geochemistry GK	2			1		K2_GIG_W01,W02,W18 K2_GIG_U01,U04,U09,U10,U13 K2_GIG_K02	45	100	4	3	2,3	T/Z(w)	Z		DN	2	S
6	W06GIG-SM3038G	Remote sensing of mineral resources GK	1		1			K2_GIG_W01,W02,W08,W15 K2_GIG_U01,U04,U13,U15 K2_GIG_K03	30	75	3	3	1,5	T/Z(w)	E		DN	2	S
7	W06GIG-SM3039G	GIS in exploration of mineral resources GK	1		1			K2_GIG_W01,W02,W08,W14,W15 K2_GIG_U01,U04,U13,U15 K2_GIG_K01	30	75	3	3	1,5	T/Z(w)	Z		DN	2	S
		Total	12		2	12			390	750	30	18	19,1					18	

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Altogether in semester

Total number of hours					Total number of ZZU hours	Total number of CNPS hours	Total number of ECTS points	Total number of ECTS points for DN classes ⁵	Number of ECTS points for BU classes ¹
lec	cl	lab	pr	sem					
12		2	12		390	750	30	18	19,1

Semester 3

Obligatory subjects / groups of classes (0 ECTS points)

No.	Subject / groups of classes code	Name of subject / groups of classes (denote group of courses with symbol GK)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form ² of course/group of courses	Way ³ of crediting	Subject / groups of classes			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN ⁵ classes	BU ¹ classes			University-wide ⁴	Concerning scientific activities ⁵	Practical ⁶	Type ⁷
1																			
		Total																	

Optional subjects / groups of classes

Number of ECTS points 30

No.	Subject / groups of classes code	Name of subject / groups of classes (denote group of courses with symbol GK)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form ² of course/group of courses	Way ³ of crediting	Subject / groups of classes			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN ⁵ classes	BU ¹ classes			University-wide ⁴	Concerning scientific activities ⁵	Practical ⁶	Type ⁷
1	W06GIG-SM3040G	Regional hydrogeology GK	2			2		K2_GIG_W01,W2,W10, W15 K2_GIG_U01,U4,U13 K2_GIG_K03	60	100	4	4	2,9	T/Z(w)	E		DN	2	S
2	W06GIG-SM3041G	Seismotectonics GK	2			1		K2_GIG_W2,W10, W14 K2_GIG_U01,U4,U10,U13 K2_GIG_K01	45	100	4	4	2,4	T/Z(w)	E		DN	2	S
3	W06GIG-SM3042G	Industrial mineral deposits and applications GK	2				2	K2_GIG_W1,W07, W12 K2_GIG_U01,U10,U13 K2_GIG_K01,K02	60	125	5	5	2,8	T/Z	E		DN	3	S
4	W06GIG-SM3043G	Analytical methods in ore deposits GK	2		2			K2_GIG_W1,W02, W10 K2_GIG_U02,U07,U13 K2_GIG_K01	60	125	5	4	2,8	T/Z(w)	E		DN	3	S
5	W06GIG-SM3044W	Geophysical exploration and mineral resources	2					K2_GIG_W1,W02, W08,W10 K2_GIG_K01	30	75	3	3	1,4	T/Z	E		DN		S
6	W06GIG-SM3045G	Analyses of mineral paragenesis GK	1		2			K2_GIG_W1,W02 K2_GIG_U01,U13 K2_GIG_K01	45	75	3		2,2	T/Z(w)	E			2	S
7	W06GIG-SM3046P	Field and laboratory practicum				8		K2_GIG_U01,U04,U13 K2_GIG_K02,K03	120	150	6	4	5,0	T	Z		DN	6	S
		Total	11	4	11	2			420	750	30	24	19,5					18	

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Altogether in semester

Total number of hours					Total number of ZZU hours	Total number of CNPS hours	Total number of ECTS points	Total number of ECTS points for DN classes ⁵	Number of ECTS points for BU classes ¹
lec	cl	lab	pr	sem					
11		4	11	2	420	750	30	24	19,5

Semester 4

Obligatory subjects / groups of classes Number of ECTS points 9

No.	Subject / groups of classes code	Name of subject / groups of classes (denote group of courses with symbol GK)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form ² of course/g group of courses	Way ³ of crediting	Subject / groups of classes			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN ⁵ classes	BU ¹ classes			University-wide ⁴	Concerning scientific activities ⁵	Practical ⁶	Type ⁷
1	W06GIG-SM3012G	Exploration Entrepreneurship GK	1			1	2	K2_GIG_W03,W05,W09 K2_GIG_U08,U09 K2_GIG_K01,K02,K03	60	100	4		3,0	Z	Z			P(3)	S
2	W06GIG-SM3013P	SOC Internship				2		K2_GIG_W05,W09 K2_GIG_U08,U09 K2_GIG_K01,K02,K03	30	50	2		1,5	T	Z			P(2)	S
3	W06GIG-SM3016P	Applied Field Exploration				3		K2_GIG_W08,W15 K2_GIG_U04,U09,U10,U13 K2_GIG_K02	45	75	3	1	2,1	T	Z		DN	P(3)	S
Total			1	0	0	6	2		135	225	9	1	6,6					8	

Optional subjects / groups of classes (21 ECTS points)

No.	Subject / groups of classes code	Name of subject / groups of classes (denote group of courses with symbol GK)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form ² of course/g group of courses	Way ³ of crediting	Subject / groups of classes			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN ⁵ classes	BU ¹ classes			University-wide ⁴	Concerning scientific activities ⁵	Practical ⁶	Type ⁷
1	W06GIG-SM3014S	Diploma Seminar					1	K2_GIG_W01 K2_GIG_U01,U13 K2_GIG_K02,K03	15	25	1	1	0,8	T	Z		DN	P(1)	S
2	W06GIG-SM3015D	Master Thesis				1		K2_GIG_W01,W05,W10 K2_GIG_U01,U04,U08,U10,U13,U15 K2_GIG_K01,K02,K03	15	500	20	20	1,8	T	Z		DN	P(20)	S
Total			0	0	0	1	1		30	525	21	21	2,6					21	

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Altogether in semester

Total number of hours					Total number of ZZU hours	Total number of CNPS hours	Total number of ECTS points	Total number of ECTS points for DN classes ⁵	Number of ECTS points for BU classes ¹
lec	cl	lab	pr	sem					
1	0	0	7	3	165	750	30	22	9,2

2. Set of examinations in semestral arrangement

Subjects / groups of classes	Names of subjects / groups of classes ending with examination	Semester
W06GIG-SM3003G	1. Project Management, Appraisal and Risk Evaluation	1
W06GIG-SM3007	2. Principles and Applications of InSAR in Mining	1
W06GIG-SM3033G	1. Sedimentology	2
W06GIG-SM3034G	2. Mineral deposits exploration	2
W06GIG-SM3035G	3. Petroleum geology	2
W06GIG-SM3036G	4. Engineering geological investigations	2
W06GIG-SM3038G	5. Remote sensing of mineral resources	2
W06GIG-SM3040G	1. Regional hydrogeology	3
W06GIG-SM3041G	2. Seismotectonics	3
W06GIG-SM3042G	3. Industrial mineral deposits and applications	3
W06GIG-SM3043G	4. Analytical methods in ore deposits	3
W06GIG-SM3044W	5. Geophysical exploration and mineral resources	3
W06GIG-SM3045G	6. Analyses of mineral paragenesis	3
	Final diploma examination	4

3. Numbers of allowable deficit of ECTS points after particular semesters

Semester	Allowable deficit of ECTS points after semester
1	12
2	8
3	0

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Opinion of student government legislative body

POLITECHNIKA WROCLAWSKA
WYDZIAŁ GEOINŻYNIERII
GÓRNICICTWA I GEOLOGII
Samorząd Studencki Wydziału Geoinżynierii,
Górnictwa i Geologii
50-421 Wrocław, Na Grebli 15, pokój 370

28.09.23

Jakub Dobrzański

Jakub Dobrzański
Chairman of the Student Government
of the Faculty of Geoengineering, Mining and Geology

Date

Name and surname, signature of student representative

28.09.23

DZIEKAN
RD
prof. dr hab. inż. Radosław Zimroz
(1)

Date

Dean's signature

COURSE DESCRIPTIONS/ KARTY PRZEDMIOTÓW

**second-level studies/ studia II stopnia
main field of study/ kierunek studiów:
Mining and Geology/ Górnictwo I Geologia**

**specjalność/specialisation:
Mineral Resources Exploration
- Track WUST - UNI MISKOLC**

Semester 1
WUST

FACULTY OF GEOENGINEERING, MINING AND GEOLOGY

SUBJECT CARD

Name of subject in Polish ... Geofizyka inżynierska
Name of subject in English Engineering Geophysics
Main field of study: Mining and geology
Specialization: Mining Engineering,
 Geotechnical and Environmental Engineering,
 Geomatics for Mineral Resource Management
 Mineral Resource Exploration
Level and form of studies: 2nd level, full-time
Kind of subject: obligatory
Subject code W06GIG-SM3004....
Group of courses NO

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15			15	
Number of hours of total student workload (CNPS)	25			50	
Form of crediting	crediting with grade			crediting with grade	
For group of courses mark (X) final course					
Number of ECTS points	1			2	
including number of ECTS points for practical classes (P)				2	
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	0,8			0,9	

*delete as not necessary

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. has knowledge of fundamentals of applied geophysics, physics and geology.
2. knows fundamentals of soil and rock mechanics.
3. is able to use MS Office software.
4. is able to work in a team.

SUBJECT OBJECTIVES

- C1 familiarize with physical phenomena in geosphere of the Earth
 C2 familiarize with engineering problems solved by means of geophysical surveying
 C3 familiarize with various geophysical surveys.
 C4 acquisition of skills to plan geophysical field surveying and to interpret its results.
 C5 development of skills to work in a group.

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge:

- PEU_W01 recognizes, names and explains engineering problems in different fields.
 PEU_W02 identifies, describes and chooses geophysical surveying methods.
 PEU_W03 analyses and assesses case studies from solving the engineering problems.

relating to skills:

PEU_U01 is able to coordinate team work, create field research plans and manage the work progress.

PEU_U02 is able to independently create solutions for complex practical problems in engineering and geoenvironmental applying knowledge about geophysical surveying, mining geophysics, utilizing modern methods in geophysical data acquisition and interpretation.

PEU_U03 is able to critically assess, process and interpreted results of the geophysical surveying and provide recommendations related to engineering problems in mining, civil engineering, engineering geology, municipal waste site, archeology, engineering properties of soil and rocks, hydrogeology, monitoring seepage in river dykes or dams.

PEU_U04 is able to solve geophysical problems.

PEU_U05 is able to conduct auto-didactical education related to detailed handling of typical software.

relating to social competences:

PEU_K01 understands the need to create and transfer to the society – among others by mass media- information and opinions related to mining engineering achievements and other activities of mining engineer; tries to transfer the information in commonly understood way, presenting different points of view; is aware of the quality and need to shape the work safety culture in mining and the responsibility for the health and life of other employees.

PROGRAMME CONTENT

Lecture		Number of hours
Lec 1	Physical properties of rocks. Inter-relationships between the various subdisciplines of applied geophysics. Overview of geophysical methods, their physical principles and applications. Methodology of geophysical surveying.	1
Lec 2	Engineering problems solved with geophysical surveying. Case studies.	2
Lec 3	Electrical resistivity methods. Tomography and VSE. IP method. Physical principles. Equipment. Methods of field surveying. Interpretation and application. Case studies.	2
Lec 4	Electromagnetic methods. FDEM and TDEM methods. Magnetotelluric methods. Physical principles. Methods of field surveying. Equipment. Interpretation and application. Case studies.	2
Lec 5	GPR surveying. Physical principles. Methods of field surveying. Equipment. Interpretation and application. Case studies.	2
Lec 6	Seismic tomography. Seismic interferometry. Physical principles. Applications. Case studies.	2
Lec 7	Mine geophysics. Seismology. Seismic methods. Active and passive seismic tomography. Microgravimetry. Case studies.	2
Lec 8	Gravity and magnetic surveying. Equipment. Methods of field surveying. Interpretation and application. Case studies.	2
	Total hours	15
Project		Number of hours

Proj 1	One selected geophysical technique. Fundamentals and equipment. Field surveying	4
Proj 2	Processing and interpretation of field data.	3
Proj 3	Solving the geophysical problems.	8
	Total hours	15

TEACHING TOOLS USED

N1. N1.Lecture aided by presentation.
N2.Demonstration.
N3.Discussion and consultations
N3Calculations
N5Practical field surveying

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT

Evaluation (F – forming during semester), P – concluding (at semester end)	Learning outcomes code	Way of evaluating learning outcomes achievement
P1	W01-W03	Test related to lecture content. Final grade.
F1	U01-U02, U05	Test. Project 1. Report on Project 1
F2	U03, U05	Test. Project 2. Report on Project 2
F3	U04, U05	Test. Solving geophysical problems
F1-F3, P2	U01-U05 K02	Grades are given for each of three project tasks including tests and reports. The final grade P2 for the project course is the weighted average grade of F1-F3.

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

- [1] Aki, K., Richards P.G., 1980. Quantitative Seismology: Theory and Methods. W.H. Freeman Co.. San Francisco.
- [2] Burger, H.R., Sheehan, A.F., Jones, C.H., 2006. Introduction to Applied Geophysics: Exploring the Shallow Subsurface. W.W. Norton & Company, Inc.
- [3] Mendecki, A.J. (ed.), 1997. Seismic Monitoring in Mines. Chapman & Hall.
- [4] Reynolds, J.M., 2011. An Introduction to Applied and Environmental Geophysics. Wiley – Blackwell. John Wiley & Sons.
- [5] Sharma, Prem V., 2002. Environmental and engineering geophysics. Cambridge University Press.
- [6] Torge, W., 1989. Gravimetry. Water de Gruyter. Berlin. New York.
- [7] Selected Journal Publications (for example journals: Progress in Geophysics, Engineering Geophysics Journal, Environmental and Engineering Geophysics, Journal of Geophysics and Engineering, Pure and Applied Geophysics).

SECONDARY LITERATURE:

- [1] Lowrie, W., 2007. Fundamentals of Geophysics. Cambridge University Press.
- [2] Milsom, J., 2003. Field Geophysics. John Wiley & Sons Ltd.
- [3] Telford, W.M., Geldart, L.P., Sheriff, R.E., 1990. Applied Geophysics. Cambridge University Press.

SUBJECT SUPERVISOR (NAME AND SURNAME, E-MAIL ADDRESS)

ANNA BARBARA GOGOLEWSKA, anna.gogolewska@pwr.edu.pl

FACULTY OF GEOENGINEERING, MINING AND GEOLOGY	
SUBJECT CARD	
Name of subject in Polish Wspomagane komputerowo modelowanie geologiczne i geostatystyka.)	
Name of subject in English: Computer Aided Geological Modelling and Geostatistics	
Main field of study (if applicable): Górnictwo i geologia.	
Specialization (if applicable): Mining Engineering, Geotechnical and Environmental Engineering, Geomatics for Mineral Resource Management Mineral Resource Exploration	
Profile: academic	
Level and form of studies: 2nd level, full-time	
Kind of subject: obligatory	
Subject code	W06GIG-SM3002
Group of courses	No

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15		45		
Number of hours of total student workload (CNPS)	50		75		
Form of crediting	crediting with grade	Examination / crediting with grade*	crediting with grade	Examination / crediting with grade*	Examination / crediting with grade*
For group of courses mark (X) final course					
Number of ECTS points	2		3		
including number of ECTS points for practical classes (P)			3		
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	0,8		1,9		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Mathematical Statistics,
2. Fundamentals of Geology and Mineral Deposits

SUBJECT OBJECTIVES

- C1 Developing basic skills in computer modelling of 3-D objects.
C2 Introduction of the principles of digital modelling of typical geological structures.
C3 Introduction to the methods of deposit parameters estimation and resources evaluation.

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge:

PEU_W01 Estimation methods, principles of geostatistics, kriging estimators

PEU_W02 Geostatistical modelling of the selected deposit parameters (domain analysis, variogram modelling,

PEU_W03 Creating and validating 3-D models of various geological structures in the comprehensive dedicated software environment.

relating to skills:

PEU_U01 Application of relevant estimation methods for quality modelling of a deposit

PEU_U02 Evaluating 3-D objects against structural and quality block models (volumes, tonnages, grades)

PEU_U03 Describing the interpretation and applied approach, creating models, evaluation results, recommendations for possible enhancements

relating to social competences:

PEK_K01 The student can think and act in a creative and enterprising way

PROGRAMME CONTENT

Lecture		Number of hours
Lec 1	Introduction to the course. Geological database and validation of the geological data.	2
Lec 2	Geology of the seam.	2
Lec 3	Structural model of the stratified deposit. Methods of the prediction of the surface layer parameters.	2
Lec 4	Spatial distribution of samples values. Regionalized variable.	2
Lec 5	BLUE Estimator of the mean value: Kriging.	2
Lec 6	Quality model of the deposit – block model of the parameter layers. Estimation and evaluation of the block model.	2
Lec 7	Reserves modelling and evaluation.	2
Lec 8	Mineral resources. International reporting. The JORC Code	1
	Total hours	15

Laboratory		Number of hours
La1	Determining the rules of work at the laboratory.	3
La2	Assignment of the individual dataset for the exercises and creating initial data files.	3
La3	Data validation and creating initial geological database.	3
La4	Construction of the structural wireframe model of stratigraphy layers.	3
La5	Construction of the block model of the deposit and overburden layers. Thickness and stripping ratio analysis.	3
La6	Data preparation to geostatistical analysis. Compositing of the samples.	3
La7	Domain analysis with the use of the statistical methods.	3
La8	Determination of the empirical variogram. Anisotropy analysis.	3
La9	Variogram modelling.	3
La10	Kriging Neighborhood Analysis - defining optimal parameters of the	3

	estimation procedure.	
La11	Estimation of quality parameters in block model of the deposit layers. Validation of the estimation quality.	3
La12	Validation of the quality model and classification of the resources. Balance resources evaluation.	3
La13	Preparation of data for continuous surface mining ultimate pit design. Ultimate pit outlines generation	3
La14	Wireframe and block modelling of the ultimate pit	3
La15	Reserves evaluation, visualization and interrogation of created models	3
	Total hours	45

TEACHING TOOLS USED

N1. Form of lectures - traditional, multimedia presentations using specialized software and demonstrations of its application "live", individual development of specialist topics covered during the lecture,
N2. individual development of project tasks within the laboratories frames, individual development of electronic reports concerning project tasks within the laboratories frames,
N3. evaluation of laboratory tasks reports with multipoint grade of student's work, group analysis of the results obtained during laboratory tasks; preparation of conclusions concerning data dependencies and constraints of mining projects, skill control tests, duty hours in laboratory.

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT

Evaluation (F – forming during semester), P – concluding (at semester end)	Learning outcomes code	Way of evaluating learning outcomes achievement
F1	PEU_W01, PEU_W02	Lecture grade on the basis of the written examination
F2	PEU_W03,	Laboratory task assessment: “structural modelling assessment
F3	PEU_U01	Laboratory task assessment: “geostatistical modelling”
F4	PEU_U02, PEU_U03	Laboratory task assessment: “reserves evaluation”.
P average of F1, F2, F3, F4		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

- [1] M. Armstrong, Basic Linear Geostatistics, Springer Verlag, 1998.
- [2] P. Goovaerts: "Geostatistics for Natural Resource Evaluation", Oxford University Press, 1997.
- [3] R. H. Grishong, Jr., 3-D Structural Geology, Springer Verlag, 2008
- [4] K. Hefferan, J. O'Brien, Earth materials, Willey-Blacwell, Chichester U.K., 2010
- [5] W. Hustrulid, M. Kuchta, Open pit mine planning and design. Chapter 3. Orebody description, Taylor&Francis, 2013.
- [6] A. G. Journel, and C.J. Huijbregts, Mining Geostatistics, Academic Press, 1978.
- [7] Ch.C. Plummer, D.H. Carlson, L. Hammersley, Physical geology, McGraw-Hill I.E. N.Y. 2010
- [8] D.R. Prothero, R.H. Dott Jr., Evolution of the Earth, McGraw-Hill I.E. N.Y., 2010
- [9] M.W. Rossi, C.V. Deutsch, Mineral Resources Estimation, Springer Verlag 2014.

SECONDARY LITERATURE:

- [10] Handouts, tutorials.

SUBJECT SUPERVISOR (NAME AND SURNAME, E-MAIL ADDRESS)

Dr inż. Krzysztof Hołodnik
Dr inż. Witold Kawalec

FACULTY OF GEOENGINEERING, MINING AND GEOLOGY	
SUBJECT CARD	
Name in Polish:	Cyfrowa kopalnia
Name in English:	Digital Mine.....
Main field of study:	Mining and geology
Specialization:	Mining Engineering, Geotechnical and Environmental Engineering, Mineral Resource Exploration
Level and form of studies:	2nd level, full-time
Kind of subject:	obligatory
Subject code:	W06GIG-SM3006
Group of courses:	No

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15		15		
Number of hours of total student workload (CNPS)	25		25		
Form of crediting	crediting with grade		crediting with grade		
For group of courses mark (X) final course					
Number of ECTS points	1		1		
including number of ECTS points for practical (P) classes			1		
Including number of ECTS points for direct teacher-student contact (BK) classes	0,8		0,8		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Computer literacy skills
2. Basic knowledge related to Mining Engineering and Mineral Processing
3. Programming

SUBJECT OBJECTIVES

- C1. Acquisition of the ability to create utility applications in the C / C ++ and LabVIEW environment
- C2. Providing students with knowledge about embedded systems, their construction, selection of components, designing, programming and their exploitation.
- C3. Familiarizing with the advances of technology & methods of future mining operations.
- C4. Acquisition and consolidation of social competencies including emotional intelligence skills involving the cooperation in the group of students aiming to effectively solve problems.
- Responsibility, honesty and fairness in the proceedings; observance force in academia and society

SUBJECT EDUCATIONAL EFFECTS**relating to knowledge:**

PEU_W01 A student has knowledge related to automation systems, control systems and measurement systems in various aspects of the mining industry.

PEU_W02 The student has knowledge of the importance of automation and robotics systems in modern mining.

relating to skills:

PEU_U01 A student is able to select and integrate elements of a specialized measuring and control system including: control unit, executive system, measuring system as well as peripheral and communication modules

PEU_U02 A student can design improvements in the existing design solutions for automation and robotics components and systems

relating to social competences:

PEU_K01 A student is aware of the need for a professional approach to technical issues, meticulous reading of documentation and knows environmental conditions in which devices and their components can function

PEU_K02 The student has knowledge concerning the benefits of creation and implementation new solutions&technologies into mining industry

PROGRAMME CONTENT		
Form of classes - lecture		Number of hours
Lec 1	Terminology (process, automation, robots, measurement devices, control systems). Definition of digital mine	2
Lec 2	Aims, benefits, drawbacks of automation. Industrial revolutions. Definition of industry 4.0. Overview of components of the 4th industrial revolution. Industry 4.0 and mining	2
Lec 3	Elements of technological process in mining. Automation of cyclic processes Measuring technologies in industry 4.0. Sensors systems. Data transmission and data storage technologies. Analytics in industry 4.0. Industrial BigData, Cloud Computing	2
Lec 4	Industrial Internet of Things. M2M communication, anti-collision systems, location of people underground	2
Lec 5	Virtual and augmented realities for industry. Simulators. Digital Twin. Digital models of processes and objects. Management information creation systems, reporting	2
Lec 6	Case study: Automation in open pit lignite mining (KTZ, Autonomous haulage (use case from Australia))	1
Lec 7	Case study: underground mine (Rock Vader – Sandvik project, other use cases from Sandvik, Epiroc, MineMaster, Zanam, AOT from ZGPS KGHM, KIC project on shaft inspection, ... etc)	2
Lec 8	Case study: mineral processing (ConVis, FlowVis) in KGHM, OPMO project	2
Total hours		15

Form of classes - laboratory		Number of hours
Lab1	Scope of the course, teaching purpose, crediting conditions, literature, data. Introduction to ARDUINO	3
Lab2	Basic sensors for physical parameters measurements	3
Lab3	Measurements in Labview	3
Lab4	Analysis and Visualization in Labview	3
Lab5	Control in labview	3
	Total hours	15

TEACHING TOOLS USED
<p>N1. Type of lectures - traditional, illustrated with multimedia presentations with the usage of audio- visual equipment.</p> <p>N2. Discussion concerning lectures and laboratory.</p> <p>N3 Configuration on laboratory classes measuring systems (hardware and software), performing of measurements, teamwork</p> <p>N4. Projects defence - oral and written form.</p> <p>N5. Duty hours.</p>

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT

Evaluation (F – forming (during semester), P – concluding (at the end of semester))	Educational effect number	Way of evaluating educational effect achievement
F1, P1	PEK_U02- PEK_U04	<p>F1.1 Grade from laboratory work's performance and its merits</p> <p>F.1.2 Grade from laboratory work's oral or written defence</p> <p>P1.Final grade (weighted average of F1.1 - 60% and F1.2 - 40%).</p>
F2, P2	PEK_U02- PEK_U04	<p>F2.1 Grade from activity during the lecture (questions, discussions etc)</p> <p>F.2.2 Grade from written exam</p> <p>P2.Final grade (weighted average of F2.1 - 20% and F2.2 - 80%).</p>

LITERATURE

PRIMARY LITERATURE:

- [1] LabVIEW™ Getting Started with LabVIEW
<http://www.ni.com/pdf/manuals/373427j.pdf>
- [2] Monk Simon: Arduino dla początkujących. Podstawy i szkice, Anderson R., Cervo D., Helion, 2018
- [3] Monk Simon: Arduino dla początkujących. Kolejny krok, Anderson R., Cervo D., Helion, 2015

ONLINE LITERATURE:

- [1] LabVIEW Tutorial
- [2] ARDUINO Tutorial
- [3] Materials prepared by Tutor
- [4] Internet websites

SUBJECT SUPERVISOR (NAME AND SURNAME, E-MAIL ADDRESS)

**Prof. dr hab. inż. Radosław Zimroz, radoslaw.zimroz@pwr.edu.pl
dr inż. Anna.Nowak-Szpak**

FACULTY OF GEOENGINEERING, MINING AND GEOLOGY

SUBJECT CARD

Name in Polish: Zarządzanie Środowiskiem
Name in English: Environmental Management
Faculty of studies (if applicable): Mining and Geology
Specialisation (if applicable): Mining Engineering
 Mineral Resource Exploration
Level and form of studies: 2nd level, full-time
Subject Type: Obligatory
Subject code: W06GIG-SM3001
Group of courses: No

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in the University (ZZU)	30				15
Number of hours of total student workload (CNPS)	50				25
Form of crediting	Crediting with grade				Crediting with grade
For a group of courses mark (X) for the final course					
Number of ECTS points	2				1
including number of ECTS points for practical (P) classes					
including number of ECTS points for direct teacher-student contact (BU) classes	1,3				0,8

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge of issues related to ecology and environmental protection.

SUBJECT OBJECTIVES

- C1. To get students acquainted with systems of environmental management both in Poland and other EU countries.
- C2. To prepare students for rational and sustainable management of environmental components.
- C3. To get students acquainted with the genesis of environmental management systems in Poland, review and standardization of environmental management systems.
- C4. To get students acquainted with benefits and obligations arising from the implementation of an environmental management system.
- C5. To present the relationship between an environmental management system and a quality

management system.

C6. To provide an overview of informative methods of supporting the implementation of environmental management systems (possibilities and practical usage of computerised systems of environmental information management, decision support in the area of environmental protection and choice of methods and tools used to support the implementation of an environmental management system).

SUBJECT LEARNING OUTCOMES

relating to knowledge:

PEU_W01 – Possesses systematic knowledge of the origins of environmental management systems, review and standardization of environmental management systems.

PEU_W02 - Possesses knowledge of the possibilities and practical applications of tools supporting the implementation of the environmental management system.

PEU_W03 - knows basic formal and legal regulations regarding the implementation and functioning of management systems, tools and instruments of environmental management.

PEU_W04 - Possesses knowledge for rational and sustainable management of environmental components.

relating to skills:

PEU_U01 – Possesses linguistic resources appropriate for specialised language and is able to use it in linguistic activities in order to communicate in the professional environment regarding the field of studies; is able to obtain necessary information and interpret and critically evaluate it, reads and understands professional literature, is able to formulate and comprehensively justify opinions, provide presentations of problems related to a studied discipline and also participate in scientific and professional discussions.

PEU_U02 – Is able to use methods and appropriate IT tools in system management of environmental components.

relating to social competencies:

PEU_K01 - Is able to think and act in a creative and enterprising way.

PROGRAMME CONTENT

Form of classes - lecture		Number of hours
Lec.1	Basic concepts: - Environment, characteristics of individual elements of the environment - Characteristics of hazards for the natural environment which are a result of human activities - Environmental Management - The Environmental Management System	2
Lec.2	Legal aspects of environmental management	2
Lec.3	History and development of environmental management systems	2
Lec.4	Environmental management systems:	6
Lec.5	- Business Charter for Sustainable Development of the International	
Lec.6	Chamber of Commerce - ICC Business Charter for Sustainable	

	<p>Development</p> <ul style="list-style-type: none"> - EMAS – Directive of the European Community Commission regarding the approval for voluntary participation by organisations in a community eco-management and eco-audit scheme - CP - Clean Production - BS 7750 - Specification for Environmental Management Systems - ISO 9000 - ISO 14000 - ISO 14001 <p>Characteristics of selected Environmental Management Systems. The benefits of the implementation of the EMS for a company. Experiences of Polish enterprises from the implementation of EMS. Process of implementation of the selected EMS in a company with an example of EMAS.</p>	
Lec.7 Lec.8	<p>Basic tools of environmental management:</p> <ul style="list-style-type: none"> - Legal and administrative instruments (laws, standards, licenses and permits) - Economic instruments (fees, taxes, deposit and refund systems, transferable rights, subsidies, liens, fines) - Instruments (techniques) social impact (ecological education, ecological propaganda) <p>Examples of basic tools of environmental management:</p> <ul style="list-style-type: none"> - Procedure for an assessment of environmental impact - Integrated permits - Audits - Safety Reports - Monitoring of the Environment 	4
Lec.9 Lec.10	Design of an environmental management system	4
Lec.11 Lec.12	<p>IT systems supporting environmental management:</p> <ul style="list-style-type: none"> - Decision Support Systems - Expert systems - Simulation Models - Geographical Information Systems <p>Selected types of information systems which support environmental management, their characteristics, examples of implementation both in Poland and in the world</p>	4
Lec.13	The benefits of an implemented and functioning environmental management system	2
Lec.14	Costs of implementation and functioning of an environmental management system	1
Lec.14 Lec.15	Environmental management systems in practice	3
	Total hours	30
Form of classes - seminar		Number of hours
Se1	The scope and form of an essay and presentation, terms of crediting and literature.	2

	Assignment of seminar topics for individual students.	
Se2	Student speeches with the use of multimedia presentations on the following issues: environmental management systems - specified examples, formal and legal conditions of administrative procedures (eg. receiving a decision on the environmental conditions of a project, an integrated decision etc.), life-cycle analysis of a selected company; fees, taxes, surcharges and environmental deposits; litter management systems, mineral resource management, renewable energy sources, selected monitoring systems, the institution of environmental protection in Poland and in the world and also alternative energy sources, etc. Group discussion on the content and form of speeches.	13
Se3		
Se4		
Se5		
Se6		
Se7		
Se8		
	Total hours	15

TEACHING TOOLS USED

- N1. Informative lecture with elements of problematic lectures.
N2. Multimedia presentations
N3. Didactic discussion during lectures and seminars
N4. Preparation of an essay in the form of a report
N5. Presentation of the essay
N6. Consultations

EVALUATION OF SUBJECT EDUCATIONAL OUTCOME ACHIEVEMENTS

Evaluation F – forming (during semester), P – concluding (at semester end)	Educational outcome number	Method of evaluating educational outcome achievement
F1- Grade from content value of an essay	PEU_U01 PEU_U02 PEU_K01	Text and graphical form of essay
F2 – Grade from presentation and issues included in an essay	PEU_U01 PEU_U02 PEU_K01	Presentation of essay
F3 – Grade from a written or oral test	PEU_W01 PEU_W02 PEU_W03 PEU_W04	Positive grade
final grade from the subject (the weighted average, respectively: 35% for the substantive content of the essay, 25% for the presentation, 40% for the lecture)		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

- [1] Ejdys J., 1998, Zarządzanie środowiskowe w przedsiębiorstwie – koszty i korzyści, Sterowanie ekorozwojem, t.2, Wyd. Politechniki Białostockiej, Białystok,
- [2] Lukashev A. F., Droste R. L., Warith M. A., 2001, Review of Expert System (ES), Geographic Information System (GIS), Decision Support System (DSS), and their applications in landfill design and management. W: Waste Management & Research nr 19,
- [3] Łunarski J. (red.), 2002, Zarządzanie środowiskiem”, Oficyna Wydawnicza Politechniki Rzeszowskiej, Rzeszów
- [4] Nowak Z., 2001, Zarządzanie środowiskiem, Wyd. Politechniki Śląskiej, Gliwice,
- [5] Matuszak-Flejszman A., 2001: Jak skutecznie wdrożyć system zarządzania środowiskowego wg normy ISO 14001. PZLiTS, Poznań
- [6] Pochyluk R. i inni, 1999, Zasady wdrażania systemu zarządzania środowiskowego zgodnego z wymaganiami normy ISO 14001, Eco-Konsult, Gdansk,
- [7] Poskrobko B., Poskrobko T., 2012, Zarządzanie środowiskiem w Polsce, Polskie Wydawnictwo Ekonomiczne, Warsaw
- [8] Poskrobko B., 1998: Zarządzanie środowiskiem. Polskie Wydawnictwo Ekonomiczne, Warsaw
- [9] Przybyłowski P. (red.), 2005, Podstawy zarządzania środowiskowego, Wyd. Akademii Morskiej, Gdynia.

SECONDARY LITERATURE

- [1] Jeżowski P. (red.), 2007: Ekonomiczne problemy ochrony środowiska i rozwoju zrównoważonego w XXI wieku. Szkoła Główna Handlowa, Warsaw
- [2] Lemański J. F., Matuszak-Flejszman A., Zabawa S. (red.), 2000: Efektywność funkcjonowania wdrożonego systemu zarządzania środowiskowego wg normy ISO 14001. PZLiTS, AE, Poznań – Pila
- [3] Websites given during lectures and seminars

SUBJECT SUPERVISOR (NAME AND SURNAME, E-MAIL ADDRESS)

Dr hab. inż. Justyna Woźniak
Dr hab. Inz. Katarzyna Pactwa,
Dr inż. Danuta Szyszka

FACULTY OF GEOENGINEERING, MINING AND GEOLOGY SUBJECT CARD
Name of subject in Polish Bezpieczeństwo i higiena pracy Name of subject in English: Occupational Health and Safety Main field of study (if applicable): Górnictwo i geologia. Specialization (if applicable): Mining Engineering, <b style="padding-left: 40px;">Geotechnical and Environmental Engineering, <b style="padding-left: 40px;">Mineral Resource Exploration
Profile: academic Level and form of studies: 2nd level, full-time Kind of subject: obligatory Subject code W06GIG-SM3005 Group of courses No

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15			15	
Number of hours of total student workload (CNPS)	25			25	
Form of crediting	crediting with grade			crediting with grade	
For group of courses mark (X) final course					
Number of ECTS points	1			1	
including number of ECTS points for practical classes (P)				1	
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	0,7			0,8	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Possesses basic knowledge of technologies used in open-pit mines and underground mines.
2. Is able to use Microsoft Office environment to prepare documents in Word, multimedia presentations in Power Point and work with Excel spreadsheets.
3. Is able to identify harmful, dangerous and nuisance factors in the workplace environment.

SUBJECT OBJECTIVES

- C1. To introduce the principles of occupational risk assessment in accordance with relevant standards
- C2 To present the principles of occupational risk assessment and the determination of admissibility with the use of STER software and the RISC SCORE method.

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge:

PEU_W01 Possesses general knowledge of rules of occupational risk assessment formulation

PEU_W02 – Possesses knowledge of evaluating and determining the admissibility of occupational risk.

PEU_W03 – Possesses general knowledge of corrective and preventive actions regarding hazards of typical work posts in the mining industry....

relating to skills:

PEU_U01 Is able to identify hazards of harmful, dangerous and nuisance factors of typical work posts in the mining industry

PEU_U02 Is able to estimate and determine risk acceptability with methods according to STER software and the RISC SCORE method.

PEU_U03 - Is able to plan corrective and preventive actions for hazards of typical work posts in the mining industry....

relating to social competences:

PEU_K01 - Is able to work in a team and together complete occupational risk assessment and develop its results and the required documentation in the form of a team report

PROGRAMME CONTENT

Lecture		Number of hours
Lec 1	Definition of occupational risk. Legal basics of occupational risk assessment. Risk assessment methods. Course of occupational risk assessment. Information necessary for occupational risk assessment. Identification of harmful, dangerous and nuisance factors in the work environment.	3
Lec 2	Estimation of occupational risk assessment and determination of admissibility. Corrective and preventive actions. Familiarising employees with the results of occupational risk assessment. Implementation of agreed corrective and preventive actions. Monitoring the effectiveness of implemented actions. Periodic occupational risk assessment. Harmful factors – identification and assessment of risks.	3
Lec 3	Dangerous factors - identification and assessment of risks.	3
Lec 4	Nuisance factors in occupational risk assessment: psychological burden, static burden, monotony.	3
Lec 5	Methods of occupational risk assessment: STER software, the RISC SCORE method, written test	3
	Total hours	15

Project		Number of hours
Pr1	Occupational risk assessment with the use of STER software for two work posts – description of work post, identification of hazards. Occupational risk assessment with the use of STER software for two work posts – estimation of occupational risk and determination of admissibility of harmful factors (dust, noise)	3
Pr2	Occupational risk assessment with the use of STER software for two work posts – estimation of occupational risk and determination of admissibility of	3

	harmful factors (vibration, chemical agents)	
Pr3	Occupational risk assessment with the use of STER software for two work posts – estimation of occupational risk and determination of admissibility of dangerous factors (slippery or uneven surfaces, falling elements, moving parts, moving machinery and transported items)	3
Pr4	Occupational risk assessment with the use of STER software for two work posts – estimation of occupational risk and determination of admissibility for nuisance factors (psychological burden, static burden, monotony)	3
Pr 5	Occupational risk assessment for a selected work post with the use of the RISC SCORE method, presentation of executed exercises, test	3
	Suma godzin	15

TEACHING TOOLS USED

N1. Informative lecture with elements of problematic lectures.
 N2 Multimedia presentations.
 N3 Didactic discussions during lectures.
 N4 Didactic discussions during laboratory classes.
 N5 Computer presentation of executed occupational risk assessments.
 N6 Consultation.

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT

Evaluation (F – forming during semester), P – concluding (at semester end)	Learning outcomes code	Way of evaluating learning outcomes achievement
F1	PEU_W01-W03	grade from a test
F2	PEU_W01-W03 PEU_U01- U03	grade from a presentation
P2	PEU_W01-W03 PEU_U01- U03	final grade from project classes (arithmetic average of F1 and F2)

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

- [1] Occupational Safety and Health in Mining. Anthology on the situation in 16 mining countries. Ed.: Kaj Elgstrand and Eva Vingård. University of Gothenburg nr 2013;47(2) ([gupea.ub.gu.se > bitstream > gupea_2077_32882_1](http://gupea.ub.gu.se/bitstream/gupea_2077_32882_1))
- [2] Boyle, Tony: Health and safety: Risk management. IOSH, 2001. (<http://www.iosh.co.uk/index.cfm?go=publications.main>)
- [3] Encyclopaedia of occupational health and safety. Fourth edition Stellman, Jeanne M. (ed.). International Labour Organization, 1998 (<http://www.ilo.org/public/english/support/publ/xtextre.htm#b103>)
<http://www.ilo.org/public/english/support/publ/encyc/>)
- [4] McKeown, Céline; Twiss, Michael: Workplace ergonomics: A practical guide, IOSH, 2001, 160 p. <http://www.iosh.co.uk/index.cfm?go=publications.main>

SECONDARY LITERATURE:

Handouts, articles

OPIEKUN PRZEDMIOTU (IMIE, NAZWISKO, ADRES E-MAIL)

Dr inż. Żaklina Konopacka

FACULTY OF GEOENGINEERING, MINING AND GEOLOGY

SUBJECT CARD

Name in Polish: Modele Decyzyjne w Zarządzaniu**Name in English: Operations Research****Main field of study (if applicable): Mining and Geology****Specialization (if applicable): Mining Engineering,
Mineral Resource Exploration****Level and form of studies: 2nd, full-time****Kind of subject: obligatory****Subject code: W06GIG-SM3000****Group of courses: NO**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15		15		
Number of hours of total student workload (CNPS)	25		50		
Form of crediting	crediting with grade		Crediting with grade		
For group of courses mark (X) final course					
Number of ECTS points	1		2		
including number of ECTS points for practical (P) classes of practical character (P)			2		
including number of ECTS points for direct teacher-student contact (BU) classes	0,8		0,7		

*delete as applicable

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. The student has basic knowledge of mining systems, technological and organizational systems in mining
2. The student has basic knowledge concerning economics in mining
3. The student has basic knowledge concerning mathematical analysis necessary to understand mathematical issues in science having engineering and economic character.
4. The student has basic knowledge and skills of using probability theory models and mathematical statistics
5. The student can use Excel spreadsheet
6. The student understands the need and knows the possibilities of lifelong learning, improving professional, personal and social skills

SUBJECT OBJECTIVES

C1 Acquiring basic knowledge, taking into consideration its applicational aspects concerning mathematical decision models used in management:

C1.1 Linear programming models

<p>C1.2 Models of planning, deposits and costs of projects</p> <p>C1.3 Queuing system models</p> <p>C1.4 Digital simulation models</p> <p>C2. Learning of qualitative understanding, interpretation and quantitative analysis with applications of selected issues concerning optimization</p> <p>C2.1. Production systems:</p> <p>C2.2. Transport issues</p> <p>C2.3. Flows in networks.</p> <p>C2.4. Project schedules</p> <p>C2.5. Queuing system models</p> <p>C3. Acquiring and consolidating the competencies of thinking and acting in a system way.</p>

SUBJECT LEARNING OUTCOMES	
Subject educational effect (knowledge)	
PEU_W01	The student has knowledge concerning basic decision models in management
PEU_W02	The student has knowledge concerning line programming models.
PEU_W03	The student has knowledge concerning models for planning and monitoring of activities, deposits, and costs of projects
PEU_W04	The student has knowledge concerning queuing system models
PEU_W05	The student has knowledge concerning simulation models.
Subject educational effect (skills)	
PEU_U01	The student has the ability to apply and interpret models using linear programming applications
PEU_U02	The student has the ability to apply and interpret models of planning and monitoring of activities, deposits, and costs of projects with the use of programming applications
PEU_U03	The student has the ability to apply and interpret queuing system models using programming applications
PEU_U04	The student has the ability to apply and interpret simulation models using programming applications
Subject educational effect (social)	
PEU_K01	The student can think and act in a system, creative and enterprising way
PEU_K02	The student is able to identify and solve problems with the use of decision models and applications

PROGRAMME CONTENT		
Form of classes - lecture		Number of hours
Le1	Introduction to modelling systems	2
Le2	Linear programming issues - optimization of production	2
Le3	Linear programming issues - flow in networks optimization (optimal allocation issues, the issue of transportation, maximum flow, minimizing costs)	2
Le4	Projects scheduling using critical path	2
Le5	Planning and balancing of deposits in projects	2
Le6	Optimization issues of queuing systems	2
Le7	Monte Carlo methods and digital simulation	3
Total hours		15

Form of classes - laboratory		Number of hours
La1	Defining and solving linear programming issues (Microsoft Excel-Solver)	2
La2	Production optimization (Microsoft Excel - Solver)	2
La3	Flows in networks optimization (Microsoft Excel - Solver)	2
La4	Projects scheduling (Microsoft Project)	2
La5	Planning and balancing of deposits in projects (Microsoft Project)	2
La6	Optimization issues of queuing systems (Microsoft Excel)	2
La7	Elements of Monte Carlo methods and digital simulation (Microsoft Excel)	3
Total hours		15

TEACHING TOOLS USED
N1. Interactive lecture with slides and discussion
N2. Laboratory exercises with the use of IT applications - discussion concerning solutions
N3. Laboratory exercises - short written tests (calculating tasks, tests of knowledge)
N4. Duty hours
N5. Own work - preparation for laboratory classes, solving additional tasks
N6. Own work - own literature studies.

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT

Evaluation (F – forming (during semester), P – concluding (at the end of semester))	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01-04	short written test.
PEU_U01-04 written test (counting exercise)		
PEU_W01-05; PEU_K01-02 Written test (knowledge test)		

PRIMARY AND SECONDARY LITERATURE
<u>PRIMARY LITERATURE</u>
[1] Ignasiak E., Borucki W., Badania operacyjne, PWE, 2001
[2] Krawczyk S., Badania operacyjne dla menedżerów, PWE
[3] Baranowska B, Badania operacyjne w zarządzaniu, PWSBIA, 1996
<u>SECONDARY LITERATURE</u>
[1] Szapiro T., Decyzje menedżerskie z Excelem, PWE 2000
[2] Trzaskalik T., Modelowanie optymalizacyjne, Absolwent
[3] Trzaskalik T., Badania operacyjne z komputerem, PWE
<u>SUBJECT SUPERVISOR (NAME AND SURNAME, E-MAIL ADDRESS)</u>
Dr inż. Witold Kawalec
Dr hab. inż. Leszek Jurdziak
Dr inż. Zbigniew Krysa

FACULTY OF GEOENGINEERING, MINING AND GEOLOGY

SUBJECT CARD**Name of subject in Polish ... Zarządzanie projektami, ocena ich opłacalności i ryzyka..****Name of subject in English: Project Management, Appraisal and Risk Evaluation.****Main field of study (if applicable): Mining and Geology****Specialization (if applicable): Mining Engineering,
Geotechnical and Environmental Engineering,
Geomatics for Mineral Resource Management
..... Mineral Resource Exploration****Profile: academic****Level and form of studies: 2nd level, full-time****Kind of subject: obligatory****Subject code ... W06GIG-SM3003G****Group of courses YES**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15		30	15	
Number of hours of total student workload (CNPS)	25		50	25	
Form of crediting	Examination				
For group of courses mark (X) final course	X				
Number of ECTS points	4				
including number of ECTS points for practical classes (P)	3				
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	3,1				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge of basic mathematical analysis, probability and statistical models
2. Skills in using Excel spreadsheets
3. Understanding of the need of lifelong learning and the importance of application of Economics, Management and Social Sciences in engineering.

SUBJECT OBJECTIVES

The course combines two groups of topics: basics of mineral economics and financial management and introduction to project management.

Part A: The purpose of the course is

C1 to introduce basic concepts of Microeconomics and financial management

C2 to introduce the concept of time value of money and present the methods used to evaluate investment projects. Different techniques are illustrated by examples and case studies. The range of application as well as the advantages and disadvantages of each method are discussed. The issues of inflation and risk analysis are included.

Part B:

C3 Introduction to project management basic concepts, methods and tools.

C4 Presentation of given project management areas: Project scope management, Project time management, Project cost management, Project risk management. Project planning, scheduling and control using Microsoft Project.

C5 Presentation of the issues of effective communication in project teams, group behaviour and leadership.

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge:

PEU_W01 knows the concepts of demand, supply and price elasticities, understands how they affect markets

PEU_W02 knows the concepts of costs in economics and accounting, understands how they differ

PEU_W03 knows the main cost categories and cost accounting methods

PEU_W04 has basic knowledge about the contents of financial statements

PEU_W05 has basic knowledge about the method of ratio analysis of financial statements

PEU_W06 knows and understands the concepts of Present Value and Future Value for simple cash flows and annuities.

PEU_W07 knows the capital budgeting methods (NPV, IRR, PBP) and understand how to interpret the results

PEU_W08 has basic knowledge about the project risk evaluation methods

relating to skills:

PEU_U01 is able to analyze the causes and effects of demand and supply changes

PEU_U02 is able to interpret and use information presented in financial statements also by means of ratio analysis

PEU_U03 is able to use different cost analysis methods and make decisions based on the results

PEU_U03 can calculate Future and Present value, also for annuities and solve simple calculation problems

PEU_U04 is able to perform discounted cash flow analysis and draw conclusions based on the results

PEU_U05 is able to carry out sensitivity analysis and scenario analysis using a financial model of an investment

PEU_U06 is able to work out basic project documentation and initiate a project

PEU_U07 is able to use basic methods of project management, monitoring and project risk management

PEU_U08 is able to implement basic conflict management methods in a project group

PEU_U09 is able to use basic group management methods, can undertake and shape the leadership position

relating to social competences:

PEU_K01 is able to think and act in a systematic, creative and entrepreneurial way

PEU_K02 has an established attitude of economic operation and decision-making based on available financial information and forecasts

PROGRAMME CONTENT		
Lecture		Number of hours
Lec.1	Supply and demand, equilibrium price, changes in demand and supply. Stock and commodity markets used by mineral industries	2
Lec.2	Costs in economics and in accounting. Cost and money outflow. Relevant cost, incremental cost, marginal cost, alternative cost. Short-term decision making.	2
Lec.3	Costs as the subject of cost accounting, different systems of cost accounting Different methods of cost data presentation (by types, divided into direct and indirect costs). Cost allocation	2
Lec.4	Variable and fixed costs. Break even point. Cost-volume –profit analysis.	1
Lec.5	Basics of financial accounting. Income statement and cash flow statement. Balance sheet. Working capital. Examples of financial statements of mining companies	2
Lec.6	Financial ratio analysis. Liquidity, profitability, activity and debt ratios. Financial and operating leverage.	2
Lec.7	The concept of time value of money. Computation of future and present value of money by means of spreadsheet functions. Basics of capital budgeting. Evaluation of different methods.	2
Lec.8	The concept of risk and return. Quantification of risk. Risk analysis in project evaluation: sensitivity analysis, scenario analysis, other methods.	2
	Total hours	15

Project		Number of hours
Pr 1	Issues of understanding communication: Definitions Models (Schramm model, Berlo’s SMCR (source, message, channel, receiver) model, McCroskey model, Reusch and Bateson model, Westley-MacLean model)	3
Pr 2	Conflict Sources of conflicts Kilmann and Thomas classification of conflict Kilmann and Thomas test Different styles of conflict solving Roles of conflict in group development.	3
Pr3	Team roles Team roles Belbin perspective Discussion group roles Effective managerial behaviour in the context of team roles	3
Pr4	Leadership Hersey and Blanchard theory Black and Mouton approach to leadership Fiedler theory and his Least Preferred Coworker Scale Situational leadership self-assessment	3
Pr5	Summary;	3

	Effective managerial behaviour from the different contexts.	
	Total hours	15

Laboratory		Number of hours
Part A		
La1	Supply and Demand curves. Elasticity of demand.	2
La2	Economic costs. Cost curves. Profit maximization cases.	2
La3	Managerial cost accounting. Decision making cases.	2
La4	Basic financial accounting. Creation of simple Balance Sheet, Profit and Loss Statement and Cash Flow Statement	2
La5	Ratio analysis based on financial statements of companies	2
La6	Time value of money and capital budgeting – calculation by means of Excel functions	2
La7	Financial model of an investment. Sensitivity and Scenario analysis.	3
Part B		
La8	Basic concepts (process, project, project management, management by projects, critical factors for project success, competences). Preparing and initiation of the project. Project analysis (project environment, stakeholders, project objectives).	3
La9	Planning and estimating of the project. Project phases and life cycle	3
La10	Project organization. Project scope management. Planning of activities, resources and costs.	3
La11	Project risk management. Project monitoring. Project management methodologies.	3
La12	Quality management. Change control. Project closing.	3
	Suma godzin	30

TEACHING TOOLS USED
N1. Interactive lecture with the use of multimedia and discussion N2. Laboratory classes: individual problem solving with the use of Excel spreadsheet N3. Laboratory classes part B and project classes: case studies solving in groups and individually. Project presentations, discussion N4. Consultation N5. Self-study: solving assigned problems, literature studies

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT

Evaluation (F – forming during semester), P – concluding (at semester end)	Learning outcomes code	Way of evaluating learning outcomes achievement
F1	PEU_W01-W08 PEU_K01-K02	Assesment of student class activity
F2	PEU_U01-U10 PEU_K01-K02	Evaluation of student's assignments
P1	PEU_W01-W08 PEU_U01-U10 PEU_K01-K02	Written test

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

1. Erhardt M., Brigham E.: Financial Management Theory and Practice. South-Western Cengage Learning, USA
2. Brigham E., Glapenski L.: Financial Management, 1997
3. Johnson H.: Making Capital Budgeting Decisions – Maximising the Value of the Firm. Financial Times/Prentice Hall (April 15, 1999)
4. Jonson H.: Strategic Capital Budgeting: Developing and Implementing the Corporate Capital Allocation Program, January 1994.
5. Lock Dennis, Project Management, Published April 11, 2013 by Routledge

SECONDARY LITERATURE:

1. Jonson H.: Determining Cost of Capital: The Key to Firm Value. Apr 1999.
2. A Guide to Project Management Body of Knowledge (PMBOK®Guide Fourth Edition), Project Management Institute, 2008 (2004). wydanie polskie, MT&DC Warszawa, 2009 (2006)
3. Johnson H.: Global Financial Institutions and Markets. December 1999

SUBJECT SUPERVISOR (NAME AND SURNAME, E-MAIL ADDRESS)

Dr inż. Gabriela Paszkowska, Gabriela.paszowska@pwr.wroc.pl

FACULTY OF GEOENGINEERING, MINING AND GEOLOGY

SUBJECT CARD

Name in Polish: *Zasady i zastosowania InSAR oraz GIS w górnictwie*
Name in English: *Principles and Application of InSAR and GIS in mining*
Main field of study: Mining and geology
Specialization: Geomatics for Mineral Resources Management
Mineral Resource Exploration
Level and form of studies: 2nd level, full-time
Kind of subject: obligatory
Subject code: W06GIG-SM3007
Group of courses: No

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30		45		
Number of hours of total student workload (CNPS)	50		75		
Form of crediting	Examination		crediting with grade		
For group of courses mark (X) final course					
Number of ECTS points	2		3		
including number of ECTS points for practical (P) classes			3		
Including number of ECTS points for direct teacher-student contact (BU) classes	1,4		2,0		

*niepotrzebne skreślić

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge of C ++ and Python programming language.
2. Basic knowledge of GIS functions and spatial data acquisition techniques
3. Ability to use GIS software package
4. Basic knowledge of databases

SUBJECT OBJECTIVES

- C1 Presentation of knowledge of satellite radar interferometry, as well as the possibility of using it in the ground deformation measurements.
- C2 Acquiring the ability to determine surface displacements based on satellite radar data.
- C3 Presentation of information on the use of GIS in advanced analysis of objects, phenomena and processes occurring in space.
- C4 Acquiring the ability to formulate and solve tasks using GIS analytical functions.
- C5 Acquiring skills to use spatial data and services in accordance with the INSPIRE Directive

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge:

PEK_W01 Has expanded knowledge in the field of using geoinformation systems to collect and process data used in modeling of both natural and anthropogenic phenomena and processes

PEK_W02 Knows the principles of construction and functioning of geoinformation systems in the mining industry and public administration

relating to skills:

PEK_U01 has the ability to use advanced GIS tools in mining, studies of natural phenomena, the impact of mining on the environment and space development,

PEK_U02 has the ability to formulate and solve spatial tasks in the GIS environment

PEK_U03 has the ability to interpret the results obtained and draw conclusions

relating to social competences:

PEU_K01 has the ability to formulate and transfer knowledge on the use of geoinformation systems in spatial analysis and presentation of their results

PROGRAMME CONTENT

Lecture		Number of hours
Lec 1	Discussion of syllabus, requirements for passing the course, literature	2
Lec 2	Introduction to Microwave Signals for Earth Observation	2
Lec 3	Principles and Applications of Passive and Active Microwave Remote Sensing	2
Lec 4	Acquisition and processing of SAR data	2
Lec 5	SAR image theory (geometric properties, polarization)	2
Lec 6	Basics of SAR data calculation using the DInSAR and SBAS methods	2
Lec 7	Principles and Applications of Interferometric SAR (monitoring surface activity, natural and anthropogenic phenomena)	2
Lec 8	Fundamental concepts of geographical information systems	2
Lec 9	Data modelling in GIS. Representation of spatial data. Spatial databases. Current status and development trends	2
Lec 10	Methods of spatial analysis in GIS	2
Lec 11	Spatial data interpolation	2
Lec 12	Map algebra. Surface analysis, local and zonal functions	2
Lec 13	Basics of spatial statistics	2
Lec 14	Spatial Information Infrastructure. Inspire Directive. Open Data	2
Lec 15	Examples of applications of geoinformation systems in mining and environmental protection	2
	Total hours	30

Laboratory		Number of hours
La1	Configuration of the environment for SAR calculations	3
La2-3	Introduction to radar data calculations - calculation tasks	6
La4	Acquiring radar data and calculating the interferogram - DInSAR method	3
La5	Unwrapping of the interferometric phase - calculations	3
La6-7	Presentation of results in the GMT environment	6
La8	Discrete data interpolation. Preparation of input data for analysis (e.g. deformation measurements in the mining area)	3
La9	Discrete data interpolation. Development mining area terrain deformation maps with various interpolation methods.	3
La10	Discrete data interpolation. Analysis and assessment of the quality and uncertainty of interpolation. Prediction map. Development of maps of changes between two periods using a raster calculator.	3
La11	Spatial analysis - assessment of the suitability of the area for the location	3
La12	of mining operation. Construction of a database of spatial location criteria	3
La13	Spatial analysis - assessment of the suitability of the area for the location	3
La14	of mining operation. Selection of analytical procedures and conducting analytical operations.	3
La15	Spatial analysis - assessment of the suitability of the area for the location	3
Total hours		45

TEACHING TOOLS USED
N1. Lectures N2. Multimedia presentations N3. Preparation of individual written term paper on a given topic N4. Multimedia materials (MOOC) N5. Laboratory instructions N6. Reports from laboratory exercises N7. Consultations

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT

Evaluation (F – forming during semester), P – concluding (at semester end)	Learning outcomes code	Way of evaluating learning outcomes achievement
F, P	PEU_W01 – 02 PEU_U01 – 03 PEU_K01	F1 Final mark for the written examination F2 Mark for the written report, P Final mark for the lecture (weighted average of F1 and F2, where F1 – 80% and F2 - 20%)
F, P	PEU_W01 – 02 PEU_U01 – 03 PEU_K01	F3 Mark for the written assignment reports F4 Mark from written tests, P2 Final mark for the laboratory (weighted average of F3 and F4, where F3 – 80% and F4 - 20%)

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

- [1] Longley P. A., Goodchild M. F., Maguire D. J., Rhind D. 2015: Geographic Information Science and Systems, 4th Edition, John Wiley & Sons;
- [2] Maguire D., Batty M., Goodchild M., 2005. GIS Spatial Analysis and Modelling. ESRI Press
- [3] Berry J., 2007-2013. Beyond Mapping IV — GIS Modelling
- [4] Satellite InSAR Data: Reservoir Monitoring from Space, A. Ferretti, EAGE; 1st edition, 2014
- [5] GMTSAR: An InSAR Processing System Based on Generic Mapping Tools (Second Edition), D. Sandwell i in., Scripps Institution of Oceanography, University of California, San Diego, La Jolla, CA, USA, 2016
- [6] InSAR Principles - Guidelines for SAR Interferometry Processing and Interpretation, ESA Publications, 2008

SECONDARY LITERATURE:

- [1] Directive 2007/2/EC of the European Parliament and of the Council of 14 March 2007 establishing an Infrastructure for Spatial Information in the European Community (INSPIRE)
- [2] Kennedy M., 2009: Introducing Geographic Information Systems with ArcGIS: A Workbook Approach to Learning GIS, Second Edition, John Wiley and Sons;
- [3] Longley P. A., Goodchild M. F., Maguire D. J., Rhind D. W., 2006. GIS. Teoria i praktyka. Wydawnictwo Naukowe PWN, Warszawa
- [4] Urbański J., 2010. GIS w badaniach przyrodniczych, Wydawnictwo Uniwersytetu Gdańskiego
- [5] Dokumentacja środowiska GMT (Generic Mapping Tools) - <http://gmt.soest.hawaii.edu/projects/gmt/wiki/Documentation>

SUBJECT SUPERVISOR (NAME AND SURNAME, E-MAIL ADDRESS)

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Semester 2 and 3
UNI MISKOLC

Course descriptions – Earth Science Engineering MSc

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University of Miskolc, Earth Science Engineering MSc
Course descriptions

Physical geology

Course Title: Physical geology		ECTS: 4												
Type of course (C/E):	Course code: MFFTT710001													
Type (lec./sem./lab./consult.) and Number of Contact Hours per Week: 2 lectures, 1 seminars														
The degree of <u>theoretical</u> or practical nature of the course: (in ECTS%)														
<p>Type of Assessment (exam. / pr. mark. / other): E During the semester the following tasks should be completed: students have to complete two field programmes: 1) studying sedimentary rocks, reporting in ppt presentations (15%), 2) studying magmatic rocks,</p> <p>Grading scale:</p> <table> <thead> <tr> <th>% value</th> <th>Grade</th> </tr> </thead> <tbody> <tr> <td>80 -100%</td> <td>5 (excellent)</td> </tr> <tr> <td>70 – 79%</td> <td>4 (good)</td> </tr> <tr> <td>60 - 69%</td> <td>3 (satisfactory)</td> </tr> <tr> <td>50 - 59%</td> <td>2 (pass)</td> </tr> <tr> <td>0 - 49%</td> <td>1 (failed)</td> </tr> </tbody> </table>			% value	Grade	80 -100%	5 (excellent)	70 – 79%	4 (good)	60 - 69%	3 (satisfactory)	50 - 59%	2 (pass)	0 - 49%	1 (failed)
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60 - 69%	3 (satisfactory)													
50 - 59%	2 (pass)													
0 - 49%	1 (failed)													
Position in Curriculum (which semester): 1.	Pre-requisites (<i>if any</i>): -													
Course Description:														
<p><u>Objectives of the course:</u> The main objectives of the course are deepening the students' abilities for geological interpretation, making them familiar with the reconstruction of rock-forming processes, introducing them to facial analysis and the stratigraphic methods.</p> <p><u>Course content:</u> Fieldtrip, analysis of sedimentary formations The formation and the inner structure of the Earth Plate tectonic background of the geological processes The role of physical geology in the geological exploration. Magmatic processes, their interpretation on field Sedimentary processes, their interpretation on field Fieldtrip, studying magmatic rocks Metamorphic processes, their interpretation on field Principles of stratigraphy, stratigraphic nomenclature Stratotype, lito-, bio- and chronostratigraphy Magneto-, chemo-, seismic, sequence, and cycle stratigraphy Reconstruction of continental sedimentary environments Reconstruction of marine sedimentary environments Defining the succession of rock-forming processes and tectonic events</p> <p><u>Teaching methodologies:</u> During the semester the following tasks should be completed: students have to complete two field programmes: 1) studying sedimentary rocks, reporting in ppt presentations (15%), 2) studying magmatic rocks,</p>														
<p>The 3-5 most important compulsory, or recommended literature (textbook, book) resources: Sam J. Boggs: Principles of Sedimentology and Stratigraphy, Prentice Hall Publishing, 2011 Angela L. Coe: Field techniques. Wiley-Blackwell 2010 Gary Nichols: Sedimentology and Stratigraphy. Wiley-Blackwell, 2009</p>														
Competencies to evolve (relevant Learning outcomes, Appendix 1):														

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Knowledge: T1, T2, T3, T7, T8, T9
Skills: K1, K2, K3, K5, K6, K7, K9, K11, K12, K13
Attitudes:
Autonomy and responsibility: F1, F2, F3, F4, F5

Demonstration of coherence of course content and unit's objectives:

The course gives the fundamentals to later specific geological courses. It introduces the basic concepts and skills necessary for interpretation of different geological processes.

Demonstration of coherence between teaching methodologies and the learning outcomes:

Theoretical part is complemented by classworks as well as field works

Responsible Academic staff member and lecturing load (*name, position, scientific degree*): **Dr. Hartai Éva** foldshe@uni-miskolc.hu

Other Academic Staff Involved in Teaching, if any and lecturing load (*name, position, scientific degree*):

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Course descriptions

Mineralogy and geochemistry

Course Title: Mineralogy and geochemistry		ECTS: 4												
Type of course (C/E):	Course code: MFFAT710005													
Type (lec./sem./lab./consult.) and Number of Contact Hours per Week: 2 lectures, 1 seminars														
The degree of <u>theoretical</u> or practical nature of the course: (in ECTS%)														
<p>Type of Assessment (exam. / pr. mark. / other): E The final grade will consist of two part. During the semester two midterm tests are written. The average of them will be the 50% of the final grade. The rest 50% is for the final exam.</p> <p>Grading scale:</p> <table border="0"> <tr> <td>% value</td> <td>Grade</td> </tr> <tr> <td>90 -100%</td> <td>5 (excellent)</td> </tr> <tr> <td>80 – 89%</td> <td>4 (good)</td> </tr> <tr> <td>70 - 79%</td> <td>3 (satisfactory)</td> </tr> <tr> <td>60 - 69%</td> <td>2 (pass)</td> </tr> <tr> <td>0 - 59%</td> <td>1 (failed)</td> </tr> </table>			% value	Grade	90 -100%	5 (excellent)	80 – 89%	4 (good)	70 - 79%	3 (satisfactory)	60 - 69%	2 (pass)	0 - 59%	1 (failed)
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0 - 59%	1 (failed)													
Position in Curriculum (which semester): 1.	Pre-requisites (<i>if any</i>): -													
Course Description:														
<p><u>Objectives of the course:</u> Students will get the knowledge of the principals of the distribution of chemical element in the Earth. They will also know the most important thermodynamic processes concerning solid materials, the geochemical classification of elements, the geochemical aspects of the genesis of the most important minerals and mineral assemblages. The geochemistry of isotopes, which explores the chemical evolution of the Earth will also be introduced, as well as the geochemical characteristics of water, organic matter, magmatic, sedimentary and metamorphic rocks by which we can describe the mineral-and rock-forming processes in the crust and mantle.</p> <p><u>Course content:</u> Introduction; Hydrogen and alkaline metals Alkaline earth metals Boron, aluminium, carbon and silicon Rare earth elements, titanium and zirconium Uranium, thorium, vanadium, niobium and tantalum Chromium, molybdenum and tungsten Midterm test (1st); Manganese, iron, cobalt and nickel Copper, gold, silver and platina group elements Zinc, cadmium, mercury, gallium, indium and thallium Tin, lead, arsenic, antimony and bismuth Nitrogen, phosphorus and oxygen Sulphur, selenium, tellurium, haloids and noble gases</p> <p><u>Teaching methodologies:</u> The final grade will consist of two part. During the semester two midterm tests are written. The average of them will be the 50% of the final grade. The rest 50% is for the final exam.</p>														
<p>The 3-5 most important compulsory, or recommended literature (textbook, book) resources: Dill H.G. (2010): The „chessboard” classification schene of mineral deposits. Elsevier, 2010. White, W. M. (2013): Geochemistry. Wiley-Blackwell. Nordstrom D.K., Blowes D.W., Ptacek C.J. (2015): Hydrogeochemistry and microbiology of mine drainage: An update. Applied Geochemistry, Elsevier. Albared, F. (2005): Geochemistry. An introduction. Cambridge Univ. Press.</p>														

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Sarkar D., Datta R., Hannigan R.(2007): Concepts, and applications in environmental geochemistry, Elsevier.
John W. Anthony, Richard A. Bideaux, Kenneth W. Bladh, and Monte C. Nichols, Eds. (2003): Handbook of Mineralogy. Mineralogical Society of America.

Competencies to evolve (relevant Learning outcomes, Appendix 1):

Knowledge: T7

Skills: K1, K2

Attitudes: A1, A2, A9

Autonomy and responsibility: F2, F5

Demonstration of coherence of course content and unit's objectives:

This is a fundamental course, discussing systematic mineralogy and geochemical background of mineral formation processes

Demonstration of coherence between teaching methodologies and the learning outcomes:

Theoretical part is complemented by mineralogy laboratory work and geochemical modeling exercises

Responsible Academic staff member and lecturing load (name, position, scientific degree): Dr. Zajzon Norbert askzn@uni-miskolc.hu

Other Academic Staff Involved in Teaching, if any and lecturing load (name, position, scientific degree): Móricz Ferenc

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Course descriptions

Geophysical exploration methods I.

Course Title: Geophysical exploration methods I.		ECTS: 4												
Type of course (C/E):	Course code: MFGFT7100021													
Type (lec./sem./lab./consult.) and Number of Contact Hours per Week: 2 lectures, 1 seminars														
The degree of <u>theoretical</u> or practical nature of the course: (in ECTS%)														
<p>Type of Assessment (exam. / pr. mark. / other): E Attendance at lectures is regulated by the university code of education and examination. Three writing tests with satisfactory results, and two assignments during the semester is the requirement of signature.</p> <p>Grading scale:</p> <table border="0"> <tr> <td>% value</td> <td>Grade</td> </tr> <tr> <td>86 -100%</td> <td>5 (excellent)</td> </tr> <tr> <td>70 – 85%</td> <td>4 (good)</td> </tr> <tr> <td>60 - 69%</td> <td>3 (satisfactory)</td> </tr> <tr> <td>46 - 59%</td> <td>2 (pass)</td> </tr> <tr> <td>0 - 45%</td> <td>1 (failed)</td> </tr> </table>			% value	Grade	86 -100%	5 (excellent)	70 – 85%	4 (good)	60 - 69%	3 (satisfactory)	46 - 59%	2 (pass)	0 - 45%	1 (failed)
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Position in Curriculum (which semester): 1.	Pre-requisites (<i>if any</i>): -													
Course Description:														
<p><u>Objectives of the course:</u> Understanding the surface geophysical methods and the geophysical methods used in boreholes for the purpose that students can design and execute geophysical research and evaluate data.</p> <p><u>Course content:</u> Classification of applied geophysics methods. Gravity methods: measured quantities, basic corrections and data processing methods. Filtering gravity maps. Evaluation of measurement data for causative bodies with simple geometries. Geological and environmental geological applications. Magnetic methods: measured quantities, basic corrections and data processing methods. Reducing magnetic data to the pole. Evaluation of measurement data for magnetizable bodies with simple geometries. Geological and environmental geological applications. The specific resistivity of rocks, the concept of apparent resistivity. Direct current geoelectric methods. VES and multi-electrode measurement methods. Introduction of electromagnetic methods. Induced Polarization (IP) in the time domain (TDIP) and the frequency domain (FDIP). Types of electric polarizations creating the IP signal and their geological background. Frequency domain electromagnetic methods (FDEM): MT and VLF methods, artificial source frequency sounding methods: measurement systems, zones around the transmitter, characteristics of the apparent resistivity and phase curves. Time-domain electromagnetic methods (TDEM): transient, IP and ground radar methods. The transient EM measurement system and the zones around the transmitter. In the case of electrical and electromagnetic methods, the possibilities of controlling the depth of penetration. The development of seismic reflected waves. The travel-time curve and its characteristic parameters. Dynamic and static corrections. The common mid-point (CMP) gather. Features of seismic (TWT) sections. Interpretation of seismic (2D and 3D) sections. Isochronal maps. Seismic stratigraphy. Vertical and horizontal resolution. Acoustic impedance, reflection and transmission coefficients. Possibilities of detecting gas reservoirs by seismic method. The bright spot. The development of seismic refracted waves. The travel-time curve and its characteristic parameters. Processing and evaluation of refraction data. Near-surface applications. The relationship between the petrophysical properties of rocks and parameters measured by well logging methods. Introduction to petrophysics. Reservoir modeling. The basics of nuclear well logging methods. Determination of lithology and porosity. Presentation of main application areas.</p>														

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The basics of acoustic well logging methods. Determination of sonic porosity and permeability. Presentation of main application areas.
The basics of electric well logging methods. The relation between resistivity and water saturation. Presentation of main application areas.
Possibilities for joint processing of open-hole well logging data. Crossplot techniques. Statistical and depth-by-depth inversion methods.
Principle of engineering geophysical sounding measurements. Determination of petrophysical and geotechnical properties of soils/rocks.

Teaching methodologies:

Attendance at lectures is regulated by the university code of education and examination. Three writing tests with satisfactory results, and two assignments during the semester is the requirement of signature.

The 3-5 most important compulsory, or recommended **literature** (textbook, book) **resources:**
Telford W. M., Geldart L. P., Sheriff R. E., 1990. Applied geophysics. Second edition. Cambridge University Press.
Kearey P., Brooks M., Hill I., 2002. An Introduction to Geophysical Exploration. Third edition. Blackwell Science Ltd.
Serra O. & L., 2004. Well logging data acquisition and application, Editions Technip.
Szabó N. P., 2015. Geophysical exploration methods I. Electronic textbook. <http://www.uni-miskolc.hu/~geofiz/education.html>
Szabó N. P., 2016. Well-logging methods. Electronic textbook. <http://www.uni-miskolc.hu/~geofiz/education.html> Scientific papers selected from geophysical journals, e.g., First Break, Near Surface Geophysics, Geophysics, Journal of Applied Geophysics etc.

Competencies to evolve (relevant Learning outcomes, Appendix 1):

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

Skills: K1, K2, K3, K5, K9, K11, K12, K13

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

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

Demonstration of coherence of course content and unit's objectives:

The course introduces the principal theoretical background and practical skills to plan and perform geophysical explorations for different geological environments and deposit types

Demonstration of coherence between teaching methodologies and the learning outcomes:

Following the theoretical part, the students are introduced to different geophysical prospecting and exploration methods in practice.

Responsible Academic staff member and lecturing load (name, position, scientific degree): Dr. Szabó Norbert Péter gfnmail@uni-miskolc.hu

Other Academic Staff Involved in Teaching, if any and lecturing load (name, position, scientific degree):

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Course descriptions

Graduate research seminar

Course Title: Graduate research seminar		ECTS: 2												
Type of course (C/E):	Course code: MFFAT710006													
Type (lec./sem./lab./consult.) and Number of Contact Hours per Week: 0 lectures, 2 seminars														
The degree of <u>theoretical</u> or practical nature of the course: (in ECTS%)														
<p>Type of Assessment (exam. / pr. mark. / other): P During the semester the following tasks should be completed: short presentation of the selected topic, outline and references (20%), elaboration of the concept map of the article (20%), submission of first draft (15%), submission of the final text (20%),</p> <p>Grading scale:</p> <table border="0"> <tr> <td>% value</td> <td>Grade</td> </tr> <tr> <td>80 -100%</td> <td>5 (excellent)</td> </tr> <tr> <td>70 – 79%</td> <td>4 (good)</td> </tr> <tr> <td>60 - 69%</td> <td>3 (satisfactory)</td> </tr> <tr> <td>50 - 59%</td> <td>2 (pass)</td> </tr> <tr> <td>0 - 49%</td> <td>1 (failed)</td> </tr> </table>			% value	Grade	80 -100%	5 (excellent)	70 – 79%	4 (good)	60 - 69%	3 (satisfactory)	50 - 59%	2 (pass)	0 - 49%	1 (failed)
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0 - 49%	1 (failed)													
Position in Curriculum (which semester): 1.	Pre-requisites (<i>if any</i>): -													
Course Description:														
<p><u>Objectives of the course:</u> To introduce the methods of information gathering and evaluation, formal and ethic requirements of scientific communication, rules for preparation of oral and poster presentations. During the course these general requirements are actualized to the field of earth science and engineering. Examples and excercises will use English publications and text materials.</p> <p><u>Course content:</u> Editorial and formal requirements of scientific publications. Planning of the concept and structure of a scientific publication, making an outline, development of a concept map. Usage of references, reference styles. Etics of scientific writing: how to avoid plagiarism, usage of citations. Information sources provided by the Central Library: hard copy, catalogue search, electronic resources. Usage of electronic information resources: search options, simple and combined search, electronic libraries. Data visualization: graphs, figures, tables. The art of presentation: preparation for an oral contribution. The art of presentation: preparation of a poster.</p> <p><u>Teaching methodologies:</u> During the semester the following tasks should be completed: short presentation of the selected topic, outline and references (20%), elaboration of the concept map of the article (20%), submission of first draft (15%), submission of the final text (20%),</p>														
<p>The 3-5 most important compulsory, or recommended literature (textbook, book) resources: L. C. Perelman, J. Paradis, and E. Barrett: The Mayfield Handbook of Technical and Scientific Writing (McGraw-Hill, 2001). G. J. Alred, C. T. Brusaw, and W. E. Oliu: Handbook of Technical Writing, (St. Martin's, New York, 2003). Hagan P; Mort P: Report writing guideline for mining entóginers. Mining Education Australia, 2014. Chun-houh Chen, Wolfgang Härdle, Antony Unwin (eds.) Handbook of Data Visualization (Springer, 2008). MEA Report writing guide. https://www.engineering.unsw.edu.au/mining-engineering/sites/mine/files/publications/MEA_ReportWritingGuide_eBook_2018ed.pdf ISO 690-2: Information and documentation - Bibliographic references.</p>														

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Competencies to evolve (relevant Learning outcomes, Appendix 1):

Knowledge: T1, T5, T8, T12

Skills: K1, K2, K3, K5, K6, K7, K8, K9, K10, K11

Attitudes: A2, A3, A4, A5, A6, A7, A8, A9

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

Demonstration of coherence of course content and unit's objectives:

Students are introduced to the information sources available paper-based and electronically. They are also introduced to best practices on scientific writing, referencing and presentation techniques.

Demonstration of coherence between teaching methodologies and the learning outcomes:

Completing a small research article and a presentation the students improve their knowledge in scientific communication. This is a learning by doing course, where one of the most important goals is to learn the proper way of scientific writing and referen

Responsible Academic staff member and lecturing load (name, position, scientific degree): Dr. Mádai Ferenc askmf@uni-miskolc.hu

Other Academic Staff Involved in Teaching, if any and lecturing load (name, position, scientific degree):

Structural geology

Course Title: Structural geology		ECTS: 4												
Type of course (C/E):	Course code: MFFAT720020													
Type (lec./sem./lab./consult.) and Number of Contact Hours per Week: 1 lectures, 2 seminars														
The degree of <u>theoretical</u> or practical nature of the course: (in ECTS%)														
<p>Type of Assessment (exam. / pr. mark. / other): E Attendance at lectures is regulated by the university code of education and examination. Writing a test and constructing a geological profile at least on satisfactory level, respectively during the semester is the requirement of signature. The exam is ora</p> <p>Grading scale:</p> <table> <thead> <tr> <th>% value</th> <th>Grade</th> </tr> </thead> <tbody> <tr> <td>86 -100%</td> <td>5 (excellent)</td> </tr> <tr> <td>70 – 85%</td> <td>4 (good)</td> </tr> <tr> <td>60 - 69%</td> <td>3 (satisfactory)</td> </tr> <tr> <td>46 - 59%</td> <td>2 (pass)</td> </tr> <tr> <td>0 - 45%</td> <td>1 (failed)</td> </tr> </tbody> </table>			% value	Grade	86 -100%	5 (excellent)	70 – 85%	4 (good)	60 - 69%	3 (satisfactory)	46 - 59%	2 (pass)	0 - 45%	1 (failed)
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Position in Curriculum (which semester): 2.	Pre-requisites (<i>if any</i>): -													
Course Description:														
<p><u>Objectives of the course:</u> The course provides a background in the fundamentals of structural geology. It introduces the methods of interpreting structural observations and determining the 3-D distribution of the lithological units, the physical properties controlling the development of fractures, folds and other structural features. The course also introduces the students to building up, constructing and analysing spatial models.</p> <p><u>Course content:</u> Theoretical backgrounds: basic terms of structural geology and tectonics. Techniques of data acquisition, recording and visualization. Stress and strain, deformation mechanisms, rheological models. Brittle and ductile features, their style and origin. Syngenetic structures and their role in further structural evolution. Plate tectonics and large scale structures. Characteristics of tectonic regimes. Practical exercises: use of tools to measure, demonstrate and analyze the structural data. Basics for constructing maps and cross sections. Lecture: Basic terms; information on the interior of the Earth. Practice: Use of geological maps; rules and geometrical basis of construction of cross sections. Lecture: Structural features of the rocks, deformation, description of movements. Practice: construction of cross sections. Lecture: Stresses, mechanics. Practice: construction of cross sections. Lecture: Rheology and failure envelopes. Practice: construction of cross sections. Lecture: Mechanisms and features of brittle deformation. Practice: construction of cross sections with drill logs Lecture: Mechanisms and features of ductile deformation Practice: construction of cross sections with drill logs. Field exercise: structural orientation measurements on folded and faulted rocks. (The exercise is organised by exchange with the contact hours of another course, in 6 hours) Practice: working with orientation data, stereograms. Practice: working with orientation data, stereograms. Practice: construction exercises. Practice: construction exercises.</p>														

Teaching methodologies:

Attendance at lectures is regulated by the university code of education and examination. Writing a test and constructing a geological profile at least on satisfactory level, respectively during the semester is the requirement of signature. The exam is oral

The 3-5 most important compulsory, or recommended **literature** (textbook, book) **resources:**

Twiss, R. J. & Moores, E. M: Structural Geology. Freeman & Co., New York, 1992, 532 p.

Ramsay, J. G. & Huber, M. I: The techniques of modern structural geology. Vol. 1: Strain Analysis. Academic Press, London, 1983, 1-308 p.

Ramsay, J. G. & Huber, M. I: The techniques of modern structural geology. Vol. 2: Folds and Fractures. Academic Press, London, 1987, 309-700 p.

Ramsay, J. G. & Lisle, R. J: The techniques of modern structural geology. Vol. 3: Applications of continuum mechanics in structural geology. Academic Press, London, 2000, 701-1062 p.

Twiss, R. J. & Moores, E. M: Tectonics. Freeman & Co., New York, 1995, 415 p.

Competencies to evolve (relevant Learning outcomes, Appendix 1):

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

Skills: K1, K2, K3, K5, K9, K11, K12, K13

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

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

Demonstration of coherence of course content and unit's objectives:

In the limited timeframes of the semester, the thematics includes all topics which belong to the structural geology on introductory level. It also provides a possibility to go deeper in some topics for those who have the appropriate basic knowledge ahead

Demonstration of coherence between teaching methodologies and the learning outcomes:

The program is arranged with giving the theoretical and practical basics first and then going to the application of these basics by making field observations, measurements and then working with these data. The students have to be able to interpret the obs

Responsible Academic staff member and lecturing load (name, position, scientific degree): Dr. Németh Norbert foldnn@uni-miskolc.hu

Other Academic Staff Involved in Teaching, if any and lecturing load (name, position, scientific degree):

University of Miskolc, Earth Science Engineering MSc
Course descriptions

Mineral deposits

Course Title: Mineral deposits		ECTS: 4												
Type of course (C/E):	Course code: MFFTT720021													
Type (lec./sem./lab./consult.) and Number of Contact Hours per Week: 2 lectures, 1 seminars														
The degree of <u>theoretical</u> or practical nature of the course: (in ECTS%)														
<p>Type of Assessment (exam. / pr. mark. / other): E Test about recognizing the different hand specimens of ores, raw materials (35%); Written test about the classification of ores with examples (65%).</p> <p>Grading scale:</p> <table border="0"> <tr> <td>% value</td> <td>Grade</td> </tr> <tr> <td>80 -100%</td> <td>5 (excellent)</td> </tr> <tr> <td>70 – 79%</td> <td>4 (good)</td> </tr> <tr> <td>60 - 69%</td> <td>3 (satisfactory)</td> </tr> <tr> <td>50 - 59%</td> <td>2 (pass)</td> </tr> <tr> <td>0 - 49%</td> <td>1 (failed)</td> </tr> </table>			% value	Grade	80 -100%	5 (excellent)	70 – 79%	4 (good)	60 - 69%	3 (satisfactory)	50 - 59%	2 (pass)	0 - 49%	1 (failed)
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0 - 49%	1 (failed)													
Position in Curriculum (which semester): 2.	Pre-requisites (<i>if any</i>): -													
Course Description:														
<p><u>Objectives of the course:</u> The key target of the course is to introduce the geology of raw material deposits, their spatial distribution, their quantity and quality for the different commodities.</p> <p><u>Course content:</u> During the introduction the students get familiar with the different groups of commodities – ores, industrial minerals, solid fossil energy minerals, construction materials and their use and history. In the next period, the students will learn the ore forming geological processes and their appearances, which creates the different deposits. Also they will learn the genetic classification of the deposits with national and international examples. It prepares the students to be able to recognize the geological features of mineralizations, alterations and tectonic preformation. It covers all the important mines and ore districts in Europe and worldwide. During the laboratory classes the students can learn the natural occurrences of the ores, non-ores and industrial minerals. They will learn the physical and chemical properties, and texture of the different raw material types, and how to identify and distinguish them. To the proper use of geological maps and sections in 3D, the students will do exercises to develop their capabilities. During the related field trips the students will examine real deposits in the field.</p> <p><u>Teaching methodologies:</u> Test about recognizing the different hand specimens of ores, raw materials (35%); Written test about the classification of ores with examples (65%).</p>														
<p>The 3-5 most important compulsory, or recommended literature (textbook, book) resources: Robb, L., (2005): Introduction to Ore-Forming Processes: Blackwell Publishing Co., 373 p. (ISBN 0-632-06378-5). EVANS, A. M. 1993: Ore Geology and Industrial Minerals – An Introduction. Blackwell Publishing, ISBN 978-0632-02953-2 CRAIG, J. R. & Vaughan, D. J. 1994: Ore Microscopy & Ore Petrography. John Wiley and Sons Inc. ISBN 10158-0012 Dill H.G. (2010): The „chessboard” classification scheme of mineral deposits. Elsevier, 2010. Cox, D.P. Singer D.E. (1992): Mineral Deposit Models, U.S.G.S. Bulletin 1993.</p>														

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Competencies to evolve (relevant Learning outcomes, Appendix 1):

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

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

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

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

Demonstration of coherence of course content and unit's objectives:

Students get familiar with the different groups of commodities – ores, industrial minerals, solid fossil energy minerals, construction materials and their use and history, as well as the ore forming geological processes and their appearances, genetic clas

Demonstration of coherence between teaching methodologies and the learning outcomes:

Theoretical part is complemented by laboratory classes where students analyze specimens from different deposit types. learn the natural occurrences of the ores, non-ores and industrial minerals. They will learn the physical and chemical properties, and te

Responsible Academic staff member and lecturing load (name, position, scientific degree): Dr. Zajzon Norbert askzn@uni-miskolc.hu

Other Academic Staff Involved in Teaching, if any and lecturing load (name, position, scientific degree): Leskó Máté

University of Miskolc, Earth Science Engineering MSc
Course descriptions

Engineering geology and hydrogeology

Course Title: Engineering geology and hydrogeology		ECTS: 4												
Type of course (C/E):	Course code: MFKHT720020													
Type (lec./sem./lab./consult.) and Number of Contact Hours per Week: 2 lectures, 1 seminars														
The degree of <u>theoretical</u> or practical nature of the course: (in ECTS%)														
<p>Type of Assessment (exam. / pr. mark. / other): E Participation in presentation lectures and practical classes is mandatory. Field trips and classroom calculations. The successful completion of the course is based on the successful completion of the semester test and the successful completion of the exam</p> <p>Grading scale:</p> <table border="0"> <tr> <td>% value</td> <td>Grade</td> </tr> <tr> <td>85 -100%</td> <td>5 (excellent)</td> </tr> <tr> <td>75 – 84%</td> <td>4 (good)</td> </tr> <tr> <td>63 - 74%</td> <td>3 (satisfactory)</td> </tr> <tr> <td>50 - 62%</td> <td>2 (pass)</td> </tr> <tr> <td>0 - 49%</td> <td>1 (failed)</td> </tr> </table>			% value	Grade	85 -100%	5 (excellent)	75 – 84%	4 (good)	63 - 74%	3 (satisfactory)	50 - 62%	2 (pass)	0 - 49%	1 (failed)
% value	Grade													
85 -100%	5 (excellent)													
75 – 84%	4 (good)													
63 - 74%	3 (satisfactory)													
50 - 62%	2 (pass)													
0 - 49%	1 (failed)													
Position in Curriculum (which semester): 2.	Pre-requisites (<i>if any</i>): -													
Course Description:														
<p><u>Objectives of the course:</u> It introduces students to the key concepts of engineering geology, modern hydrogeology, and field hydrogeology, soil formation, soil classification methods, laboratory and field soil tests, water-to-rock underwater stress, and groundwater flow patterns.</p> <p><u>Course content:</u> Introduction to the examination of soil characteristics Determination of shear strength parameters of soils Soil consolidation Shallow and deep foundation, the basics of EC7 design The most important basics, problems and relationships of hydrogeology Hydrogeological pools, flow systems, sustainability, artificial replenishment Hydrogeochemistry, transport processes Water management issues, particularly in cross-border areas Hydrogeology of the Carpathian Basin Isotope hydrogeology, use of stable isotopes to understand groundwater Groundwater recharge and their interpretation Well hydraulics calculations Isotope hydrogeology, use of radioactive isotopes to understand groundwater</p> <p><u>Teaching methodologies:</u> Participation in presentation lectures and practical classes is mandatory. Field trips and classroom calculations. The successful completion of the course is based on the successful completion of the semester test and the successful completion of the exam</p>														
<p>The 3-5 most important compulsory, or recommended literature (textbook, book) resources: David Daming: Introduction to Hydrogeology, McGraw-Hill Higher Education, 2002. F. G. Bell: Engineering Geology, Oxford, Blackwell Scientific Publications, 1992 Dr. Juhász József: Hidrogeológia. Akadémiai kiadó, Budapest, 2002. Dr. Juhász József: Mérnökgeológia I-III. Miskolci Egyetemi Kiadó, 1999; 2002; 2003 Dr. Kleb Béla: Mérnökgeológia Budapest, 1980 David Daming: Introduction to Hydrogeology, McGraw-Hill Higher Education,</p>														

University of Miskolc, Earth Science Engineering MSc
Course descriptions

2002. F. G. Bell: Engineering Geology, Oxford, Blackwell Scientific Publications, 1992 S. E. Ingebritsen, W. E. Sanford: Groundwater in Geologic Processes. Cambridge University Press, 1998. Kruseman G.P. and Ridder N.A: Analysis and Evaluation of Pumping Test Data, ILRI publication, Wageningen, Netherlands, 1990, pp. 1-377. Neven Kresic: Quantitative Solutions in Hydrogeology and Groundwater Modeling. Lewis Publishers, 1997. Barnes, C. W. (1988): Earth, Time and Life. John Wiley and Sons, New York Brookfield, M. (2006): Principles of Stratigraphy. Blackwell Publishing, New York

Competencies to evolve (relevant Learning outcomes, Appendix 1):

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

Skills: K1, K2, K3, K5, K6, K7, K8, K9, K10, K11, K12, K13

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

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

Demonstration of coherence of course content and unit's objectives:

The course provides the theory and practical skills to understand the hydrogeological and engineering geological background for interpretation of different geological and geotechnical processes.

Demonstration of coherence between teaching methodologies and the learning outcomes:

Theoretical part is complemented by laboratory classes where students perform calculations and modeling exercises of hydrogeological systems and geotechnical characterization of soils.

Responsible Academic staff member and lecturing load (name, position, scientific degree): Dr. Szűcs Péter hgszucs@ui-miskolc.hu

Other Academic Staff Involved in Teaching, if any and lecturing load (name, position, scientific degree):

University of Miskolc, Earth Science Engineering MSc
Course descriptions

Analytical technics in mineralogy and petrology

Course Title: Analytical technics in mineralogy and petrology		ECTS: 2												
Type of course (C/E):	Course code: MFFAT720025													
Type (lec./sem./lab./consult.) and Number of Contact Hours per Week: 1 lectures, 1 seminars														
The degree of <u>theoretical</u> or practical nature of the course: (in ECTS%)														
<p>Type of Assessment (exam. / pr. mark. / other): P 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 a</p> <p>Grading scale:</p> <table> <thead> <tr> <th>% value</th> <th>Grade</th> </tr> </thead> <tbody> <tr> <td>80 -100%</td> <td>5 (excellent)</td> </tr> <tr> <td>70 – 79%</td> <td>4 (good)</td> </tr> <tr> <td>60 - 69%</td> <td>3 (satisfactory)</td> </tr> <tr> <td>50 - 59%</td> <td>2 (pass)</td> </tr> <tr> <td>0 - 49%</td> <td>1 (failed)</td> </tr> </tbody> </table>			% value	Grade	80 -100%	5 (excellent)	70 – 79%	4 (good)	60 - 69%	3 (satisfactory)	50 - 59%	2 (pass)	0 - 49%	1 (failed)
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70 – 79%	4 (good)													
60 - 69%	3 (satisfactory)													
50 - 59%	2 (pass)													
0 - 49%	1 (failed)													
Position in Curriculum (which semester): 2.	Pre-requisites (<i>if any</i>): -													
Course Description:														
<p><u>Objectives of the course:</u> 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.</p> <p><u>Course content:</u> Description of the work, formulating analytical pairs, work and lab safety teaching Physical properties (hardness, magnetic, solubility, density), density measurements X-ray diffraction lecture I. X-ray diffraction lecture II. X-ray diffraction practice DTA lecture DTA quantitative calculations Scanning electron microscopy lecture I. Scanning electron microscopy lecture II. Scanning electron microscopy practice Formula calculations</p> <p><u>Teaching methodologies:</u> 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 a</p>														
<p>The 3-5 most important compulsory, or recommended literature (textbook, book) resources: 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.</p>														

University of Miskolc, Earth Science Engineering MSc
Course descriptions

King M. et al. (1993): Mineral Powder Diffraction File Search- and Databook. ICDD, USA.

Competencies to evolve (relevant Learning outcomes, Appendix 1):

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

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

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

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

Demonstration of coherence of course content and unit's objectives:

Lectures cover the theoretical fundamentals for different methods of analysis of minerals, which is essential basics for geological exploration tasks.

Demonstration of coherence between teaching methodologies and the learning outcomes:

Following the introduction of different analytical methods, this is a learning by doing course where students go through the preparation, analysis and interpretation steps for various analytical techniques (XRPD, EPMA, SEM)

Responsible Academic staff member and lecturing load (name, position, scientific degree): Dr. Zajzon Norbert askzn@uni-miskolc.hu

Other Academic Staff Involved in Teaching, if any and lecturing load (name, position, scientific degree):

University of Miskolc, Earth Science Engineering MSc
Course descriptions

Geological interpretation and prospecting

Course Title: Geological interpretation and prospecting		ECTS: 4												
Type of course (C/E):	Course code: MFFAT730026													
Type (lec./sem./lab./consult.) and Number of Contact Hours per Week: 2 lectures, 2 seminars														
The degree of <u>theoretical</u> or practical nature of the course: (in ECTS%)														
<p>Type of Assessment (exam. / pr. mark. / other): E Participation in presentation lectures and practical classes is mandatory. Field trips and classroom exercises. The successful completion of the course is based on the successful completion of the semester test and the successful completion of the exam.</p> <p>Grading scale:</p> <table border="0"> <tr> <td>% value</td> <td>Grade</td> </tr> <tr> <td>80 -100%</td> <td>5 (excellent)</td> </tr> <tr> <td>70 – 79%</td> <td>4 (good)</td> </tr> <tr> <td>60 - 69%</td> <td>3 (satisfactory)</td> </tr> <tr> <td>50 - 59%</td> <td>2 (pass)</td> </tr> <tr> <td>0 - 49%</td> <td>1 (failed)</td> </tr> </table>			% value	Grade	80 -100%	5 (excellent)	70 – 79%	4 (good)	60 - 69%	3 (satisfactory)	50 - 59%	2 (pass)	0 - 49%	1 (failed)
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70 – 79%	4 (good)													
60 - 69%	3 (satisfactory)													
50 - 59%	2 (pass)													
0 - 49%	1 (failed)													
Position in Curriculum (which semester): 3.	Pre-requisites (<i>if any</i>): -													
Course Description:														
<p><u>Objectives of the course:</u> The main objective of this course is (1) to integrate all the information from the different applied survey methods to allow assessing the economic potential of mineral raw material occurrences, (2) to build capacity to use practical methods in mineral exploration, (3) to develop team working skills, (4) training of different exploration tasks in real field situations</p> <p><u>Course content:</u> Introduction, objectives, team exercise information Exploration methods, quality control and quality assurance Project planning and scheduling Resource estimation terminology and basic methods Team exercise – Rudabánya and Martonyi geology Geological models in interpretation Overview of available statistical tools Spatial distribution statistics – basic practices JORC and NI43-101 reporting standards, exploration requirements Introduction to Rockworks modelling Team field exercise – Rudabánya sample Preparation, handling and storage Team exercise –data harmonization with geophysics and geochemistry Presentation and discussion of team exercise project Rudabánya and Martonyi</p> <p><u>Teaching methodologies:</u> Participation in presentation lectures and practical classes is mandatory. Field trips and classroom exercises. The successful completion of the course is based on the successful completion of the semester test and the successful completion of the exam.</p>														
<p>The 3-5 most important compulsory, or recommended literature (textbook, book) resources: Marjoriebanks R. 2010: Geological Methods in Minerals Exploration and Mining ISBN 978-3-540-74370-5 e-ISBN 978-3-540-74375-0 Sinclair A.J. and Blacwell G.H. 2002: Applied Mineral Inventory Estimation ISBN 0-511-03145-9 eBook Alastair J. Sinclair and Garston H. Blackwell 2004 2002</p>														

University of Miskolc, Earth Science Engineering MSc
Course descriptions

Competencies to evolve (relevant Learning outcomes, Appendix 1):

Knowledge: T1, T2, T3, T4, T5, T7, T8, T9

Skills: K1, K2, K3, K5, K6, K7, K8, K9, K10, K11, K12, K13

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

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

Demonstration of coherence of course content and unit's objectives:

The course goes through the key points of performance and quality assurance of geological prospection and exploration tasks. This is a synthetizing course for the whole master programme.

Demonstration of coherence between teaching methodologies and the learning outcomes:

Following the theoretical part, the students complete small projects about mineral resource assessment and a complex project where geological, geophysical and geochemical prospecting data should be interpreted.

Responsible Academic staff member and lecturing load (name, position, scientific degree): Dr. Földessy János foldfj@uni-miskolc.hu

Other Academic Staff Involved in Teaching, if any and lecturing load (name, position, scientific degree):

Geophysical interpretation and prospecting

Course Title: Geophysical interpretation and prospecting		ECTS: 4												
Type of course (C/E):	Course code: MFGFT730025													
Type (lec./sem./lab./consult.) and Number of Contact Hours per Week: 2 lectures, 2 seminars														
The degree of <u>theoretical</u> or practical nature of the course: (in ECTS%)														
<p>Type of Assessment (exam. / pr. mark. / other): E During the semester the following tasks should be completed: presentation on a report covering the process from exploration planning to interpretation (60%), exam (40%)</p> <p>Grading scale:</p> <table> <thead> <tr> <th>% value</th> <th>Grade</th> </tr> </thead> <tbody> <tr> <td>80 -100%</td> <td>5 (excellent)</td> </tr> <tr> <td>70 – 79%</td> <td>4 (good)</td> </tr> <tr> <td>60 - 69%</td> <td>3 (satisfactory)</td> </tr> <tr> <td>50 - 59%</td> <td>2 (pass)</td> </tr> <tr> <td>0 - 49%</td> <td>1 (failed)</td> </tr> </tbody> </table>			% value	Grade	80 -100%	5 (excellent)	70 – 79%	4 (good)	60 - 69%	3 (satisfactory)	50 - 59%	2 (pass)	0 - 49%	1 (failed)
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0 - 49%	1 (failed)													
Position in Curriculum (which semester): 3.	Pre-requisites (<i>if any</i>): -													
Course Description:														
<p><u>Objectives of the course:</u> In the scope of this subject students acquire knowledge about the closing phase of geological-geophysical exploration and study the linkage and hierarchy of different geophysical methods. They learn how to determine the most probable geological model by using geophysical measurement results and other geoscientific information jointly. They study the points of view of exploration and measurement planning related to the interpretation of data acquired</p> <p><u>Course content:</u> Water exploration by geophysical methods: Some types of water aquifers. Simultaneous application of geoelectrical and IP methods. The use of frequency and time domain EM methods in water exploration. The role of GPR and surface nuclear magnetic resonance methods. The most important well logging methods and their interpretation. Case histories including water base protection. Coal, bauxite, uranium exploration: Coal formation, low-rank and high-rank coals. The physical parameters of different coal types. The use of surface geophysical methods, the advantages of underground exploration. In-seam seismic surveys, in mine geoelectrical methods. Well logging methods for coal qualification. Complex coal exploration case histories. Bauxite formation (carbonate, lateritic bauxite). The role of seismic refraction and VLF method in bauxite exploration. Well logging for quantitative interpretation and neutron activation analysis. The most important types of uranium deposits. The determination of K, U, Th content with (airborne, surface, borehole) NGS method. Rn measurement applied in U exploration. Geophysical methods in geothermal exploration: The types of heat propagation (conduction, convection), Fourier equations, Fourier-Kirchhoff equation, heat transport in porous, isotropic formation. Radioactive heat production. Heat flow maps and their interpretation. The depth dependence of heat flow and temperature for a continental and an oceanic crust. Mantle plumes and hot spots. The role of gravity, magnetic, EM methods in geothermal exploration and the application of passive and active seismic methods. Complex case histories in geothermal energy exploration. HC exploration: HC formation, the basic geological elements of a petroleum system. Different stages of HC exploration (lead, prospect, play). The role of gravity exploration (from the torsion balance invented by R. Eötvös till ROVdog seafloor gravity) measurements in the course of HC exploration including reservoir monitoring. The application of frequency domain EM methods (MT, CSAMT, CSEM, MCSEM). Simultaneous interpretation of marine controlled source electromagnetics and marine seismic reflection. Seismic reflection method for 1D, 2D and 2D situation. Corrections, migration process, VSP, time to depth transformation. The most important seismic attributes. Geological information can be gained based on seismic sequence analysis. Information can be gained from seismic data cube (time slice, horizon slice, etc.).</p>														

University of Miskolc, Earth Science Engineering MSc
Course descriptions

Interpretation of up-to-date open hole, cased hole logging data systems, the role of production logging. Complex HC exploration case history presented by a MOL expert

Teaching methodologies:

During the semester the following tasks should be completed: presentation on a report covering the process from exploration planning to interpretation (60%), exam (40%)

The 3-5 most important compulsory, or recommended **literature** (textbook, book) **resources:**
Kearey P., Brooks M., Hill I.: An Introduction to Geophysical Exploration, Blackwell Publishing, 2002
Bacon M., Simm R., Redshaw T.: 3-D Seismic Interpretation, 2003
Serra O.: Well Logging and Reservoir Evaluation, 2007
Periodicals: Geophysical Transactions, The Leading Edge, First Break, etc.
Work-help tutorials, geophysical softwares

Competencies to evolve (relevant Learning outcomes, Appendix 1):

Knowledge: T1, T2, T3, T4, T5, T7, T8, T9

Skills: K1, K2, K3, K5, K6, K7, K8, K9, K10, K11, K12, K13

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

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

Demonstration of coherence of course content and unit's objectives:

The course goes through the key points of performance and quality assurance of geophysical prospection and exploration tasks. This is a synthesizing course for the whole master programme.

Demonstration of coherence between teaching methodologies and the learning outcomes:

During the semester the students complete a project-based tasks based on geophysical exploration data and prepare presentations on relevant topics.

Responsible Academic staff member and lecturing load (name, position, scientific degree): Dr. Takács Ernő

Other Academic Staff Involved in Teaching, if any and lecturing load (name, position, scientific degree):

University of Miskolc, Earth Science Engineering MSc
Course descriptions

Global environmental geophysics

Course Title: Global environmental geophysics		ECTS: 2												
Type of course (C/E):	Course code: MFGFT730027													
Type (lec./sem./lab./consult.) and Number of Contact Hours per Week: 1 lectures, 1 seminars														
The degree of <u>theoretical</u> or practical nature of the course: (in ECTS%)														
Type of Assessment (exam. / pr. mark. / other): exam attendance on the lectures and seminars and the solution of one personal task with presentation.														
Grading scale: <table border="0"> <tr> <td>% value</td> <td>Grade</td> </tr> <tr> <td>86 -100%</td> <td>5 (excellent)</td> </tr> <tr> <td>71 – 85%</td> <td>4 (good)</td> </tr> <tr> <td>61 - 70%</td> <td>3 (satisfactory)</td> </tr> <tr> <td>46 - 60%</td> <td>2 (pass)</td> </tr> <tr> <td>0 - 45%</td> <td>1 (failed)</td> </tr> </table>			% value	Grade	86 -100%	5 (excellent)	71 – 85%	4 (good)	61 - 70%	3 (satisfactory)	46 - 60%	2 (pass)	0 - 45%	1 (failed)
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61 - 70%	3 (satisfactory)													
46 - 60%	2 (pass)													
0 - 45%	1 (failed)													
Position in Curriculum (which semester): 3.	Pre-requisites (<i>if any</i>): -													
Course Description:														
<u>Objectives of the course:</u> Training global environmental geophysics to a level that graduated engineers can begin to work in the field of general geophysics and maintain communication with colleagues working as experts in the field of global environmental geophysics.														
<u>Course content:</u> Solar System. Zonal interior of the Sun, radiochemical transformation in it, differential rotation of the Sun, its atmosphere with processes acting on the Earth. Physical and geometrical parameters of the Sun, solar cycles. Activity of geophysical and astronomical observatories. The classification of the planets of the Solar System. The main physical, chemical and geometrical parameters of the planets. The gravitational and magnetic field of the planets. The main features of the magnetosphere of the Earth, characterization of ionosphere. Magnetic field's reversal. Different types of remanent magnetization. Composition of the Earth' interior based on seismic tomography, the most significant boundaries. Visiting Kövesligethy Radó Seismological Observatory. The zonal composition of the Earth, characterization of the zones, putting emphasis on mantle convection, liquid and solid core. Radiometric dating methods, their reliability. Radioactive heat production. Heat flux map of the Earth. Hot spots, mantle plums. Viscosity, temperature, elastic waves velocity and density in the function of depth. Focal depth determination. Magnitude definitions, energy released, intensity. Focal mechanism based on first motion studies using focal spheres. Connection between plate tectonics and earthquake mechanism. Applied monitoring technologies by CTBTO for detecting nuclear explosion. Student's .ppt presentations, questions, evaluation.														
<u>Teaching methodologies:</u> attendance on the lectures and seminars and the solution of one personal task with presentation.														
The 3-5 most important compulsory, or recommended literature (textbook, book) resources: Frank Stacey & Paul Davis: Physics of the Earth. Cambridge Univ. Press, 4. edition 2008. ISBN-10: 0521873622 William Lowrie: Fundamentals of Geophysics 2nd edition, Cambridge Univ. Press. 2007. ISBN- 13 978-0-521-85902-8 http://www.uni-miskolc.hu/~geofiz/PG_GlobenvGeophysics.pdf https://www.ctbto.org/verification-regime/monitoring-technologies-how-they-work/														
Competencies to evolve (relevant Learning outcomes, Appendix 1):														

University of Miskolc, Earth Science Engineering MSc
Course descriptions

Knowledge: T1, T2, T3, T4, T5, T6, T7, T8, T9

Skills: K1, K2, K3, K12, K13

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

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

Demonstration of coherence of course content and unit's objectives:

The course gives detailed theoretical background to understand large-scale, global geophysical processes and their investigation.

Demonstration of coherence between teaching methodologies and the learning outcomes:

Theoretical part is complemented by individual task which the student should elaborate and present during the semester

Responsible Academic staff member and lecturing load (*name, position, scientific degree*): **Dr. Pethő Gábor**, private professor gfp@uni-miskolc.hu

Other Academic Staff Involved in Teaching, if any and lecturing load (*name, position, scientific degree*):

University of Miskolc, Earth Science Engineering MSc
Course descriptions

Geoelectric lectureship

Course Title: Geoelectric lectureship		ECTS: 4												
Type of course (C/E):	Course code: MFGFT730031													
Type (lec./sem./lab./consult.) and Number of Contact Hours per Week: 2 lectures, 2 seminars														
The degree of <u>theoretical</u> or practical nature of the course: (in ECTS%)														
Type of Assessment (exam. / pr. mark. / other): exam attendance on the seminars and solution of one personal task with presentation.														
Grading scale: <table border="0"> <tr> <td>% value</td> <td>Grade</td> </tr> <tr> <td>86 -100%</td> <td>5 (excellent)</td> </tr> <tr> <td>71 – 85%</td> <td>4 (good)</td> </tr> <tr> <td>61 - 70%</td> <td>3 (satisfactory)</td> </tr> <tr> <td>46 - 60%</td> <td>2 (pass)</td> </tr> <tr> <td>0 - 45%</td> <td>1 (failed)</td> </tr> </table>			% value	Grade	86 -100%	5 (excellent)	71 – 85%	4 (good)	61 - 70%	3 (satisfactory)	46 - 60%	2 (pass)	0 - 45%	1 (failed)
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61 - 70%	3 (satisfactory)													
46 - 60%	2 (pass)													
0 - 45%	1 (failed)													
Position in Curriculum (which semester): 3.	Pre-requisites (<i>if any</i>): -													
Course Description:														
<p><u>Objectives of the course:</u> System of electrical and electromagnetic geophysical methods. Physical basics of direct current (DC) geoelectric methods. Solution of the Laplace equation in layered homogeneous isotropic half space. The geological information content and calculation of the kernel function. Hankel and the Inverse Hankel transformation. Physical basics of alternating current (AC) electromagnetic methods. Derivation of telegraph and wave equations. Information content of the wave number. Wavelength, penetration depth and propagation speed of electromagnetic waves. Characterization of dielectric, lossy and good conducting media. The zones formed around the electric and magnetic dipoles and the phase surfaces of the electromagnetic fields in the various zones. Electromagnetic field calculation of the horizontal electric dipole source in inhomogeneous anisotropic media. Electromagnetic field calculation of the vertical magnetic dipole source in inhomogeneous anisotropic media. Presentation of reports.</p>														
<p><u>Course content:</u> System of electrical and electromagnetic geophysical methods. Physical basics of direct current (DC) geoelectric methods. Solution of the Laplace equation in a layered homogeneous isotropic half space. The geological information content and calculation of the kernel function. The Hankel and the Inverse Hankel transformation. Physical basics of alternating current (AC) electromagnetic methods. Derivation of telegraph and wave equations. Information content of the wave number. Wavelength, penetration depth and propagation speed of electromagnetic waves. Characterization of dielectric, lossy and good conducting media. The zones formed around the electric and magnetic dipoles and the phase surfaces of the electromagnetic fields in the various zones. Electromagnetic field calculation of the horizontal electric dipole source in inhomogeneous anisotropic media. Electromagnetic field calculation of the vertical magnetic dipole source in inhomogeneous anisotropic media. Presentation of reports and semester closing.</p>														
<p><u>Teaching methodologies:</u> attendance on the seminars and solution of one personal task with presentation.</p>														
The 3-5 most important compulsory, or recommended literature (textbook, book) resources:														

University of Miskolc, Earth Science Engineering MSc
Course descriptions

Kearey, P., Brooks, M., Hill I., 2002: An introduction to geophysical exploration, Blackwell Science Ltd., ISBN 0-632-04929-4
Keller, G. W., Frischknecht F. C.: Electrical Methods in Geophysical Prospecting, Pergamon Press, Oxford, 1966.
Sumner, J. S.: Principles of Induced Polarization for Geophysical Exploration, Elsevier Scientific Publishing Company, Amsterdam, 1976.
Telford W. M., Geldart L. P., Sheriff R. E., 1990: Applied Geophysics. 2nd Edition. Cambridge University Press, ISBN: 0 521 32693 1
Wait, J. R.: Overvoltage Research and Geophysical Applications, Pergamon Press, London, 1959.
Periodicals: Geophysical Transactions, First Break, etc.
Other educational materials and study aids on the web page of Geophysical Department:
<http://www.uni-miskolc.hu/~geofiz>

Competencies to evolve (relevant Learning outcomes, Appendix 1):

Knowledge:

Skills:

Attitudes:

Autonomy and responsibility:

Demonstration of coherence of course content and unit's objectives:

Geoelectric lectureship is an elective subject in the geophysical engineering specialization of the Earth Science Engineering Master Program. The main goal of the specialization is to train engineers who, by developing geophysical methods and applying the

Demonstration of coherence between teaching methodologies and the learning outcomes:

The lectures of the course introduce in detail the methods included in the curriculum and their geological and mathematical-physical descriptions. In practice, students become familiar with and apply each method during field measurements. Each student ela

Responsible Academic staff member and lecturing load (name, position, scientific degree): Dr. Turai Endre, gfturai@gold.uni-miskolc.hu

Other Academic Staff Involved in Teaching, if any and lecturing load (name, position, scientific degree):

Geological mapping

Course Title: Geological mapping		ECTS: 4												
Type of course (C/E):	Course code: MFFTT720029													
Type (lec./sem./lab./consult.) and Number of Contact Hours per Week: 1 lectures, 2 seminars														
The degree of <u>theoretical</u> or practical nature of the course: (in ECTS%)														
<p>Type of Assessment (exam. / pr. mark. / other): practical mark Criterion for signature: Preparation of two geological cross-sections based on real Carpathian geological maps (from Slovakia and Romania); Preparation of covered and uncovered (without Quaternary deposits) geological map of an about 2 sq. km territory (i</p> <p>Grading scale:</p> <table> <thead> <tr> <th>% value</th> <th>Grade</th> </tr> </thead> <tbody> <tr> <td>90 -100%</td> <td>5 (excellent)</td> </tr> <tr> <td>75 – 89%</td> <td>4 (good)</td> </tr> <tr> <td>60 - 74%</td> <td>3 (satisfactory)</td> </tr> <tr> <td>45 - 59%</td> <td>2 (pass)</td> </tr> <tr> <td>0 - 44%</td> <td>1 (failed)</td> </tr> </tbody> </table>			% value	Grade	90 -100%	5 (excellent)	75 – 89%	4 (good)	60 - 74%	3 (satisfactory)	45 - 59%	2 (pass)	0 - 44%	1 (failed)
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60 - 74%	3 (satisfactory)													
45 - 59%	2 (pass)													
0 - 44%	1 (failed)													
Position in Curriculum (which semester): 2.	Pre-requisites (<i>if any</i>): -													
Course Description:														
<p><u>Objectives of the course:</u> The subject gives knowledge on the figuration of geological phenomena on topographic maps, on preparing geological maps, cross-sections, their legend and on assembling explanatory report</p> <p><u>Course content:</u> The aim of preparing geological maps. The geological map and its additional parts (geological cross-sections, stratigraphical columns and legend). Geological phenomena figured in the geological maps: lithostratigraphical units, structural characteristics. Different types of geological boundaries and their recognition on the field. Orientation on the field with topographical map and with GPS. Documentation of field observations in the field booklet and on the topographical map. Preparation of geological cross-sections. Preparation of covered and uncovered (without Quaternary deposits) geological maps with stratigraphical column and legend. Assembly of explanatory reports</p> <p><u>Teaching methodologies:</u> Criterion for signature: Preparation of two geological cross-sections based on real Carpathian geological maps (from Slovakia and Romania); Preparation of covered and uncovered (without Quaternary deposits) geological map of an about 2 sq. km territory (i</p>														
<p>The 3-5 most important compulsory, or recommended literature (textbook, book) resources: Tearprock, D.J. & Bischke, R.E. (2002): Applied Subsurface Geological Mapping with Structural Methods 2nd Edition, 846 p., Prentice Hall Hamilton, D.E. & Jones, T.A.: Computer modeling of geological surfaces and volumes. – AAPG Computer applications in geology. No.1., 589 p. Tulsa, Oklahoma McClay, K. (1995): The mapping of Geological Structures. Geolog. Soc. of London Handbook. John Wiley Sons, Chichester, New York, Brisbane, Toronto, Singapore. SURFER 8.0 Tutorial and User’s Guide. - Golden Software. P512 . Denver</p>														
Competencies to evolve (relevant Learning outcomes, Appendix 1):														
Knowledge: T1, T2, T3, T4, T5, T7, T8, T9														

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Skills: K1, K2, K3, K5, K6, K7, K9, K11, K12, K13

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

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

Demonstration of coherence of course content and unit's objectives:

Theoretical part and laboratory exercises give an overview to the students about methodology and tools of geological mapping works.

Demonstration of coherence between teaching methodologies and the learning outcomes:

After giving the theoretical basis of mapping methodology, this is a learning by doing course, where the students should complete geological mapping work in the Bükk mountains

Responsible Academic staff member and lecturing load (*name, position, scientific degree*): **Dr. Less György, full professor** foldlgy@uni-miskolc.hu

Other Academic Staff Involved in Teaching, if any and lecturing load (*name, position, scientific degree*):

University of Miskolc, Earth Science Engineering MSc
Course descriptions

Sedimentology

Geochemical prospecting methods

Course Title: Geochemical prospecting methods		ECTS: 4												
Type of course (C/E):	Course code: MFFAT720031													
Type (lec./sem./lab./consult.) and Number of Contact Hours per Week: 1 lectures, 2 seminars														
The degree of <u>theoretical</u> or practical nature of the course: (in ECTS%)														
<p>Type of Assessment (exam. / pr. mark. / other): practical mark completion of three exercises during the semester and participation in a 2-3 days field trip and completion of a sampling plan based on the field trip</p> <p>Grading scale:</p> <table> <tr> <td>% value</td> <td>Grade</td> </tr> <tr> <td>80 -100%</td> <td>5 (excellent)</td> </tr> <tr> <td>70 – 79%</td> <td>4 (good)</td> </tr> <tr> <td>60 - 69%</td> <td>3 (satisfactory)</td> </tr> <tr> <td>50 - 59%</td> <td>2 (pass)</td> </tr> <tr> <td>0 - 49%</td> <td>1 (failed)</td> </tr> </table>			% value	Grade	80 -100%	5 (excellent)	70 – 79%	4 (good)	60 - 69%	3 (satisfactory)	50 - 59%	2 (pass)	0 - 49%	1 (failed)
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0 - 49%	1 (failed)													
Position in Curriculum (which semester): 2.	Pre-requisites (<i>if any</i>): -													
Course Description:														
<p><u>Objectives of the course:</u> Introduction into a basic area of mineral exploration methods, including the theoretical background of geochemical sampling, the detailed discussion of different sampling and analytical methods, as well as the methods of data processing and interpretation. Completion of a geochemical exploration project, including field sampling, sample preparation, data processing and interpretation is an important part of the course.</p> <p><u>Course content:</u> Geochemical distribution of chemical elements in different rock types, Periodic table for geochemists Concept of the geochemical background. Geochemical delineation of a mineralization, a mineral deposit. Primary dispersion, methods of its exploration. Geochemical aspects of weathering. Geochemistry of the surface environment. Sorption processes Secondary dispersion and methods of its exploration. Sampling methods, sampling standards. Soil surveys, vegetation and water surveys. Stream sediment sampling methods, heavy minerals geochemistry. Major analytical methods. Data processing and statistical methods.</p> <p><u>Teaching methodologies:</u> completion of three exercises during the semester and participation in a 2-3 days field trip and completion of a sampling plan based on the field trip</p>														
<p>The 3-5 most important compulsory, or recommended literature (textbook, book) resources: Reedman J.H.: Techniques in mineral exploration (Appl. Sci. Publ. London, 1979) Kuzvart M. & Böhmer M.: Prospecting and exploration of mineral deposits (Elsevier, 1986) Wite W.M. (2007): Geochemistry. Online textbook, (John Hopkins University, 2007)</p>														

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Hawkes H.E.: Principles of geochemical prospecting. (US DOE, Geological survey bulletin 1000-F)
Geboj N.J.; Engle E.A. (2011): Quality Assurance and Quality Control of Geochemical Data: A Primer for the Research Scientist (USGS Open-File Report 2011-1187)
Sarkar D., Datta R., Hannigan R.: Concepts and applications in environmental geochemistry. (Elsevier, 2007)

Competencies to evolve (relevant Learning outcomes, Appendix 1):

Knowledge: T1, T2, T3, T4, T5, T7, T8, T9

Skills: K1, K2, K3, K5, K6, K7, K8, K9, K11, K12, K13

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

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

Demonstration of coherence of course content and unit's objectives:

The course content introduces the fundamental parameters of the near-surface geochemical system as well as practical skills to plan, organize, perform a geochemical prospecting campaign and interpret the resulting dataset.

Demonstration of coherence between teaching methodologies and the learning outcomes:

Students shall understand the interrelationship between different elements of the near-surface geochemical system. Practical skills are developed by a project-like exercise to compile a geochemical prospecting sampling plan of an ore field.

Responsible Academic staff member and lecturing load (name, position, scientific degree): Dr. Mádai Ferenc, associate professor askmf@uni-miskolc.hu

Other Academic Staff Involved in Teaching, if any and lecturing load (name, position, scientific degree):

University of Miskolc, Earth Science Engineering MSc
Course descriptions

Non-metallic industrial minerals

Course Title: Non-metallic industrial minerals		ECTS: 4												
Type of course (C/E):	Course code: MFFTT730030													
Type (lec./sem./lab./consult.) and Number of Contact Hours per Week: 2 lectures, 2 seminars														
The degree of <u>theoretical</u> or practical nature of the course: (in ECTS%)														
<p>Type of Assessment (exam. / pr. mark. / other): exam Lectures with .ppt presentation, laboratory exercises for sample and specimen preparation, fieldtrips, methods for data validation and documentation. Short written test. Individual data research + presentation (60-40%) in an essay. Oral examination</p> <p>Grading scale:</p> <table border="0"> <tr> <td>% value</td> <td>Grade</td> </tr> <tr> <td>90 -100%</td> <td>5 (excellent)</td> </tr> <tr> <td>76 – 89%</td> <td>4 (good)</td> </tr> <tr> <td>60 - 75%</td> <td>3 (satisfactory)</td> </tr> <tr> <td>50 - 59%</td> <td>2 (pass)</td> </tr> <tr> <td>0 - 49%</td> <td>1 (failed)</td> </tr> </table>			% value	Grade	90 -100%	5 (excellent)	76 – 89%	4 (good)	60 - 75%	3 (satisfactory)	50 - 59%	2 (pass)	0 - 49%	1 (failed)
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60 - 75%	3 (satisfactory)													
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0 - 49%	1 (failed)													
Position in Curriculum (which semester): 3.	Pre-requisites (<i>if any</i>): -													
Course Description:														
<p><u>Objectives of the course:</u> The course will allow students to gather knowledge on the non-metallic mineral resources, geological characteristics of the deposits, type and mode of the accumulations, spatial distribution and quality-quantity data of the mineral types, technological requirements, exploration, exploitation and beneficiation techniques</p> <p><u>Course content:</u> The introductory part is a short review on the geological settings and related petrological-geochemical knowledge, related non-metallic resources, industrial mineral groups. The first part dissects the grouping on genetical and industrial-application point of view mineral resources. During the semester detailed knowledge is offered on 1) native element, 2) sulphide, 3) halogenide, 4) oxide/hydroxide, 5) carbonate/nitrate, 6) borate, 7) sulphate, 8) phosphate and 9) silicate types of industrial minerals. Students get familiar with their mineralogy, deposits and formation, extraction and uses based on detailed international data. We also study the rock type industrial minerals, their generating and applications. In the case of silicates emphasis is put on clay minerals, feldspars and zeolites. Separate lecture+laboratory visit discusses the exploitation and beneficiation techniques. During the laboratory exercises and field trips students learn to recognize industrial minerals, to give mineralogical characterization, exploration and quality remarks, their natural types of occurrence.</p> <p><u>Teaching methodologies:</u> Lectures with .ppt presentation, laboratory exercises for sample and specimen preparation, fieldtrips, methods for data validation and documentation. Short written test. Individual data research + presentation (60-40%) in an essay. Oral examination</p>														
<p>The 3-5 most important compulsory, or recommended literature (textbook, book) resources: EVANS A.M. (1993) Ore Geology and Industrial Minerals: an Introduction. Blackwell Publishing, 379 p ISBN 978-0-632-02953-2 Ciulo P. A. (1996) Industrial minerals and their uses. Noyes Publication, New Jersey, 607 p https://minerals.usgs.gov/minerals/pubs/myb.html https://www.ima-europe.eu/</p>														

University of Miskolc, Earth Science Engineering MSc
Course descriptions

Competencies to evolve (relevant Learning outcomes, Appendix 1):

Knowledge: T1, T2, T3, T4, T5, T7, T8, T9

Skills: K1, K2, K3, K5, K6, K7, K8, K9, K11, K12, K13

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

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

Demonstration of coherence of course content and unit's objectives:

Students get familiar with their mineralogy, deposits and formation, extraction and uses based on detailed international data. We also study the rock type industrial minerals, their generating and applications. In the case of silicates emphasis is put on

Demonstration of coherence between teaching methodologies and the learning outcomes:

Field trips and individual exercises enhance the skills of the student and to understand the genetic conditions of formation of non-metallic deposits. During the laboratory exercises and field trips students learn to recognize industrial minerals, to give

Responsible Academic staff member and lecturing load (*name, position, scientific degree*): Dr. Kristály Ferenc, professor emeritus askkf@uni-miskolc.hu

Other Academic Staff Involved in Teaching, if any and lecturing load (*name, position, scientific degree*):

List of competences

a) Knowledge

- T1 - Understands the processes described by the general and specific theories required for the practising of the fields of earth science engineering (geologist-engineering, geophysical-engineering, geoinformatics-engineering), understands the internal connections between geological processes, and knows the planning and interpretation procedures based on the processes.
- T2 - Has a solid technical and scientific knowledge required for the high-level progress in earth sciences engineering disciplines, among others in numerical methods, technical physics and their contexts.
- T3 - Based on his/her knowledge, understands the structure of the raw material extraction sector, the technologies used for the extraction and preparation of mineral raw materials, as well as the scope of geo-environmental tasks, their external socio-economic environment and regulatory system.
- T4 - Has a thorough knowledge and understanding of the best practices applied to earth science engineering tasks and the long-term development directions that can be expected in this field in the medium term.
- T5 - Knows the problem-solving (research-planning and management) techniques of best available practices in earth sciences.
- T6 - At the application level, knows the GIS methods of computer design and analysis and the geoinformatics systems.
- T7 - Knows in detail the geological and geophysical methods suitable for exploring natural resources.
- T8 - Has a well-established knowledge of the methods of exploring mineral deposits.
- T9 - Has detailed knowledge and sound application practice on the methods of knowledge acquisition and data collection in the technical earth sciences, and on their instrumental measurement and IT data processing procedures.
- T10 - Has a well-established knowledge of the legal, economic, administrative, safety, work and fire protection, information technology and environmental protection fields related to the fields of earth science engineering.

b) Skills

- K1 - Able to apply general and specific basic and applied scientific theories within the technical earth sciences, able to systematize them, to solve independent engineering tasks (mainly complex geological prospecting, final report summarizing exploration results, geological-geophysical parts of environmental impact assessments).
- K2 - Able to convey knowledge authentically by preparing presentations and written documents in Hungarian or in a foreign language.
- K3 - Able to perform complex planning, construction, inspection and official licensing tasks (geological-geophysical exploration plans of natural resources, acquisition of environmental geology) with the innovative application of theories and terminology describing technical earth science knowledge.
- K4 - Able to review legal and economic knowledge and activities related to technical earth science tasks, to optimize connections.
- K5 - Able to actively cooperate with, organize, manage, and supervise larger and more complex activities based on or incorporating technical earth science tasks (especially mining, environmental technology investments, operations).
- K6 - Uses modern information acquisition and data collection methods.
- K7 - Able to solve technical problems requiring innovative skills in theory and practice (especially field, surface, underground data collection, measurements, and their processing and interpretation requiring innovative skills).
- K8 - Able to process raw material exploration and production data and organize it into geoinformatics databases (systems).
- K9 - Able to prospect and explore geological structures, to plan these research phases.
- K10 - Able to take quantitative and qualitative assessment of mineral resources, to evaluate their economics, to compile concession tenders and to give opinions on this type of report.
- K11 - Able to contribute to the solution of geological-geophysical tasks arising during the extraction of mineral raw materials (planning, investment, operation, closure) and to analyze the solution possibilities.

University of Miskolc, Earth Science Engineering MSc

Course descriptions

K12 - Able to review the structure of the raw materials extraction sector, the technologies used for the extraction and processing of mineral raw materials, as well as the scope of geo-environmental tasks, their external socio-economic environment and regulatory system.

K13 - Able to organize cooperation with related disciplines and manage the (working) group within the framework of larger and more complex activities based on or incorporating technical earth science tasks.

c) Competence in terms of attitude

A1 - Open and receptive to the knowledge and acceptance of professional and technological methodological developments in the fields of technical earth sciences, to the acquisition of their management, and to the participation in their development.

A2 - Actively applies innovative skills and knowledge in solving professional problems in the fields of earth science engineering.

A3 - Commits and convincingly demonstrates to knowing and adhering to the professional and ethical values.

A4 - Professionalism and professional solidarity have deepened.

A5 - Respects and follows the ethical principles and written rules of work and professional culture in activities, and is able to follow them even when managing small workgroups.

A6 - In the course of professional work, observes and adheres to the requirements of safety, health, environmental protection and quality assurance and control (SHE and QA / QC).

A7 - Has a sufficient motivation to carry out activities in often changing working, geographical and cultural circumstances.

(d) Competence in terms of autonomy and responsibility

F1 - With the in-depth knowledge of the received strategic guidelines and external environmental requirements, is able to plan the work independently, and is also suitable to lead workgroups.

F2 - Takes responsibility and is accountable for the work processes carried out under his / her control, for the employees working in them.

F3 - Makes decisions carefully, in consultation with representatives of other disciplines (primarily legal, economic, and environmental), independently, takes responsibility for decisions.

F4 - In addition to constructive teamwork, is an autonomous specialist capable of making professional decisions in the field of operation entrusted to him/her.

F5 - Committed to the practice of sustainable natural resource management, occupational health and safety

Semester 4
WUST

EIT label – Teaching units <TIMREX – T-shaped Master Programme for Innovative Mineral Resource Exploration>

Course title	Applied field exploration					
European Credits (ECTS)	3	Time (hours) given to the students			45	
Type (Lecture, internship, exercise etc.)	Lectures: , Auditorium classes: , Lab. Classes: , Project classes: , Practical classes: , Seminar classes: , Fieldwork: 3	Student whole working time (hours)			75	
Description of content	The goal of the course is that students should acquire a hands-on understanding of different field exploration methodologies, and how they can be integrated for targeting VMS deposits. Geological, geophysical and geochemical exploration methods in VMS exploration. Practical field mapping exercises in structural geology, stratigraphy, hydrothermal alteration. Practical geophysical surveying using UAV technology. GIS-based data synthesis for exploration target selection. Drill core logging and assaying.					
Learning outcomes of the curricular unit (knowledge, skills and competences to be developed by the students)	<p>Knowledge: when passed the student is expected to have:</p> <ul style="list-style-type: none"> -knowledge about different field methods and their use during an exploration program. -knowledge about drilling and sampling methods. -knowledge about different methods for field mapping. <p>Skills: when passed the student is expected to have the ability to</p> <ul style="list-style-type: none"> - acquire in-depth structural, volcanological and alteration data from outcrops in the field - contextualize field observations in relation to ore genetic model for VMS deposits. - synthesize different types of geological and geophysical data for targeting a VMS deposit. <p>Competences: ,</p>					
Assessment methods and criteria	<p>Exercises U G# 1.20 Project work G U 3 4 5 1.80 The course is mainly presented via practicals in the field, but also with complementary lectures and exercises, in addition to project work.</p>					
Recommended readings	Online compendium in Canvas room					
TU Coordinator	Nils Jansson, Nils.Jansson@ltu.se					
Contribution to EIT's Overarching Learning Outcomes (tick relevant box/es)*	OLO 1 Entrepreneurship	OLO2 Innovation	OLO3 Creativity	OLO4 Intercultural	OLO5 Value judgments / Sustainability	OLO6 Leadership

EIT label – Teaching units <TIMREX – T-shaped Master Programme for Innovative Mineral Resource Exploration>

Justification for OLO contribution	
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EIT label – Teaching units <TIMREX – T-shaped Master Programme for Innovative Mineral Resource Exploration>

Course title	SOC Internship		
European Credits (ECTS)	2	Time (hours) given to the students	30
Type (Lecture, internship, exercise etc.)	Lectures:, Auditorium classes: , Lab. Classes: , Project classes: 2 , Practical classes:, Seminar classes: , Fieldwork: x	Student whole working time (hours)	50
Description of content	<p>The aim of the course is to enable students to work in socially responsible workplaces, and apply their skills and knowledge to promote social good. While this develops them to become work-ready professionals, it also nurtures them to become advocates who help build a better world.</p> <p>EDUCATIONAL GOALS:</p> <ol style="list-style-type: none"> 1. To actively participate in the affairs of the community and in concrete actions on the ground that aim to promote the public interest, equality and solidarity. 2. To reflect on social license to operate issues 3. To work in direct contact with the beneficiaries of the civic activities undertaken e.g.: reception, facilitation, support, social assistance, etc. <p>EXAMPLES OF SOCIAL AND CIVIC ISSUES IN MINERALS INDUSTRIES:</p> <ul style="list-style-type: none"> • Depletion of natural capital (degradation of air, land and water quality), land use conflicts, health impacts • Digitalization and automation generate particular challenges for well-being in mining regions. Limited job opportunities for local workforce and skills mismatches. • High and continuous transparency and accountability standards of the industry, effective methods of information sharing and dialogue • A more equitable value-sharing, Corporate Social Responsibility issues • Facilitation of environmental awareness • Preservation and restoring of historic sites, 		
Learning outcomes of the curricular unit (knowledge, skills and competences to be developed by the students)	<p>Knowledge: to understand that social responsibility incorporates an ethical, social and environmentally-friendly perspective to our personal and professional activities</p> <p>Skills: To be able to engage in an informal professional discussion and business communication</p> <p>Competences: To cope with complexity, uncertainty and change in global contexts</p>		

EIT label – Teaching units <TIMREX – T-shaped Master Programme for Innovative Mineral Resource Exploration>

Assessment methods and criteria	Criterion: Submission of a project report					
Recommended readings						
TU Coordinator	Supervisors of the student’s Master thesis					
Contribution to EIT’s Overarching Learning Outcomes (tick relevant box/es)*	OLO 1 Entrepreneurship	OLO2 Innovation	OLO3 Creativity	OLO4 Intercultural	OLO5 Value judgments / Sustainability	OLO6 Leadership
	Students will be engaged in professional discussion and business communication				Students will be able to understand that social responsibility incorporates an ethical, social and environmentally-friendly perspective to our personal and professional activities	
Justification for OLO contribution						

Course title	Exploration entrepreneurship		
European Credits (ECTS)	4	Time (hours) given to the students	60
Type (Lecture, internship, exercise etc.)	Lectures: 1, Auditorium classes: , Lab. Classes: , Project classes: 1, Practical classes: 3, Seminar classes: 2, Fieldwork:	Student whole working time (hours)	100
Description of content	<p>To equip students with the professional skills to increase their employability and entrepreneurship skills to meet the current market demands. The EFGeoMentoring scheme aims at improving international networking and supporting the life-long learning and CPD requirements of experienced geology professionals. In addition, it allows students to benefit from insider knowledge about international work perspectives in different sectors of geological profession and countries.</p> <p>Mentoring within the course is a process during which an experienced professional with and EurGeol title (mentor) accompanies the student in a targeted way. Mentoring contributes to developing personal, entrepreneurial, networking, social and professional skills regarding the mineral prospecting and exploration activity. It allows learning from professional experiences that can only be acquired through practice and can't be found in any textbook. Mentoring improves the opportunities of career beginners by providing career-enhancing contacts and involvement in professional networks.</p> <p>At the beginning of the mentoring cooperation, students formulate clear goals and communicate them to their mentor. In consultation with the mentor, concrete topics and the respective roles within the mentoring process will be defined. Since the student is at the centre of the process, it is their task to become aware of their own plans and their support needs.</p> <p>OBJECTIVES OF THE MODULE:</p> <ul style="list-style-type: none"> • Intensify international networking among geologists all across Europe and beyond • Provide young professionals with contacts helping them to think through, plan and access their short, medium or long-term career development • Contribute on internship positions • Improve gender balance and increase diversity in leadership positions by providing targeted support to women and under-represented minorities • Facilitate life-long learning and Continuing Professional Development (CPD) <p>The EFG mentors are professionals who have acquired a high level of industrial and/or academic experience and work in industrial practice, business, academia, education or administration.</p> <ul style="list-style-type: none"> • Coaching: The mentor actively guides and encourages the student to develop essential skills and attitudes for the future ("How do I assert myself? How do I behave in negotiations? What do I do in challenging work contexts?") • Advice: The mentor advises the student in concrete situations, in current questions and difficulties. Mentors support students in solving problems and assist them in making tough decisions. 		

	<ul style="list-style-type: none"> • Help: The mentor can help open otherwise locked doors that allow the student to pursue their goals. • Support: The mentor supports the student in essential decisions without deciding. Mentors assist in the development of professional strategies, as well as in career planning and review of possible obstacles. • Inform: The mentor informs the student about (informal) rules and processes applied in organisations or professional life in general. According to the student's background, mentors can also inform about seminars or conferences that they consider helpful. • Participation: Mentors allow students to participate in parts of their professional career, experiences and strategic decisions. They allow students to share their professional life and invite them, for instance, to participate in meetings or appointments. • Give feedback: Mentor and student provide each other with constructive feedback about their appearance and public perception. • Networking: Mentors give the students hints on maintaining and using contacts. They introduce the students into active networks and provide professional contacts. The mentor provides the student with the chance to create a successful CV and take a chance on social networks such as LinkedIn.
<p>Learning outcomes of the curricular unit (knowledge, skills and competences to be developed by the students)</p>	<p>Knowledge: to provide background training to support the learning process; make students aware of broad professional issues; provide business and entrepreneurship skills to develop an awareness of business management and commercial practices regarding mineral prospecting and exploration.</p> <p>Skills: Develop relationships with other persons and maintain them. Can talk frankly about his ideas, fears and weaknesses. Identifying investment opportunities in the mineral resources sector.</p> <p>Competences: To define professional targets, wants to succeed and is actively committed to implementing these targets. Not afraid of making mistakes and experimenting with new ideas. Willing to question himself critically, accept external advice, and implement it.</p>
<p>Assessment methods and criteria</p>	<p>Practical mark</p> <p>At the end of the mentoring process, students will a) reflect their mentoring experience on a two-page report highlighting benefits and potential gaps for future implementation b) prepare a small business plan for an identified innovative idea of their own.</p> <p>Slack channel will allow for student-mentor exchange and networking within the whole cohort of participants.</p> <p>Mentoring is a one-to-one relationship between a mentor and a student.</p> <ul style="list-style-type: none"> • Mentoring takes place beyond a dependent relationship (e.g. supervisor-subordinate or professor-student relationships). • During the mentoring process, learning and experimentation occur in a protected environment. • An integral part of mentoring is the development of professional skills and competencies. <p>Mentoring is a reciprocal process of "give and take". Both sides learn from each</p>

	other because even the mentor will have the opportunity to critically question his professional perspective and discover new perspectives, software and applications, and previously unperceived situations.					
Recommend ed readings	<p>Mentoring Mindset, Skills and Tools 4th Edition: Make it easy for mentors and students, 2020, Synergetic People Development Pty Ltd, 252 pages, ISBN 0980356458</p> <p>The Mentoring Guide: Helping Mentors and Students Succeed, 2019, Michigan Publishing Services, ISBN: 1607855399.</p> <p>Wang, J., Shibayama, S., 2022. Mentorship and creativity: Effects of mentor creativity and mentoring style. Research Policy 51, 104451. doi:10.1016/j.respol.2021.104451</p> <p>Entrepreneurship: A Guide To Success For Entrepreneurs And Aspiring Entrepreneurs, 2018, ISBN 978-1720221654</p> <p>Entrepreneurship: Successfully Launching New Ventures, Global Edition, 2018, Pearson, ISBN: 9781292255330</p>					
TU Coordinator	Pavlos Tyrologou, pavlos.tyrologou@gmail.com					
Contribution to EIT's Overarching Learning Outcomes (tick relevant box/es)*	OLO 1 Entrepreneurship	OLO2 Innovation	OLO3 Creativity	OLO4 Intercultural	OLO5 Value judgments / Sustainability	OLO6 Leadership
	XX		X	XX	XX	XX
Justification for OLO contribution						

COURSE DESCRIPTIONS/ KARTY PRZEDMIOTÓW

**second-level studies/ studia II stopnia
main field of study/ kierunek studiów:
Mining and Geology/ Górnictwo I Geologia**

**specjalność/specialisation:
Mineral Resources Exploration
- Track WUST - UNI ZAGREB**

Semester 1
WUST

FACULTY OF GEOENGINEERING, MINING AND GEOLOGY

SUBJECT CARD**Name of subject in Polish ...** Geofizyka inżynierska**Name of subject in English** Engineering Geophysics**Main field of study:** Mining and geology**Specialization:** Mining Engineering,
Geotechnical and Environmental Engineering,
Geomatics for Mineral Resource Management
..... Mineral Resource Exploration**Level and form of studies:** 2nd level, full-time**Kind of subject:** obligatory**Subject code** W06GIG-SM3004....**Group of courses** NO

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15			15	
Number of hours of total student workload (CNPS)	25			50	
Form of crediting	crediting with grade			crediting with grade	
For group of courses mark (X) final course					
Number of ECTS points	1			2	
including number of ECTS points for practical classes (P)				2	
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	0,8			0,9	

*delete as not necessary

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. has knowledge of fundamentals of applied geophysics, physics and geology.
2. knows fundamentals of soil and rock mechanics.
3. is able to use MS Office software.
4. is able to work in a team.

SUBJECT OBJECTIVES

- C1 familiarize with physical phenomena in geosphere of the Earth
 C2 familiarize with engineering problems solved by means of geophysical surveying
 C3 familiarize with various geophysical surveys.
 C4 acquisition of skills to plan geophysical field surveying and to interpret its results.
 C5 development of skills to work in a group.

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge:

- PEU_W01 recognizes, names and explains engineering problems in different fields.
 PEU_W02 identifies, describes and chooses geophysical surveying methods.
 PEU_W03 analyses and assesses case studies from solving the engineering problems.

relating to skills:

PEU_U01 is able to coordinate team work, create field research plans and manage the work progress.

PEU_U02 is able to independently create solutions for complex practical problems in engineering and geoenvironmental applying knowledge about geophysical surveying, mining geophysics, utilizing modern methods in geophysical data acquisition and interpretation.

PEU_U03 is able to critically assess, process and interpreted results of the geophysical surveying and provide recommendations related to engineering problems in mining, civil engineering, engineering geology, municipal waste site, archeology, engineering properties of soil and rocks, hydrogeology, monitoring seepage in river dykes or dams.

PEU_U04 is able to solve geophysical problems.

PEU_U05 is able to conduct auto-didactical education related to detailed handling of typical software.

relating to social competences:

PEU_K01 understands the need to create and transfer to the society – among others by mass media- information and opinions related to mining engineering achievements and other activities of mining engineer; tries to transfer the information in commonly understood way, presenting different points of view; is aware of the quality and need to shape the work safety culture in mining and the responsibility for the health and life of other employees.

PROGRAMME CONTENT

Lecture		Number of hours
Lec 1	Physical properties of rocks. Inter-relationships between the various subdisciplines of applied geophysics. Overview of geophysical methods, their physical principles and applications. Methodology of geophysical surveying.	1
Lec 2	Engineering problems solved with geophysical surveying. Case studies.	2
Lec 3	Electrical resistivity methods. Tomography and VSE. IP method. Physical principles. Equipment. Methods of field surveying. Interpretation and application. Case studies.	2
Lec 4	Electromagnetic methods. FDEM and TDEM methods. Magnetotelluric methods. Physical principles. Methods of field surveying. Equipment. Interpretation and application. Case studies.	2
Lec 5	GPR surveying. Physical principles. Methods of field surveying. Equipment. Interpretation and application. Case studies.	2
Lec 6	Seismic tomography. Seismic interferometry. Physical principles. Applications. Case studies.	2
Lec 7	Mine geophysics. Seismology. Seismic methods. Active and passive seismic tomography. Microgravimetry. Case studies.	2
Lec 8	Gravity and magnetic surveying. Equipment. Methods of field surveying. Interpretation and application. Case studies.	2
	Total hours	15
Project		Number of hours

Proj 1	One selected geophysical technique. Fundamentals and equipment. Field surveying	4
Proj 2	Processing and interpretation of field data.	3
Proj 3	Solving the geophysical problems.	8
	Total hours	15

TEACHING TOOLS USED

N1. N1.Lecture aided by presentation.
N2.Demonstration.
N3.Discussion and consultations
N3Calculations
N5Practical field surveying

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT

Evaluation (F – forming during semester), P – concluding (at semester end)	Learning outcomes code	Way of evaluating learning outcomes achievement
P1	W01-W03	Test related to lecture content. Final grade.
F1	U01-U02, U05	Test. Project 1. Report on Project 1
F2	U03, U05	Test. Project 2. Report on Project 2
F3	U04, U05	Test. Solving geophysical problems
F1-F3, P2	U01-U05 K02	Grades are given for each of three project tasks including tests and reports. The final grade P2 for the project course is the weighted average grade of F1-F3.

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

- [1] Aki, K., Richards P.G., 1980. Quantitative Seismology: Theory and Methods. W.H. Freeman Co.. San Francisco.
- [2] Burger, H.R., Sheehan, A.F., Jones, C.H., 2006. Introduction to Applied Geophysics: Exploring the Shallow Subsurface. W.W. Norton & Company, Inc.
- [3] Mendecki, A.J. (ed.), 1997. Seismic Monitoring in Mines. Chapman & Hall.
- [4] Reynolds, J.M., 2011. An Introduction to Applied and Environmental Geophysics. Wiley – Blackwell. John Wiley & Sons.
- [5] Sharma, Prem V., 2002. Environmental and engineering geophysics. Cambridge University Press.
- [6] Torge, W., 1989. Gravimetry. Water de Gruyter. Berlin. New York.
- [7] Selected Journal Publications (for example journals: Progress in Geophysics, Engineering Geophysics Journal, Environmental and Engineering Geophysics, Journal of Geophysics and Engineering, Pure and Applied Geophysics).

SECONDARY LITERATURE:

- [1] Lowrie, W., 2007. Fundamentals of Geophysics. Cambridge University Press.
- [2] Milsom, J., 2003. Field Geophysics. John Wiley & Sons Ltd.
- [3] Telford, W.M., Geldart, L.P., Sheriff, R.E., 1990. Applied Geophysics. Cambridge University Press.

SUBJECT SUPERVISOR (NAME AND SURNAME, E-MAIL ADDRESS)

ANNA BARBARA GOGOLEWSKA, anna.gogolewska@pwr.edu.pl

FACULTY OF GEOENGINEERING, MINING AND GEOLOGY SUBJECT CARD	
Name of subject in Polish Wspomagane komputerowo modelowanie geologiczne i geostatystyka.)	
Name of subject in English: Computer Aided Geological Modelling and Geostatistics	
Main field of study (if applicable): Górnictwo i geologia.	
Specialization (if applicable): Mining Engineering, Geotechnical and Environmental Engineering, Geomatics for Mineral Resource Management Mineral Resource Exploration	
Profile: academic	
Level and form of studies: 2nd level, full-time	
Kind of subject: obligatory	
Subject code	W06GIG-SM3002
Group of courses	No

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15		45		
Number of hours of total student workload (CNPS)	50		75		
Form of crediting	crediting with grade	Examination / crediting with grade*	crediting with grade	Examination / crediting with grade*	Examination / crediting with grade*
For group of courses mark (X) final course					
Number of ECTS points	2		3		
including number of ECTS points for practical classes (P)			3		
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	0,8		1,9		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Mathematical Statistics,
2. Fundamentals of Geology and Mineral Deposits

SUBJECT OBJECTIVES

- C1 Developing basic skills in computer modelling of 3-D objects.
 C2 Introduction of the principles of digital modelling of typical geological structures.
 C3 Introduction to the methods of deposit parameters estimation and resources evaluation.

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge:

PEU_W01 Estimation methods, principles of geostatistics, kriging estimators

PEU_W02 Geostatistical modelling of the selected deposit parameters (domain analysis, variogram modelling,

PEU_W03 Creating and validating 3-D models of various geological structures in the comprehensive dedicated software environment.

relating to skills:

PEU_U01 Application of relevant estimation methods for quality modelling of a deposit

PEU_U02 Evaluating 3-D objects against structural and quality block models (volumes, tonnages, grades)

PEU_U03 Describing the interpretation and applied approach, creating models, evaluation results, recommendations for possible enhancements

relating to social competences:

PEK_K01 The student can think and act in a creative and enterprising way

PROGRAMME CONTENT

Lecture		Number of hours
Lec 1	Introduction to the course. Geological database and validation of the geological data.	2
Lec 2	Geology of the seam.	2
Lec 3	Structural model of the stratified deposit. Methods of the prediction of the surface layer parameters.	2
Lec 4	Spatial distribution of samples values. Regionalized variable.	2
Lec 5	BLUE Estimator of the mean value: Kriging.	2
Lec 6	Quality model of the deposit – block model of the parameter layers. Estimation and evaluation of the block model.	2
Lec 7	Reserves modelling and evaluation.	2
Lec 8	Mineral resources. International reporting. The JORC Code	1
	Total hours	15

Laboratory		Number of hours
La1	Determining the rules of work at the laboratory.	3
La2	Assignment of the individual dataset for the exercises and creating initial data files.	3
La3	Data validation and creating initial geological database.	3
La4	Construction of the structural wireframe model of stratigraphy layers.	3
La5	Construction of the block model of the deposit and overburden layers. Thickness and stripping ratio analysis.	3
La6	Data preparation to geostatistical analysis. Compositing of the samples.	3
La7	Domain analysis with the use of the statistical methods.	3
La8	Determination of the empirical variogram. Anisotropy analysis.	3
La9	Variogram modelling.	3
La10	Kriging Neighborhood Analysis - defining optimal parameters of the	3

	estimation procedure.	
La11	Estimation of quality parameters in block model of the deposit layers. Validation of the estimation quality.	3
La12	Validation of the quality model and classification of the resources. Balance resources evaluation.	3
La13	Preparation of data for continuous surface mining ultimate pit design. Ultimate pit outlines generation	3
La14	Wireframe and block modelling of the ultimate pit	3
La15	Reserves evaluation, visualization and interrogation of created models	3
	Total hours	45

TEACHING TOOLS USED

N1. Form of lectures - traditional, multimedia presentations using specialized software and demonstrations of its application "live", individual development of specialist topics covered during the lecture,
N2. individual development of project tasks within the laboratories frames, individual development of electronic reports concerning project tasks within the laboratories frames,
N3. evaluation of laboratory tasks reports with multipoint grade of student's work, group analysis of the results obtained during laboratory tasks; preparation of conclusions concerning data dependencies and constraints of mining projects, skill control tests, duty hours in laboratory.

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT

Evaluation (F – forming during semester), P – concluding (at semester end)	Learning outcomes code	Way of evaluating learning outcomes achievement
F1	PEU_W01, PEU_W02	Lecture grade on the basis of the written examination
F2	PEU_W03,	Laboratory task assessment: “structural modelling assessment
F3	PEU_U01	Laboratory task assessment: “geostatistical modelling”
F4	PEU_U02, PEU_U03	Laboratory task assessment: “reserves evaluation”.
P average of F1, F2, F3, F4		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

- [1] M. Armstrong, Basic Linear Geostatistics, Springer Verlag, 1998.
- [2] P. Goovaerts: "Geostatistics for Natural Resource Evaluation", Oxford University Press, 1997.
- [3] R. H. Grishong, Jr., 3-D Structural Geology, Springer Verlag, 2008
- [4] K. Hefferan, J. O'Brien, Earth materials, Willey-Blacwell, Chichester U.K., 2010
- [5] W. Hustrulid, M. Kuchta, Open pit mine planning and design. Chapter 3. Orebody description, Taylor&Francis, 2013.
- [6] A. G. Journel, and C.J. Huijbregts, Mining Geostatistics, Academic Press, 1978.
- [7] Ch.C. Plummer, D.H. Carlson, L. Hammersley, Physical geology, McGraw-Hill I.E. N.Y. 2010
- [8] D.R. Prothero, R.H. Dott Jr., Evolution of the Earth, McGraw-Hill I.E. N.Y., 2010
- [9] M.W. Rossi, C.V. Deutsch, Mineral Resources Estimation, Springer Verlag 2014.

SECONDARY LITERATURE:

- [10] Handouts, tutorials.

SUBJECT SUPERVISOR (NAME AND SURNAME, E-MAIL ADDRESS)

Dr inż. Krzysztof Hołodnik
Dr inż. Witold Kawalec

FACULTY OF GEOENGINEERING, MINING AND GEOLOGY	
SUBJECT CARD	
Name in Polish:	Cyfrowa kopalnia
Name in English:	Digital Mine.....
Main field of study:	Mining and geology
Specialization:	Mining Engineering, Geotechnical and Environmental Engineering, Mineral Resource Exploration
Level and form of studies:	2nd level, full-time
Kind of subject:	obligatory
Subject code:	W06GIG-SM3006
Group of courses:	No

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15		15		
Number of hours of total student workload (CNPS)	25		25		
Form of crediting	crediting with grade		crediting with grade		
For group of courses mark (X) final course					
Number of ECTS points	1		1		
including number of ECTS points for practical (P) classes			1		
Including number of ECTS points for direct teacher-student contact (BK) classes	0,8		0,8		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Computer literacy skills
2. Basic knowledge related to Mining Engineering and Mineral Processing
3. Programming

SUBJECT OBJECTIVES

- C1. Acquisition of the ability to create utility applications in the C / C ++ and LabVIEW environment
- C2. Providing students with knowledge about embedded systems, their construction, selection of components, designing, programming and their exploitation.
- C3. Familiarizing with the advances of technology & methods of future mining operations.
- C4. Acquisition and consolidation of social competencies including emotional intelligence skills involving the cooperation in the group of students aiming to effectively solve problems.
- Responsibility, honesty and fairness in the proceedings; observance force in academia and society

SUBJECT EDUCATIONAL EFFECTS**relating to knowledge:**

PEU_W01 A student has knowledge related to automation systems, control systems and measurement systems in various aspects of the mining industry.

PEU_W02 The student has knowledge of the importance of automation and robotics systems in modern mining.

relating to skills:

PEU_U01 A student is able to select and integrate elements of a specialized measuring and control system including: control unit, executive system, measuring system as well as peripheral and communication modules

PEU_U02 A student can design improvements in the existing design solutions for automation and robotics components and systems

relating to social competences:

PEU_K01 A student is aware of the need for a professional approach to technical issues, meticulous reading of documentation and knows environmental conditions in which devices and their components can function

PEU_K02 The student has knowledge concerning the benefits of creation and implementation new solutions&technologies into mining industry

PROGRAMME CONTENT		
Form of classes - lecture		Number of hours
Lec 1	Terminology (process, automation, robots, measurement devices, control systems). Definition of digital mine	2
Lec 2	Aims, benefits, drawbacks of automation. Industrial revolutions. Definition of industry 4.0. Overview of components of the 4th industrial revolution. Industry 4.0 and mining	2
Lec 3	Elements of technological process in mining. Automation of cyclic processes Measuring technologies in industry 4.0. Sensors systems. Data transmission and data storage technologies. Analytics in industry 4.0. Industrial BigData, Cloud Computing	2
Lec 4	Industrial Internet of Things. M2M communication, anti-collision systems, location of people underground	2
Lec 5	Virtual and augmented realities for industry. Simulators. Digital Twin. Digital models of processes and objects. Management information creation systems, reporting	2
Lec 6	Case study: Automation in open pit lignite mining (KTZ, Autonomous haulage (use case from Australia))	1
Lec 7	Case study: underground mine (Rock Vader – Sandvik project, other use cases from Sandvik, Epiroc, MineMaster, Zanam, AOT from ZGPS KGHM, KIC project on shaft inspection, ... etc)	2
Lec 8	Case study: mineral processing (ConVis, FlowVis) in KGHM, OPMO project	2
Total hours		15

Form of classes - laboratory		Number of hours
Lab1	Scope of the course, teaching purpose, crediting conditions, literature, data. Introduction to ARDUINO	3
Lab2	Basic sensors for physical parameters measurements	3
Lab3	Measurements in Labview	3
Lab4	Analysis and Visualization in Labview	3
Lab5	Control in labview	3
	Total hours	15

TEACHING TOOLS USED
<p>N1. Type of lectures - traditional, illustrated with multimedia presentations with the usage of audio- visual equipment.</p> <p>N2. Discussion concerning lectures and laboratory.</p> <p>N3 Configuration on laboratory classes measuring systems (hardware and software), performing of measurements, teamwork</p> <p>N4. Projects defence - oral and written form.</p> <p>N5. Duty hours.</p>

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT

Evaluation (F – forming (during semester), P – concluding (at the end of semester))	Educational effect number	Way of evaluating educational effect achievement
F1, P1	PEK_U02- PEK_U04	<p>F1.1 Grade from laboratory work's performance and its merits</p> <p>F.1.2 Grade from laboratory work's oral or written defence</p> <p>P1.Final grade (weighted average of F1.1 - 60% and F1.2 - 40%).</p>
F2, P2	PEK_U02- PEK_U04	<p>F2.1 Grade from activity during the lecture (questions, discussions etc)</p> <p>F.2.2 Grade from written exam</p> <p>P2.Final grade (weighted average of F2.1 - 20% and F2.2 - 80%).</p>

LITERATURE

PRIMARY LITERATURE:

- [1] LabVIEW™ Getting Started with LabVIEW
<http://www.ni.com/pdf/manuals/373427j.pdf>
- [2] Monk Simon: Arduino dla początkujących. Podstawy i szkice, Anderson R., Cervo D., Helion, 2018
- [3] Monk Simon: Arduino dla początkujących. Kolejny krok, Anderson R., Cervo D., Helion, 2015

ONLINE LITERATURE:

- [1] LabVIEW Tutorial
- [2] ARDUINO Tutorial
- [3] Materials prepared by Tutor
- [4] Internet websites

SUBJECT SUPERVISOR (NAME AND SURNAME, E-MAIL ADDRESS)

**Prof. dr hab. inż. Radosław Zimroz, radoslaw.zimroz@pwr.edu.pl
dr inż. Anna.Nowak-Szpak**

FACULTY OF GEOENGINEERING, MINING AND GEOLOGY

SUBJECT CARD

Name in Polish: Zarządzanie Środowiskiem
Name in English: Environmental Management
Faculty of studies (if applicable): Mining and Geology
Specialisation (if applicable): Mining Engineering
 Mineral Resource Exploration
Level and form of studies: 2nd level, full-time
Subject Type: Obligatory
Subject code: W06GIG-SM3001
Group of courses: No

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in the University (ZZU)	30				15
Number of hours of total student workload (CNPS)	50				25
Form of crediting	Crediting with grade				Crediting with grade
For a group of courses mark (X) for the final course					
Number of ECTS points	2				1
including number of ECTS points for practical (P) classes					
including number of ECTS points for direct teacher-student contact (BU) classes	1,3				0,8

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge of issues related to ecology and environmental protection.

SUBJECT OBJECTIVES

- C1. To get students acquainted with systems of environmental management both in Poland and other EU countries.
- C2. To prepare students for rational and sustainable management of environmental components.
- C3. To get students acquainted with the genesis of environmental management systems in Poland, review and standardization of environmental management systems.
- C4. To get students acquainted with benefits and obligations arising from the implementation of an environmental management system.
- C5. To present the relationship between an environmental management system and a quality

management system.

C6. To provide an overview of informative methods of supporting the implementation of environmental management systems (possibilities and practical usage of computerised systems of environmental information management, decision support in the area of environmental protection and choice of methods and tools used to support the implementation of an environmental management system).

SUBJECT LEARNING OUTCOMES

relating to knowledge:

PEU_W01 – Possesses systematic knowledge of the origins of environmental management systems, review and standardization of environmental management systems.

PEU_W02 - Possesses knowledge of the possibilities and practical applications of tools supporting the implementation of the environmental management system.

PEU_W03 - knows basic formal and legal regulations regarding the implementation and functioning of management systems, tools and instruments of environmental management.

PEU_W04 - Possesses knowledge for rational and sustainable management of environmental components.

relating to skills:

PEU_U01 – Possesses linguistic resources appropriate for specialised language and is able to use it in linguistic activities in order to communicate in the professional environment regarding the field of studies; is able to obtain necessary information and interpret and critically evaluate it, reads and understands professional literature, is able to formulate and comprehensively justify opinions, provide presentations of problems related to a studied discipline and also participate in scientific and professional discussions.

PEU_U02 – Is able to use methods and appropriate IT tools in system management of environmental components.

relating to social competencies:

PEU_K01 - Is able to think and act in a creative and enterprising way.

PROGRAMME CONTENT

Form of classes - lecture		Number of hours
Lec.1	Basic concepts: - Environment, characteristics of individual elements of the environment - Characteristics of hazards for the natural environment which are a result of human activities - Environmental Management - The Environmental Management System	2
Lec.2	Legal aspects of environmental management	2
Lec.3	History and development of environmental management systems	2
Lec.4	Environmental management systems:	6
Lec.5	- Business Charter for Sustainable Development of the International	
Lec.6	Chamber of Commerce - ICC Business Charter for Sustainable	

	<p>Development</p> <ul style="list-style-type: none"> - EMAS – Directive of the European Community Commission regarding the approval for voluntary participation by organisations in a community eco-management and eco-audit scheme - CP - Clean Production - BS 7750 - Specification for Environmental Management Systems - ISO 9000 - ISO 14000 - ISO 14001 <p>Characteristics of selected Environmental Management Systems. The benefits of the implementation of the EMS for a company. Experiences of Polish enterprises from the implementation of EMS. Process of implementation of the selected EMS in a company with an example of EMAS.</p>	
Lec.7 Lec.8	<p>Basic tools of environmental management:</p> <ul style="list-style-type: none"> - Legal and administrative instruments (laws, standards, licenses and permits) - Economic instruments (fees, taxes, deposit and refund systems, transferable rights, subsidies, liens, fines) - Instruments (techniques) social impact (ecological education, ecological propaganda) <p>Examples of basic tools of environmental management:</p> <ul style="list-style-type: none"> - Procedure for an assessment of environmental impact - Integrated permits - Audits - Safety Reports - Monitoring of the Environment 	4
Lec.9 Lec.10	Design of an environmental management system	4
Lec.11 Lec.12	<p>IT systems supporting environmental management:</p> <ul style="list-style-type: none"> - Decision Support Systems - Expert systems - Simulation Models - Geographical Information Systems <p>Selected types of information systems which support environmental management, their characteristics, examples of implementation both in Poland and in the world</p>	4
Lec.13	The benefits of an implemented and functioning environmental management system	2
Lec.14	Costs of implementation and functioning of an environmental management system	1
Lec.14 Lec.15	Environmental management systems in practice	3
	Total hours	30
Form of classes - seminar		Number of hours
Se1	The scope and form of an essay and presentation, terms of crediting and literature.	2

	Assignment of seminar topics for individual students.	
Se2	Student speeches with the use of multimedia presentations on the following issues: environmental management systems - specified examples, formal and legal conditions of administrative procedures (eg. receiving a decision on the environmental conditions of a project, an integrated decision etc.), life-cycle analysis of a selected company; fees, taxes, surcharges and environmental deposits; litter management systems, mineral resource management, renewable energy sources, selected monitoring systems, the institution of environmental protection in Poland and in the world and also alternative energy sources, etc. Group discussion on the content and form of speeches.	13
Se3		
Se4		
Se5		
Se6		
Se7		
Se8		
	Total hours	15

TEACHING TOOLS USED

- N1. Informative lecture with elements of problematic lectures.
N2. Multimedia presentations
N3. Didactic discussion during lectures and seminars
N4. Preparation of an essay in the form of a report
N5. Presentation of the essay
N6. Consultations

EVALUATION OF SUBJECT EDUCATIONAL OUTCOME ACHIEVEMENTS

Evaluation F – forming (during semester), P – concluding (at semester end)	Educational outcome number	Method of evaluating educational outcome achievement
F1- Grade from content value of an essay	PEU_U01 PEU_U02 PEU_K01	Text and graphical form of essay
F2 – Grade from presentation and issues included in an essay	PEU_U01 PEU_U02 PEU_K01	Presentation of essay
F3 – Grade from a written or oral test	PEU_W01 PEU_W02 PEU_W03 PEU_W04	Positive grade
final grade from the subject (the weighted average, respectively: 35% for the substantive content of the essay, 25% for the presentation, 40% for the lecture)		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

- [1] Ejdys J., 1998, Zarządzanie środowiskowe w przedsiębiorstwie – koszty i korzyści, Sterowanie ekorozwojem, t.2, Wyd. Politechniki Białostockiej, Białystok,
- [2] Lukashev A. F., Droste R. L., Warith M. A., 2001, Review of Expert System (ES), Geographic Information System (GIS), Decision Support System (DSS), and their applications in landfill design and management. W: Waste Management & Research nr 19,
- [3] Łunarski J. (red.), 2002, Zarządzanie środowiskiem”, Oficyna Wydawnicza Politechniki Rzeszowskiej, Rzeszów
- [4] Nowak Z., 2001, Zarządzanie środowiskiem, Wyd. Politechniki Śląskiej, Gliwice,
- [5] Matuszak-Flejszman A., 2001: Jak skutecznie wdrożyć system zarządzania środowiskowego wg normy ISO 14001. PZLiTS, Poznań
- [6] Pochyluk R. i inni, 1999, Zasady wdrażania systemu zarządzania środowiskowego zgodnego z wymaganiami normy ISO 14001, Eco-Konsult, Gdansk,
- [7] Poskrobko B., Poskrobko T., 2012, Zarządzanie środowiskiem w Polsce, Polskie Wydawnictwo Ekonomiczne, Warsaw
- [8] Poskrobko B., 1998: Zarządzanie środowiskiem. Polskie Wydawnictwo Ekonomiczne, Warsaw
- [9] Przybyłowski P. (red.), 2005, Podstawy zarządzania środowiskowego, Wyd. Akademii Morskiej, Gdynia.

SECONDARY LITERATURE

- [1] Jeżowski P. (red.), 2007: Ekonomiczne problemy ochrony środowiska i rozwoju zrównoważonego w XXI wieku. Szkoła Główna Handlowa, Warsaw
- [2] Lemański J. F., Matuszak-Flejszman A., Zabawa S. (red.), 2000: Efektywność funkcjonowania wdrożonego systemu zarządzania środowiskowego wg normy ISO 14001. PZLiTS, AE, Poznań – Pila
- [3] Websites given during lectures and seminars

SUBJECT SUPERVISOR (NAME AND SURNAME, E-MAIL ADDRESS)

Dr hab. inż. Justyna Woźniak
Dr hab. Inz. Katarzyna Pactwa,
Dr inż. Danuta Szyszka

<p>FACULTY OF GEOENGINEERING, MINING AND GEOLOGY SUBJECT CARD</p> <p>Name of subject in Polish Bezpieczeństwo i higiena pracy Name of subject in English: Occupational Health and Safety Main field of study (if applicable): Górnictwo i geologia. Specialization (if applicable): Mining Engineering, Geotechnical and Environmental Engineering, Mineral Resource Exploration</p> <p>Profile: academic Level and form of studies: 2nd level, full-time Kind of subject: obligatory Subject code W06GIG-SM3005 Group of courses No</p>
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	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15			15	
Number of hours of total student workload (CNPS)	25			25	
Form of crediting	crediting with grade			crediting with grade	
For group of courses mark (X) final course					
Number of ECTS points	1			1	
including number of ECTS points for practical classes (P)				1	
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	0,7			0,8	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Possesses basic knowledge of technologies used in open-pit mines and underground mines.
2. Is able to use Microsoft Office environment to prepare documents in Word, multimedia presentations in Power Point and work with Excel spreadsheets.
3. Is able to identify harmful, dangerous and nuisance factors in the workplace environment.

SUBJECT OBJECTIVES

- C1. To introduce the principles of occupational risk assessment in accordance with relevant standards
- C2 To present the principles of occupational risk assessment and the determination of admissibility with the use of STER software and the RISC SCORE method.

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge:

PEU_W01 Possesses general knowledge of rules of occupational risk assessment formulation

PEU_W02 – Possesses knowledge of evaluating and determining the admissibility of occupational risk.

PEU_W03 – Possesses general knowledge of corrective and preventive actions regarding hazards of typical work posts in the mining industry....

relating to skills:

PEU_U01 Is able to identify hazards of harmful, dangerous and nuisance factors of typical work posts in the mining industry

PEU_U02 Is able to estimate and determine risk acceptability with methods according to STER software and the RISC SCORE method.

PEU_U03 - Is able to plan corrective and preventive actions for hazards of typical work posts in the mining industry....

relating to social competences:

PEU_K01 - Is able to work in a team and together complete occupational risk assessment and develop its results and the required documentation in the form of a team report

PROGRAMME CONTENT

Lecture		Number of hours
Lec 1	Definition of occupational risk. Legal basics of occupational risk assessment. Risk assessment methods. Course of occupational risk assessment. Information necessary for occupational risk assessment. Identification of harmful, dangerous and nuisance factors in the work environment.	3
Lec 2	Estimation of occupational risk assessment and determination of admissibility. Corrective and preventive actions. Familiarising employees with the results of occupational risk assessment. Implementation of agreed corrective and preventive actions. Monitoring the effectiveness of implemented actions. Periodic occupational risk assessment. Harmful factors – identification and assessment of risks.	3
Lec 3	Dangerous factors - identification and assessment of risks.	3
Lec 4	Nuisance factors in occupational risk assessment: psychological burden, static burden, monotony.	3
Lec 5	Methods of occupational risk assessment: STER software, the RISC SCORE method, written test	3
	Total hours	15

Project		Number of hours
Pr1	Occupational risk assessment with the use of STER software for two work posts – description of work post, identification of hazards. Occupational risk assessment with the use of STER software for two work posts – estimation of occupational risk and determination of admissibility of harmful factors (dust, noise)	3
Pr2	Occupational risk assessment with the use of STER software for two work posts – estimation of occupational risk and determination of admissibility of	3

	harmful factors (vibration, chemical agents)	
Pr3	Occupational risk assessment with the use of STER software for two work posts – estimation of occupational risk and determination of admissibility of dangerous factors (slippery or uneven surfaces, falling elements, moving parts, moving machinery and transported items)	3
Pr4	Occupational risk assessment with the use of STER software for two work posts – estimation of occupational risk and determination of admissibility for nuisance factors (psychological burden, static burden, monotony)	3
Pr 5	Occupational risk assessment for a selected work post with the use of the RISC SCORE method, presentation of executed exercises, test	3
	Suma godzin	15

TEACHING TOOLS USED

N1. Informative lecture with elements of problematic lectures.
 N2 Multimedia presentations.
 N3 Didactic discussions during lectures.
 N4 Didactic discussions during laboratory classes.
 N5 Computer presentation of executed occupational risk assessments.
 N6 Consultation.

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT

Evaluation (F – forming during semester), P – concluding (at semester end)	Learning outcomes code	Way of evaluating learning outcomes achievement
F1	PEU_W01-W03	grade from a test
F2	PEU_W01-W03 PEU_U01- U03	grade from a presentation
P2	PEU_W01-W03 PEU_U01- U03	final grade from project classes (arithmetic average of F1 and F2)

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

- [1] Occupational Safety and Health in Mining. Anthology on the situation in 16 mining countries. Ed.: Kaj Elgstrand and Eva Vingård. University of Gothenburg nr 2013;47(2) ([gupea.ub.gu.se > bitstream > gupea_2077_32882_1](http://gupea.ub.gu.se/bitstream/gupea_2077_32882_1))
- [2] Boyle, Tony: Health and safety: Risk management. IOSH, 2001. (<http://www.iosh.co.uk/index.cfm?go=publications.main>)
- [3] Encyclopaedia of occupational health and safety. Fourth edition Stellman, Jeanne M. (ed.). International Labour Organization, 1998 (<http://www.ilo.org/public/english/support/publ/xtextre.htm#b103>)
<http://www.ilo.org/public/english/support/publ/encyc/>)
- [4] McKeown, Céline; Twiss, Michael: Workplace ergonomics: A practical guide, IOSH, 2001, 160 p. <http://www.iosh.co.uk/index.cfm?go=publications.main>

SECONDARY LITERATURE:

Handouts, articles

OPIEKUN PRZEDMIOTU (IMIE, NAZWISKO, ADRES E-MAIL)

Dr inż. Żaklina Konopacka

FACULTY OF GEOENGINEERING, MINING AND GEOLOGY

SUBJECT CARD**Name in Polish: Modele Decyzyjne w Zarządzaniu****Name in English: Operations Research****Main field of study (if applicable): Mining and Geology****Specialization (if applicable): Mining Engineering,
Mineral Resource Exploration****Level and form of studies: 2nd, full-time****Kind of subject: obligatory****Subject code: W06GIG-SM3000****Group of courses: NO**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15		15		
Number of hours of total student workload (CNPS)	25		50		
Form of crediting	crediting with grade		Crediting with grade		
For group of courses mark (X) final course					
Number of ECTS points	1		2		
including number of ECTS points for practical (P) classes of practical character (P)			2		
including number of ECTS points for direct teacher-student contact (BU) classes	0,8		0,7		

*delete as applicable

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. The student has basic knowledge of mining systems, technological and organizational systems in mining
2. The student has basic knowledge concerning economics in mining
3. The student has basic knowledge concerning mathematical analysis necessary to understand mathematical issues in science having engineering and economic character.
4. The student has basic knowledge and skills of using probability theory models and mathematical statistics
5. The student can use Excel spreadsheet
6. The student understands the need and knows the possibilities of lifelong learning, improving professional, personal and social skills

SUBJECT OBJECTIVES

C1 Acquiring basic knowledge, taking into consideration its applicational aspects concerning mathematical decision models used in management:

C1.1 Linear programming models

<p>C1.2 Models of planning, deposits and costs of projects</p> <p>C1.3 Queuing system models</p> <p>C1.4 Digital simulation models</p> <p>C2. Learning of qualitative understanding, interpretation and quantitative analysis with applications of selected issues concerning optimization</p> <p>C2.1. Production systems:</p> <p>C2.2. Transport issues</p> <p>C2.3. Flows in networks.</p> <p>C2.4. Project schedules</p> <p>C2.5. Queuing system models</p> <p>C3. Acquiring and consolidating the competencies of thinking and acting in a system way.</p>

SUBJECT LEARNING OUTCOMES	
Subject educational effect (knowledge)	
PEU_W01	The student has knowledge concerning basic decision models in management
PEU_W02	The student has knowledge concerning line programming models.
PEU_W03	The student has knowledge concerning models for planning and monitoring of activities, deposits, and costs of projects
PEU_W04	The student has knowledge concerning queuing system models
PEU_W05	The student has knowledge concerning simulation models.
Subject educational effect (skills)	
PEU_U01	The student has the ability to apply and interpret models using linear programming applications
PEU_U02	The student has the ability to apply and interpret models of planning and monitoring of activities, deposits, and costs of projects with the use of programming applications
PEU_U03	The student has the ability to apply and interpret queuing system models using programming applications
PEU_U04	The student has the ability to apply and interpret simulation models using programming applications
Subject educational effect (social)	
PEU_K01	The student can think and act in a system, creative and enterprising way
PEU_K02	The student is able to identify and solve problems with the use of decision models and applications

PROGRAMME CONTENT		
Form of classes - lecture		Number of hours
Le1	Introduction to modelling systems	2
Le2	Linear programming issues - optimization of production	2
Le3	Linear programming issues - flow in networks optimization (optimal allocation issues, the issue of transportation, maximum flow, minimizing costs)	2
Le4	Projects scheduling using critical path	2
Le5	Planning and balancing of deposits in projects	2
Le6	Optimization issues of queuing systems	2
Le7	Monte Carlo methods and digital simulation	3
Total hours		15

Form of classes - laboratory		Number of hours
La1	Defining and solving linear programming issues (Microsoft Excel-Solver)	2
La2	Production optimization (Microsoft Excel - Solver)	2
La3	Flows in networks optimization (Microsoft Excel - Solver)	2
La4	Projects scheduling (Microsoft Project)	2
La5	Planning and balancing of deposits in projects (Microsoft Project)	2
La6	Optimization issues of queuing systems (Microsoft Excel)	2
La7	Elements of Monte Carlo methods and digital simulation (Microsoft Excel)	3
Total hours		15

TEACHING TOOLS USED
N1. Interactive lecture with slides and discussion
N2. Laboratory exercises with the use of IT applications - discussion concerning solutions
N3. Laboratory exercises - short written tests (calculating tasks, tests of knowledge)
N4. Duty hours
N5. Own work - preparation for laboratory classes, solving additional tasks
N6. Own work - own literature studies.

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT

Evaluation (F – forming (during semester), P – concluding (at the end of semester))	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01-04	short written test.
PEU_U01-04 written test (counting exercise)		
PEU_W01-05; PEU_K01-02 Written test (knowledge test)		

PRIMARY AND SECONDARY LITERATURE
<u>PRIMARY LITERATURE</u>
[1] Ignasiak E., Borucki W., Badania operacyjne, PWE, 2001
[2] Krawczyk S., Badania operacyjne dla menedżerów, PWE
[3] Baranowska B, Badania operacyjne w zarządzaniu, PWSBIA, 1996
<u>SECONDARY LITERATURE</u>
[1] Szapiro T., Decyzje menedżerskie z Excelem, PWE 2000
[2] Trzaskalik T., Modelowanie optymalizacyjne, Absolwent
[3] Trzaskalik T., Badania operacyjne z komputerem, PWE
<u>SUBJECT SUPERVISOR (NAME AND SURNAME, E-MAIL ADDRESS)</u>
Dr inż. Witold Kawalec
Dr hab. inż. Leszek Jurdziak
Dr inż. Zbigniew Krysa

FACULTY OF GEOENGINEERING, MINING AND GEOLOGY

SUBJECT CARD**Name of subject in Polish ... Zarządzanie projektami, ocena ich opłacalności i ryzyka..****Name of subject in English: Project Management, Appraisal and Risk Evaluation.****Main field of study (if applicable): Mining and Geology****Specialization (if applicable): Mining Engineering,
Geotechnical and Environmental Engineering,
Geomatics for Mineral Resource Management
..... Mineral Resource Exploration****Profile: academic****Level and form of studies: 2nd level, full-time****Kind of subject: obligatory****Subject code ... W06GIG-SM3003G****Group of courses YES**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15		30	15	
Number of hours of total student workload (CNPS)	25		50	25	
Form of crediting	Examination				
For group of courses mark (X) final course	X				
Number of ECTS points	4				
including number of ECTS points for practical classes (P)	3				
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	3,1				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge of basic mathematical analysis, probability and statistical models
2. Skills in using Excel spreadsheets
3. Understanding of the need of lifelong learning and the importance of application of Economics, Management and Social Sciences in engineering.

SUBJECT OBJECTIVES

The course combines two groups of topics: basics of mineral economics and financial management and introduction to project management.

Part A: The purpose of the course is

C1 to introduce basic concepts of Microeconomics and financial management

C2 to introduce the concept of time value of money and present the methods used to evaluate investment projects. Different techniques are illustrated by examples and case studies. The range of application as well as the advantages and disadvantages of each method are discussed. The issues of inflation and risk analysis are included.

Part B:

C3 Introduction to project management basic concepts, methods and tools.

C4 Presentation of given project management areas: Project scope management, Project time management, Project cost management, Project risk management. Project planning, scheduling and control using Microsoft Project.

C5 Presentation of the issues of effective communication in project teams, group behaviour and leadership.

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge:

PEU_W01 knows the concepts of demand, supply and price elasticities, understands how they affect markets

PEU_W02 knows the concepts of costs in economics and accounting, understands how they differ

PEU_W03 knows the main cost categories and cost accounting methods

PEU_W04 has basic knowledge about the contents of financial statements

PEU_W05 has basic knowledge about the method of ratio analysis of financial statements

PEU_W06 knows and understands the concepts of Present Value and Future Value for simple cash flows and annuities.

PEU_W07 knows the capital budgeting methods (NPV, IRR, PBP) and understand how to interpret the results

PEU_W08 has basic knowledge about the project risk evaluation methods

relating to skills:

PEU_U01 is able to analyze the causes and effects of demand and supply changes

PEU_U02 is able to interpret and use information presented in financial statements also by means of ratio analysis

PEU_U03 is able to use different cost analysis methods and make decisions based on the results

PEU_U03 can calculate Future and Present value, also for annuities and solve simple calculation problems

PEU_U04 is able to perform discounted cash flow analysis and draw conclusions based on the results

PEU_U05 is able to carry out sensitivity analysis and scenario analysis using a financial model of an investment

PEU_U06 is able to work out basic project documentation and initiate a project

PEU_U07 is able to use basic methods of project management, monitoring and project risk management

PEU_U08 is able to implement basic conflict management methods in a project group

PEU_U09 is able to use basic group management methods, can undertake and shape the leadership position

relating to social competences:

PEU_K01 is able to think and act in a systematic, creative and entrepreneurial way

PEU_K02 has an established attitude of economic operation and decision-making based on available financial information and forecasts

PROGRAMME CONTENT		
Lecture		Number of hours
Lec.1	Supply and demand, equilibrium price, changes in demand and supply. Stock and commodity markets used by mineral industries	2
Lec.2	Costs in economics and in accounting. Cost and money outflow. Relevant cost, incremental cost, marginal cost, alternative cost. Short-term decision making.	2
Lec.3	Costs as the subject of cost accounting, different systems of cost accounting Different methods of cost data presentation (by types, divided into direct and indirect costs). Cost allocation	2
Lec.4	Variable and fixed costs. Break even point. Cost-volume –profit analysis.	1
Lec.5	Basics of financial accounting. Income statement and cash flow statement. Balance sheet. Working capital. Examples of financial statements of mining companies	2
Lec.6	Financial ratio analysis. Liquidity, profitability, activity and debt ratios. Financial and operating leverage.	2
Lec.7	The concept of time value of money. Computation of future and present value of money by means of spreadsheet functions. Basics of capital budgeting. Evaluation of different methods.	2
Lec.8	The concept of risk and return. Quantification of risk. Risk analysis in project evaluation: sensitivity analysis, scenario analysis, other methods.	2
	Total hours	15

Project		Number of hours
Pr 1	Issues of understanding communication: Definitions Models (Schramm model, Berlo’s SMCR (source, message, channel, receiver) model, McCroskey model, Reusch and Bateson model, Westley-MacLean model)	3
Pr 2	Conflict Sources of conflicts Kilmann and Thomas classification of conflict Kilmann and Thomas test Different styles of conflict solving Roles of conflict in group development.	3
Pr3	Team roles Team roles Belbin perspective Discussion group roles Effective managerial behaviour in the context of team roles	3
Pr4	Leadership Hersey and Blanchard theory Black and Mouton approach to leadership Fiedler theory and his Least Preferred Coworker Scale Situational leadership self-assessment	3
Pr5	Summary;	3

	Effective managerial behaviour from the different contexts.	
	Total hours	15

Laboratory		Number of hours
Part A		
La1	Supply and Demand curves. Elasticity of demand.	2
La2	Economic costs. Cost curves. Profit maximization cases.	2
La3	Managerial cost accounting. Decision making cases.	2
La4	Basic financial accounting. Creation of simple Balance Sheet, Profit and Loss Statement and Cash Flow Statement	2
La5	Ratio analysis based on financial statements of companies	2
La6	Time value of money and capital budgeting – calculation by means of Excel functions	2
La7	Financial model of an investment. Sensitivity and Scenario analysis.	3
Part B		
La8	Basic concepts (process, project, project management, management by projects, critical factors for project success, competences). Preparing and initiation of the project. Project analysis (project environment, stakeholders, project objectives).	3
La9	Planning and estimating of the project. Project phases and life cycle	3
La10	Project organization. Project scope management. Planning of activities, resources and costs.	3
La11	Project risk management. Project monitoring. Project management methodologies.	3
La12	Quality management. Change control. Project closing.	3
	Suma godzin	30

TEACHING TOOLS USED
N1. Interactive lecture with the use of multimedia and discussion N2. Laboratory classes: individual problem solving with the use of Excel spreadsheet N3. Laboratory classes part B and project classes: case studies solving in groups and individually. Project presentations, discussion N4. Consultation N5. Self-study: solving assigned problems, literature studies

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT

Evaluation (F – forming during semester), P – concluding (at semester end)	Learning outcomes code	Way of evaluating learning outcomes achievement
F1	PEU_W01-W08 PEU_K01-K02	Assesment of student class activity
F2	PEU_U01-U10 PEU_K01-K02	Evaluation of student's assignments
P1	PEU_W01-W08 PEU_U01-U10 PEU_K01-K02	Written test

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

1. Erhardt M., Brigham E.: Financial Management Theory and Practice. South-Western Cengage Learning, USA
2. Brigham E., Glapenski L.: Financial Management, 1997
3. Johnson H.: Making Capital Budgeting Decisions – Maximising the Value of the Firm. Financial Times/Prentice Hall (April 15, 1999)
4. Jonson H.: Strategic Capital Budgeting: Developing and Implementing the Corporate Capital Allocation Program, January 1994.
5. Lock Dennis, Project Management, Published April 11, 2013 by Routledge

SECONDARY LITERATURE:

1. Jonson H.: Determining Cost of Capital: The Key to Firm Value. Apr 1999.
2. A Guide to Project Management Body of Knowledge (PMBOK®Guide Fourth Edition), Project Management Institute, 2008 (2004). wydanie polskie, MT&DC Warszawa, 2009 (2006)
3. Johnson H.: Global Financial Institutions and Markets. December 1999

SUBJECT SUPERVISOR (NAME AND SURNAME, E-MAIL ADDRESS)

Dr inż. Gabriela Paszkowska, Gabriela.paszowska@pwr.wroc.pl

FACULTY OF GEOENGINEERING, MINING AND GEOLOGY

SUBJECT CARD

Name in Polish: *Zasady i zastosowania InSAR oraz GIS w górnictwie*
Name in English: *Principles and Application of InSAR and GIS in mining*
Main field of study: Mining and geology
Specialization: Geomatics for Mineral Resources Management
Mineral Resource Exploration
Level and form of studies: 2nd level, full-time
Kind of subject: obligatory
Subject code: W06GIG-SM3007
Group of courses: No

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30		45		
Number of hours of total student workload (CNPS)	50		75		
Form of crediting	Examination		crediting with grade		
For group of courses mark (X) final course					
Number of ECTS points	2		3		
including number of ECTS points for practical (P) classes			3		
Including number of ECTS points for direct teacher-student contact (BU) classes	1,4		2,0		

*niepotrzebne skreślić

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge of C ++ and Python programming language.
2. Basic knowledge of GIS functions and spatial data acquisition techniques
3. Ability to use GIS software package
4. Basic knowledge of databases

SUBJECT OBJECTIVES

- C1 Presentation of knowledge of satellite radar interferometry, as well as the possibility of using it in the ground deformation measurements.
- C2 Acquiring the ability to determine surface displacements based on satellite radar data.
- C3 Presentation of information on the use of GIS in advanced analysis of objects, phenomena and processes occurring in space.
- C4 Acquiring the ability to formulate and solve tasks using GIS analytical functions.
- C5 Acquiring skills to use spatial data and services in accordance with the INSPIRE Directive

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge:

PEK_W01 Has expanded knowledge in the field of using geoinformation systems to collect and process data used in modeling of both natural and anthropogenic phenomena and processes

PEK_W02 Knows the principles of construction and functioning of geoinformation systems in the mining industry and public administration

relating to skills:

PEK_U01 has the ability to use advanced GIS tools in mining, studies of natural phenomena, the impact of mining on the environment and space development,

PEK_U02 has the ability to formulate and solve spatial tasks in the GIS environment

PEK_U03 has the ability to interpret the results obtained and draw conclusions

relating to social competences:

PEU_K01 has the ability to formulate and transfer knowledge on the use of geoinformation systems in spatial analysis and presentation of their results

PROGRAMME CONTENT

Lecture		Number of hours
Lec 1	Discussion of syllabus, requirements for passing the course, literature	2
Lec 2	Introduction to Microwave Signals for Earth Observation	2
Lec 3	Principles and Applications of Passive and Active Microwave Remote Sensing	2
Lec 4	Acquisition and processing of SAR data	2
Lec 5	SAR image theory (geometric properties, polarization)	2
Lec 6	Basics of SAR data calculation using the DInSAR and SBAS methods	2
Lec 7	Principles and Applications of Interferometric SAR (monitoring surface activity, natural and anthropogenic phenomena)	2
Lec 8	Fundamental concepts of geographical information systems	2
Lec 9	Data modelling in GIS. Representation of spatial data. Spatial databases. Current status and development trends	2
Lec 10	Methods of spatial analysis in GIS	2
Lec 11	Spatial data interpolation	2
Lec 12	Map algebra. Surface analysis, local and zonal functions	2
Lec 13	Basics of spatial statistics	2
Lec 14	Spatial Information Infrastructure. Inspire Directive. Open Data	2
Lec 15	Examples of applications of geoinformation systems in mining and environmental protection	2
	Total hours	30

Laboratory		Number of hours
La1	Configuration of the environment for SAR calculations	3
La2-3	Introduction to radar data calculations - calculation tasks	6
La4	Acquiring radar data and calculating the interferogram - DInSAR method	3
La5	Unwrapping of the interferometric phase - calculations	3
La6-7	Presentation of results in the GMT environment	6
La8	Discrete data interpolation. Preparation of input data for analysis (e.g. deformation measurements in the mining area)	3
La9	Discrete data interpolation. Development mining area terrain deformation maps with various interpolation methods.	3
La10	Discrete data interpolation. Analysis and assessment of the quality and uncertainty of interpolation. Prediction map. Development of maps of changes between two periods using a raster calculator.	3
La11	Spatial analysis - assessment of the suitability of the area for the location	3
La12	of mining operation. Construction of a database of spatial location criteria	3
La13	Spatial analysis - assessment of the suitability of the area for the location	3
La14	of mining operation. Selection of analytical procedures and conducting analytical operations.	3
La15	Spatial analysis - assessment of the suitability of the area for the location	3
Total hours		45

TEACHING TOOLS USED
N1. Lectures N2. Multimedia presentations N3. Preparation of individual written term paper on a given topic N4. Multimedia materials (MOOC) N5. Laboratory instructions N6. Reports from laboratory exercises N7. Consultations

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT

Evaluation (F – forming during semester), P – concluding (at semester end)	Learning outcomes code	Way of evaluating learning outcomes achievement
F, P	PEU_W01 – 02 PEU_U01 – 03 PEU_K01	F1 Final mark for the written examination F2 Mark for the written report, P Final mark for the lecture (weighted average of F1 and F2, where F1 – 80% and F2 - 20%)
F, P	PEU_W01 – 02 PEU_U01 – 03 PEU_K01	F3 Mark for the written assignment reports F4 Mark from written tests, P2 Final mark for the laboratory (weighted average of F3 and F4, where F3 – 80% and F4 - 20%)

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

- [1] Longley P. A., Goodchild M. F., Maguire D. J., Rhind D. 2015: Geographic Information Science and Systems, 4th Edition, John Wiley & Sons;
- [2] Maguire D., Batty M., Goodchild M., 2005. GIS Spatial Analysis and Modelling. ESRI Press
- [3] Berry J., 2007-2013. Beyond Mapping IV — GIS Modelling
- [4] Satellite InSAR Data: Reservoir Monitoring from Space, A. Ferretti, EAGE; 1st edition, 2014
- [5] GMTSAR: An InSAR Processing System Based on Generic Mapping Tools (Second Edition), D. Sandwell i in., Scripps Institution of Oceanography, University of California, San Diego, La Jolla, CA, USA, 2016
- [6] InSAR Principles - Guidelines for SAR Interferometry Processing and Interpretation, ESA Publications, 2008

SECONDARY LITERATURE:

- [1] Directive 2007/2/EC of the European Parliament and of the Council of 14 March 2007 establishing an Infrastructure for Spatial Information in the European Community (INSPIRE)
- [2] Kennedy M., 2009: Introducing Geographic Information Systems with ArcGIS: A Workbook Approach to Learning GIS, Second Edition, John Wiley and Sons;
- [3] Longley P. A., Goodchild M. F., Maguire D. J., Rhind D. W., 2006. GIS. Teoria i praktyka. Wydawnictwo Naukowe PWN, Warszawa
- [4] Urbański J., 2010. GIS w badaniach przyrodniczych, Wydawnictwo Uniwersytetu Gdańskiego
- [5] Dokumentacja środowiska GMT (Generic Mapping Tools) - <http://gmt.soest.hawaii.edu/projects/gmt/wiki/Documentation>

SUBJECT SUPERVISOR (NAME AND SURNAME, E-MAIL ADDRESS)

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Semester 2 and 3
UNI ZAGREB

EIT label – Teaching units <TIMREX – T-shaped Master Programme for Innovative Mineral Resource Exploration>

University of Zagreb, RGNF

Course title	Sedimentology		
European Credits (ECTS)	5	Time (hours) given to the students	75
Type (Lecture, internship, exercise etc.)	Lectures: 2, Auditorium classes: , Lab. Classes: , Project classes: , Practical classes: 3, Seminar classes: , Fieldwork: x	Student whole working time (hours)	125
Description of content	<p>to acquire the main techniques in defining sedimentary facies, to recognize sedimentation processes, to recognize the basic features of modern and palaeo- depositional environments, to recognize and interpret characteristic sedimentary sequences, to analyse all elements present in the sedimentary environment and interpret possible depositional environment</p> <p>This course gives students knowledge about sedimentary processes and its interpretation.</p> <p>L1 - DEFINITION OF FACIES CYCLES AND SEDIMENTARY SEQUENCES L2 - WAYS OF VERTICAL SUCCESSIONS DISPLAY (SEDIMENTARY COLUMNS); WAYS AND POSSIBILITIES OF CORRELATION L3 - SEDIMENTARY ENVIRONMENT OF ALUVIAL FANS; TECTONIC SETTINGS, PROCESSES, CHARACTERISTIC SEQUENCES L4 - DEPOSITIONAL ENVIRONMENT OF BRAIDED, MEANDRING AND ANASTOMOSING RIVERS; TECTONIC SETTINGS, PROCESSES, CHARACTERISTIC SEQUENCES L5 - DELTAIC SEDIMENTARY ENVIRONMENT; PROCESSES, TYPES OF DELTAS; PARTS OF THE DELTA; CHARACTERISTIC SEQUENCE L6 – SILICICLASTIC SHORELINE; SILICICLASTIC SHELF / RAMP DEPOSITIONAL ENVIRONMENT; NEARSHORE SHELF / RAMP PROCESSES L7 – WAVE- TIDE- STORM-INFLUENCED SILICICLASTIC SHORELINE (SHELF/ RAMP) L8 – SHALLOW-MARINE CARBONATE ENVIRONMENTS; DEPOSITION ON CARBONATE PLATFORM (processes), CARBONATE RAMP / SHELF L9 - CHARACTERISTICS AND FACIES OF CARBONATE PLATFORM (according to Flügel, 2004) L10 - CHARACTERISTICS AND FACIES OF CARBONATE RAMP / SHELF (according to Flügel, 2004) L11 - EVAPORITIC SEDIMENTARY ENVIRONMENTS L12 - CARBONATE DIAGENESIS – DOLOMITES, KARST FORMATION L13 - DEEPWATER SEDIMENTARY ENVIRONMENTS - PELAGIC DEPOSITION IN THE OCEANS L14 - DEEPWATER SEDIMENTARY ENVIRONMENTS – RESEDIMENTED, MASS-FLOW DEPOSITS: DEBRITES, TURBIDITY</p>		

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	CURRENTS; CHARACTERISTICS OF TURBIDITE FANS L15 - MIXED (SILICLASTIC-CARBONATE) SEDIMENTARY ENVIRONMENTS - CHARACTERISTIC SEQUENCES					
Learning outcomes of the curricular unit (knowledge, skills and competences to be developed by the students)	<p>Knowledge: To conduct complex sedimentological investigations, including the construction of strata sequences, facies differentiation and interpretation of sedimentary environments.</p> <p>Skills: To construct general and thematic geological maps, as well as geological profiles with accompanying descriptions</p> <p>Competences: To engage in informed professional discussion and business communication,</p>					
Assessment methods and criteria	<p>exam</p> <p>During the semester the requirement for signature is attendance of lectures and practicum. Students will participate in research and practical work as part of practicum. At the end oral exam will be organized.</p> <p>Theoretical part is complemented by research work, practical work and field works where students will learn about sedimentology processes and depositional environment.</p>					
Recommended readings	Flügel, E., (2004): Microfacies of Carbonate Rocks; Analysis, Interpretation and Application. Springer (976 pp)					
TU Coordinator	Dunja Aljinović, dunja.aljinovic@rgn.hr					
Contribution to EIT's Overarching Learning Outcomes (tick relevant box/es)*	OLO 1 Entrepreneurship	OLO2 Innovation	OLO3 Creativity	OLO4 Intercultural	OLO5 Value judgments / Sustainability	OLO6 Leadership
	Students will be engaged in informed professional discussion and business communication		Students will have to construct general and thematic geological maps and profiles with accompanying descriptions			

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Justification for OLO contribution	
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EIT label – Teaching units <TIMREX – T-shaped Master Programme for Innovative Mineral Resource Exploration>

Course title	Mineral Deposits Exploration		
European Credits (ECTS)	5	Time (hours) given to the students	75
Type (Lecture, internship, exercise etc.)	Lectures: 2, Auditorium classes: , Lab. Classes: , Project classes: , Practical classes: 3, Seminar classes: x, Fieldwork:	Student whole working time (hours)	125
Description of content	<p>The objective of the course is to get acquainted with geological methods of exploring mineral deposits and their evaluation.</p> <p>The course contributes to skills of students which should be applied during geological part of exploration of mineral resources.</p> <p>L1 - Classification of mineral deposits. Economic aspects of mineral deposits.</p> <p>L2 - Nature and morphology of orebodies.</p> <p>L3 - Metallogeny, metallogenic provinces and periods.</p> <p>L4 - Geological criteria in the exploration of mineral deposits. Magmatic control factor.</p> <p>L5 - Structural control factor.</p> <p>L6 - Geological models of mineral deposits as a basis for exploration planning. Reconnaissance. Selection and definition of areas for exploration of a mineral deposit.</p> <p>L7 - Application of geophysical methods and remote sensing in the exploration of mineral deposits.</p> <p>L8 - Prospecting indications (alteration, alteration mineral assemblages, ore outcrops and remains of old mining).</p> <p>L9 - Prospecting indications (indicator elements, indicator minerals).</p> <p>L10 - Geochemical prospecting methods.</p> <p>L11 - Sampling media (stream sediments, soil, lake sediments, sediment cover, water, gases, vegetation, rocks).</p> <p>L12 - Statistical processing of geochemical prospecting results.</p> <p>L13 - Sampling of mineral resources.</p> <p>L14 - Mining legislation. Categorisation and classification of mineral reserves.</p> <p>L15 - Calculation of mineral reserves. Preparation of a mineral reserves study.</p>		
Learning outcomes of the curricular unit (knowledge, skills and competences to be developed by the students)	<p>Knowledge: To describe all phases of raw materials exploration, from prospecting of deposits to the preparation of reports on raw materials reserves. To select basic geological, geochemical, geophysical, and statistical methods in exploration of selected mineral raw materials deposits.</p> <p>Skills: To apply statistical methods and spatial analyses in interpretation of laboratory and field measurements. To use information technology in computation and modelling of geological phenomena and processes. To identify the properties of geological materials and processes within hydrogeological, engineering geological and petroleum</p>		

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	<p>engineering investigation and mineral exploration. Competences: , To apply standards and (legal) regulations related to geological research, geohazards, environmental protection, water exploitation, exploitation of mineral resources or construction conditions. To interpret and summarize the results of field, laboratory and office research and prepare and present a geological expert report using other relevant data sources. To create geological reports for the economy and strategic documents.</p>					
Assessment methods and criteria	<p>exam The requirement for signature is attendance of lectures and practicum. Students will have to write seminar on specific topic, and have independent assignments. At the end oral exam will be organized. Through seminars and workshops, independent assignments and field works students will learn about mineral deposits and importance and methods of its exploration.</p>					
Recommended readings	<p>1. Moon, C.J., Whateley, M.G.K. & Evans, A.M. (2009): Introduction to mineral exploration, Blackwell Science, 496 s. 2. Anells, A.E. (1991): Mineral Deposits Evaluation, Chapman & Hall, 436 s</p>					
TU Coordinator	Goran Durn, goran.durn@rgn.hr					
Contribution to EIT's Overarching Learning Outcomes (tick relevant box/es)*	OLO 1 Entrepreneurship	OLO2 Innovation	OLO3 Creativity	OLO4 Intercultural	OLO5 Value judgments / Sustainability	OLO6 Leadership
	Students will create geological reports for the economy and strategic documents.	Students will apply statistical methods and spatial analyses in interpretation of laboratory and field measurements.	Students will apply statistical methods and spatial analyses in interpretation of laboratory and field measurements.		Students will apply standards and (legal) regulations.	
Justification for OLO contribution						

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Course title	Petroleum Geology		
European Credits (ECTS)	5	Time (hours) given to the students	75
Type (Lecture, internship, exercise etc.)	Lectures: 2, Auditorium classes: , Lab. Classes: , Project classes: , Practical classes: 3, Seminar classes: x, Fieldwork: x	Student whole working time (hours)	125
Description of content	<p>The goal is to acquire specific knowledge and skills in the field of petroleum geology, which are intended to prepare the students, future engineers for all aspects of exploration and exploitation of oil, gas, condensate and geothermal waters as well as for professional interaction with engineers of related professions in teamwork. Students acquire specific skills in the area of exploration and exploitation of oil and gas.</p> <p>Lectures (30 hours)</p> <p>Abiogenic theories of petroleum origin and biogenic theory of petroleum origin (presentation of arguments and guided discussion)</p> <p>Biomarkers as indicators of origin of source rocks and deposition conditions</p> <p>Types of kerogen (conditions of deposition of organic matter, composition and structure of kerogen)</p> <p>Pyrolysis of source rocks (generation and maturation parameters)</p> <p>Differences in porosity of clastic and carbonate sediments. Permeability of clastic and carbonate sediments. Correlations of porosity and permeability.</p> <p>Directions and ranges of primary and secondary migration in different stratigraphic-tectonic conditions</p> <p>Diagenetic processes important for the migration and accumulation of hydrocarbons</p> <p>Diapirism. Origin and processes during diapir movement. The significance of diapirism in petroleum geology. Diapirs in the Adriatic s</p> <p>An overview of the types of traps in the world</p> <p>Theoretical foundations of basin modelling</p> <p>Oil and natural gas reserves in conventional accumulations in the world</p> <p>Reflective seismic surveys - significance in petroleum geological exploration and limitations with regard to reservoir type</p> <p>Drilling of a deep exploratory well (TDC laboratory, Master Log)</p> <p>Application of the results of interpretation of well logging. Measurement systems with respect to energy sources: electrical, radioactive, sound. Influences on the results of geophysical measurements in wells: temperature, well diameter, influence of mud</p> <p>Specifics of exploration of unconventional oil and natural gas accumulations (ultra-deep accumulations, oil and natural</p>		

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	<p>gas in shales, natural gas in coal seams) Practical Exercises Comparison of effective porosity differences based on a simple experiment (weighing two dry samples of different effective porosity, immersing the samples in water for 15 minutes after which the samples are weighed again, and their porosity is estimated based on the change in mass) Luminescence of oil and natural gas (observation and description) Preparation of samples taken in the field (separation of fossil content by wet sieving, preparation of samples for analysis of total organic carbon content) Microscopy of fossil contents, discussion of observation results in terms of interpretation of sediment characteristics Analysis of total organic carbon content Project work (15 hours) Systematization of input data Shale volume analysis by interpreting the spontaneous potential curve Calculation of the share of rock thickness with reservoir properties within the total rock thickness (Net / Gross) Porosity analysis of reservoir rocks by interpretation of well - logs in a specialized computer program Making a contour map of the top of the reservoir in a computer software Making a contour map of the bottom of the reservoir in a computer software Making a map of the spatial distribution of the share of rock thickness with collector properties within the total rock thickness in a computer software Making a map of the spatial distribution of reservoir porosity in a computer software Making a cross-section through the reservoir Calculation of reserves based on the constructed reservoir model Making a simple 1D basin model</p> <p>Fieldwork (15 hours) Construction of geological column in clastic sedimentary rocks of Neogene age and sampling for assessment of generative potential of source rocks Construction of a geological column of a characteristic transgressive cycle of Neogene rocks Reconstruction of the circumstances that led to natural hydrocarbon outcrops</p>
<p>Learning outcomes of the curricular unit (knowledge, skills and competences to be developed by the students)</p>	<p>Knowledge: Interpret the results of analyses and measurements: laboratory and field (from outcrops and from wells) Bring conclusions about the generative-maturation properties of source rocks based on the results of pyrolysis Discuss the interconnectedness of the elements of the petrogeological system Describe the main elements of the drilling rig and the work of geologists during the drilling of deep wells Skills: Analyse the role of biomarkers in determining the origin of hydrocarbons (origin of organic matter and</p>

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	sedimentation environment). Estimate geological (total) reserves of hydrocarbon based on a simple reservoir model constructed in a computer software Competences: Assess the significance of petrophysical properties of reservoir and cap rocks for hydrocarbon accumulation and production. Compare research on conventional and unconventional hydrocarbon accumulations,					
Assessment methods and criteria	exam The requirement for signature is attendance of lectures and practicum. Students will have to write seminar on specific topic, and have independent assignments. At the end oral exam will be organized. Theoretical part is complemented by practical work through seminars and workshops, independent assignments and field works where students will learn about importance of geology in petroleum exploration.					
Recommended readings	Selected chapters: Velić, J. (2007): Geologija ležišta nafte i plina [Geology of Oil and Gas Reservoirs], Zagreb, Sveučilište u Zagrebu, Rudarsko-geološko-naftni fakultet, 2007 (university textbook)					
TU Coordinator	Marko Cvetković, Iva Kolenković Močilac, marko.cvetkovic@rgn.hr iva.kolenkovic@rgn.hr					
Contribution to EIT's Overarching Learning Outcomes (tick relevant box/es)*	OLO 1 Entrepreneurship	OLO2 Innovation	OLO3 Creativity	OLO4 Intercultural	OLO5 Value judgments / Sustainability	OLO6 Leadership
	Student will learn how to have professional interaction with engineers of related professions.					Student will work in teamwork.
Justification for OLO contribution						

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Course title	Engineering Geological Investigations		
European Credits (ECTS)	5	Time (hours) given to the students	60
Type (Lecture, internship, exercise etc.)	Lectures: 2, Auditorium classes: , Lab. Classes: , Project classes: , Practical classes: 2, Seminar classes: , Fieldwork:	Student whole working time (hours)	125
Description of content	<p>The objective is to adopt basic knowledge about engineering geological investigations for the purpose of design in civil engineering and mining.</p> <p>This course covers all important aspects of engineering geological investigations.</p> <p>Course content elaborated according to the schedule of lectures and exercises:</p> <p>T1: Lectures - Types of engineering geological investigations; Exercises - Review of geotechnical reports</p> <p>T2: Lectures - Engineering geological investigations in site investigations; Exercises - Description of natural characteristics of the investigated area</p> <p>T3: Lectures – Methods of detailed engineering geological investigations; Exercises - Geomechanical classification and engineering description of coarse grained soil</p> <p>T4: Lectures - Genetic classification of soil and rock mass, rock mass weathering and engineering geological profile; Exercises – Geomechanical classification and engineering description of fine grained soil</p> <p>T5: Lectures - Classification and categorization of rock mass; Exercises - Engineering geological description of rock mass – clastic rocks</p> <p>T6: Lectures - Methods of engineering geological investigations for site investigations related to foundation construction; Exercises – Engineering geological description of rock mass – carbonate rocks</p> <p>T7: Lectures - Methods of engineering geological investigations for site investigations related to slope constructions; Exercises - Classification and categorization of rock mass</p> <p>T8: Lectures - Methods of engineering geological investigations for site investigations related to dam construction; Exercises – Construction of borehole log</p> <p>T9: Lectures - Methods of engineering geological investigations for site investigations related to tunnel construction; Exercises - Correlation of exploration boreholes</p> <p>T10: Lectures - Methods of engineering geological investigations of active geomorphological and geodynamic processes; Exercises - Construction of engineering geological profile</p> <p>T11: Lectures - Engineering geological investigations and potential problems in soluble and clastic rocks; Exercises - Engineering geological mapping of tunnels – 1st Par</p> <p>T12: Lectures - Engineering geological investigations and potential problems in magmatic and metamorphic rocks;</p>		

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	<p>Exercises - Engineering geological mapping of tunnels – 2nd Part T13: Lectures - Review of the results of engineering geological investigations and preparation of technical documentation; Exercises - Engineering geological mapping of the road route – 1st Part T14: Lectures - Methods and results of regional engineering geological investigations; Exercises - Engineering geological mapping of the road route – 2nd Part T15: Lectures – Application of results of regional engineering geological investigations; Exercises - Reconnaissance engineering geological mapping in scale 1:5000</p>					
<p>Learning outcomes of the curricular unit (knowledge, skills and competences to be developed by the students)</p>	<p>Knowledge: Select appropriate level of site investigations for the purpose of different types of studies and projects from geotechnical engineering. Select appropriate type of regional engineering geological investigations for the purpose of different types of studies and projects. To make concept of detailed engineering geological investigations for different types of structures/constructions. Identify causes of active geomorphological processes (sliding, erosion, subsidence, etc.) and consequences of geodynamic processes (earthquakes) and to apply appropriate methods of engineering geological investigations. Identify weathering profiles in different rock types and to apply appropriate methods of engineering geological investigations. Identify potential geotechnical problems in different rock types for the purpose of performing engineering constructions in geotechnical engineering. Classify and to describe soil and rock mass according to different recommendations and standards in engineering. Skills: Evaluate the results of conducted research and testing. Construct an engineering geological profile and technical tunnel drawings Conduct reconnaissance engineering geological mapping Competences: ,</p>					
<p>Assessment methods and criteria</p>	<p>exam During the semester the requirement for signature is attendance of lectures. Students will participate in research and practical work as part of practicum. Students will have preliminary exam, written and oral exam. Theoretical part is complemented by practical work through project work and independent assignments.</p>					
<p>Recommended readings</p>	<p>Selected chapters from: De Vallejo, L.G., Ferrer, M., de Freitas, M. (2011): Geological Engineering. CRC Press, 700 p.</p>					
<p>TU Coordinator</p>	<p>Snježana Mihalić Arbanas, snjezana.mihalic-arbanas@rgn.hr</p>					
<p>Contribution to EIT's Overarching</p>	<p>OLO 1</p>	<p>OLO2 Innovation</p>	<p>OLO3 Creativity</p>	<p>OLO4</p>	<p>OLO5 Value</p>	<p>OLO6 Leadership</p>

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Learning Outcomes (tick relevant box/es)*	Entrepreneurship			Intercultural	judgments / Sustainability	
		Students will conduct reconnaissance engineering geological mapping.	Students will construct an engineering geological profile and technical tunnel drawings.		Students will apply standards and (legal) regulations.	
Justification for OLO contribution						

EIT label – Teaching units <TIMREX – T-shaped Master Programme for Innovative Mineral Resource Exploration>

Course title	Exploration Geochemistry		
European Credits (ECTS)	4	Time (hours) given to the students	45
Type (Lecture, internship, exercise etc.)	Lectures: 2, Auditorium classes: , Lab. Classes: , Project classes: x, Practical classes: 1, Seminar classes: , Fieldwork:	Student whole working time (hours)	100
Description of content	<p>Students will be introduced to the basic principles of geochemical prospecting, i.e., finding the geochemical anomaly caused by the weathering of the ore deposit. Students will be introduced to the behavior of trace elements in surface environments, sampling media (soil, water, sediment, plant rocks), chemical analysis of geological materials (AAS, ICP), statistical methods and interpretation of geochemical data. Students will develop their communication skills through oral presentation and writing reports related to project assignments. Students will acquire a basic knowledge about importance of geochemical prospecting.</p> <p>LECTURES</p> <ol style="list-style-type: none"> 1. Introduction to the course, basic principles of geochemical prospecting 2. Primary dispersion 3. Secondary dispersion 4. Sampling media, sampling and sample preparation for analysis 5. Instrumental analytical methods 6. Statistical methods in geochemical prospecting; background and threshold determination. 7. Construction of geochemical maps 8. Types of geochemical research and report writing 9-10. Principles of geochemical prospecting in environmental protection <p>EXERCISES (5 blocks of 3 hours)</p> <p>The 15 hours of exercises will include a series of individual tasks that students will have to solve independently and present orally and in the form of an essay. In addition to individual assignments, students will receive a geochemical prospecting project on which they will work throughout the semester in synergy with exercises from two other courses (Remote Mineral Exploration and GIS in Mineral Exploration) and prepare an geological report.</p>		
Learning outcomes of the curricular unit (knowledge, skills and competences to be developed by the students)	<p>Knowledge: To explain the behaviour of chemical elements in surface environments and the processes that control the geochemical anomaly.</p> <p>To select a suitable sampling medium, the proper sample preparation procedure, and the analytical method, as well as analyte in order to find the geochemical anomaly caused by the weathering of the ore body.</p>		

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	<p>Skills: To apply univariate, bivariate and multivariate statistical methods in the interpretation of geochemical data. To construct geochemical maps. Design preliminary, regional and detailed geochemical survey of mineral resources. Competences: To systematize and combine the results of geochemical prospecting with other data and prepare and present a geological report.,</p>					
Assessment methods and criteria	<p>exam Students are required to attend classes, solve independent project tasks, participate in a team project and pass the written exam. Through practical work and independent assignments students will be introduced to the basic principles of geochemical prospecting,</p>					
Recommended readings	<p>1. Moon, C.J. (2006): Exploration Geochemistry (pp 155-178). In: Introduction to Mineral Exploration; 2nd Edition; Charles J. Moon, Michael K.G. Whateley & Anthony M. Evans (Editors); Blackwell Publishing, 2006, 469p.</p>					
TU Coordinator	<p>Marta Mileusnić, marta.mileusnic@rgn.hr</p>					
Contribution to EIT's Overarching Learning Outcomes (tick relevant box/es)*	OLO 1 Entrepreneurship	OLO2 Innovation	OLO3 Creativity	OLO4 Intercultural	OLO5 Value judgments / Sustainability	OLO6 Leadership
		<p>Students will develop communication skills through oral presentation and writing reports related to project assignments.</p>				<p>Students will develop communication skills through oral presentation and writing reports related to project assignments.</p>
Justification for OLO contribution						

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Course title	Remote sensing of mineral resources		
European Credits (ECTS)	3	Time (hours) given to the students	30
Type (Lecture, internship, exercise etc.)	Lectures: 1, Auditorium classes: , Lab. Classes: x, Project classes: x, Practical classes: 1, Seminar classes: , Fieldwork:	Student whole working time (hours)	75
Description of content	<p>Students will acquire basic knowledge from remote sensing, with an emphasis on their application in mineral exploration. To enable students to independently collect and analyse multispectral, hyperspectral and radar satellite images required for analysis at surface mineral resources. Introduce students to the automatic supervised and unsupervised classification of satellite images in the analysis of surface mineral raw materials. Through the course students will acquire basic knowledge about application of remote sensing in mineral raw materials exploration.</p> <p>P-1. Introduction, review and definition of remote sensing of mineral resources</p> <p>P-2. Electromagnetic radiation. Active and passive sensors for remote sensing.</p> <p>P-3. Electromagnetic radiation. Active and passive sensors for remote sensing of mineral resources.</p> <p>P-4. Satellite missions, sensors, accessories and equipment of existing satellite systems for remote sensing of mineral resources.</p> <p>P-5. Spatial, spectral, radiometric and temporal resolution of satellite images used in the analysis of mineral resources</p> <p>P-6. Use of software tools and programming languages for remote sensing of mineral resources 1</p> <p>P-7. Use of software tools and programming languages for remote sensing of mineral resources 2.</p> <p>P-8. Pre-processing of satellite images.</p> <p>P-9. Elimination of geometric errors in sensor operation</p> <p>P-10. Elimination of atmospheric and morphological influences on the quality of satellite images 1</p> <p>P-11. Elimination of atmospheric and morphological influences on the quality of satellite images 2</p> <p>P-12. Supervised and unsupervised classification on the example of mineral resources research 1.</p> <p>P-13. Supervised and unsupervised classification on the example of mineral exploration 2.</p> <p>P-14. Use of Synthetic Antenna Radar (InSAR) for mineral analysis 1</p> <p>P-15. Use of Synthetic Antenna Radar (InSAR) for mineral analysis 2</p>		

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<p>Learning outcomes of the curricular unit (knowledge, skills and competences to be developed by the students)</p>	<p>Knowledge: Describe the basic principles and methods of remote sensing for surface mineral raw materials. Use multispectral and hyperspectral images for analysis at surface raw materials Describe the characteristics of electromagnetic radiation for the purposes of remote sensing of mineral resources.</p> <p>Skills: Develop a controlled and uncontrolled classification of mineral resources from satellite images Apply at least one software tool for interpretation and processing in remote sensing of mineral resources.</p> <p>Competences: ,</p>					
<p>Assessment methods and criteria</p>	<p>exam Students will have lectures and project work. Students are required to attend classes and solve project tasks independently and / or in a team. Students will learn about remote sensing, with an emphasis on their application in mineral exploration through lessons and practical work.</p>					
<p>Recommended readings</p>						
<p>TU Coordinator</p>	<p>Ivan Medved, ivan.medved@rgn.hr</p>					
<p>Contribution to EIT’s Overarching Learning Outcomes (tick relevant box/es)*</p>	<p>OLO 1 Entrepreneurship</p>	<p>OLO2 Innovation Students will independently collect and analyse mineral resources via remote sensing.</p>	<p>OLO3 Creativity</p>	<p>OLO4 Intercultural</p>	<p>OLO5 Value judgments / Sustainability</p>	<p>OLO6 Leadership</p>
<p>Justification for OLO contribution</p>						

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Course title	GIS in Exploration of Mineral Resources		
European Credits (ECTS)	3	Time (hours) given to the students	30
Type (Lecture, internship, exercise etc.)	Lectures: 1, Auditorium classes: , Lab. Classes: x, Project classes: x, Practical classes: 1, Seminar classes: , Fieldwork:	Student whole working time (hours)	75
Description of content	<p>Master all significant options in GIS software while solving specific examples from the profession. Acquiring the knowledge needed to develop your own GIS projects. Advanced use of geoinformatics on computer and mobile platform. Visualization of GIS projects for the purpose of making cartographic contents of diploma theses. Through the course students will acquire basic knowledge about application of GIS software in mineral exploration.</p> <p>P1 Introductory lecture on the subject. Overview of teaching topics. V1 Curriculum in the semester. Merlin, ArcMap, networking, computer usage rules.</p> <p>P2 Basics of GIS (repetition of undergraduate material). V2 Reminder to ArcView, advantages and disadvantages.</p> <p>P3 Scanning and image processing. V3 Handling maps in paper and digital form.</p> <p>P4 Raster georeferencing. V4 Georeferencing three sheets with known points on geological maps.</p> <p>P5 Raster georeferencing V5 Raster georeferencing over vectors.</p> <p>P6 Raster georeferencing V6 Raster georeferencing over a raster.</p> <p>P7 Review projects and quick maps. V7 Development of an overview project and GIS map for each location.</p> <p>P8 Vectorization of geological map, part 1. V8 Vectorization of a geological map within a given area, Part 1.</p> <p>P9 Vectorization of geological map, part 2. V9 Vectorization of geological map within a given area, part 2.</p> <p>P10 Stages of GIS project development on the example of making a map of mineral resources of western Slavonia, introductory part. V10 Stages of GIS project development on the example of making a map of mineral resources of Western Slavonia, making a GIS project</p> <p>P11 Geotransformation of vector and raster GIS in HTRS96 / TM and WGS84, in general. V11 Geotransformation of vector and raster GIS in HTRS96 / TM and WGS84, data table.</p> <p>P12 SGA Geoportal data, in general. V12 Data from SGA Geoportal, use in GIS project.</p> <p>P13 Geoconversions of point data in Geotrans, in general. V13 Geoconversions of point data in Geotrans, task.</p> <p>P14 Geodetic transformations, parameters and test data, in general. V14 Geodetic transformations, parameters and test data, task.</p> <p>P15 Description of the RGNF WEBGIS system. V15 Work in RGNF WEBGIS system.</p>		

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<p>Learning outcomes of the curricular unit (knowledge, skills and competences to be developed by the students)</p>	<p>Knowledge: To apply statistical methods and spatial analyses in interpretation of laboratory and field measurements To use information technology in computation and modelling of geological phenomena and processes To interpret the results of geological and geochemical prospecting, geophysical and remote sensing investigation of mineral deposits using geographic information system in the analysis of spatial data. Skills: To construct general and thematic geological maps, as well as geological cross-sections with accompanying descriptions To interpret and summarize the results of field, laboratory and office research and prepare and present a geological expert report using other relevant data sources Competences: ,</p>					
<p>Assessment methods and criteria</p>	<p>practical mark The student is obliged to do all the exercises and attend 80% of the lectures. It is necessary to complete all project tasks and submit the final GIS projects for review and evaluation. Knowledge is evaluated based on assessment from project assignments, attendance at exercises and overall commitment to teaching. Students will learn about GIS softwers with an emphasis on their application in mineral exploration through lessons and project exercise and independent assignments.</p>					
<p>Recommended readings</p>	<p>1. De Smith, M., Longley, P., Goodchild, M.: Geospatial Analysis - A comprehensive guide (online + PDF format), https://spatialanalysisonline.com/ 2. ESRI: Free eBooks as part of its “Best Practices” series, (online + PDF format), https://www.gislounge.com/free-gis-books/ 3. The Rutgers Center on Public Security (PDF format), https://www.rutgerscps.org/gis-book.html</p>					
<p>TU Coordinator</p>	<p>Dario Perković, dario.perkovic@rgn.hr</p>					
<p>Contribution to EIT’s Overarching Learning Outcomes (tick relevant box/es)*</p>	<p>OLO 1 Entrepreneurship</p>	<p>OLO2 Innovation</p>	<p>OLO3 Creativity</p>	<p>OLO4 Intercultural</p>	<p>OLO5 Value judgments / Sustainability</p>	<p>OLO6 Leadership</p>
		<p>Students will independently collect and analyse mineral resources via GIS softwares.</p>	<p>Students will independently collect and analyse mineral resources via GIS softwares.</p>			

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Justification for OLO contribution	
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EIT label – Teaching units <TIMREX – T-shaped Master Programme for Innovative Mineral Resource Exploration>

Course title	Seismotectonics		
European Credits (ECTS)	4	Time (hours) given to the students	45
Type (Lecture, internship, exercise etc.)	Lectures: 2, Auditorium classes: , Lab. Classes: , Project classes: x, Practical classes: 1, Seminar classes: , Fieldwork:	Student whole working time (hours)	100
Description of content	<p>To describe the basics on seismotectonics in different geodynamic settings on Earth, in particular in Croatia, in circum Adriatic region and in the Eastern Mediterranean, and to provide students general knowledge on field and lab methods used in evaluation of seismicity and seismic hazard, assessment of recent tectonic movements on local and regional scale, active stress regimes in the Earth's crust, and in identification and characterization of active, seismogenic faults and seismogenic sources.</p> <p>The course cover all the important data and seismotectonic properties of certain areas.</p> <p>L1. Introduction to Seismology. Seismicity in Croatia and in neighbouring countries. Global seismicity. Seismic waves, seismometers and seismograms. Earthquake intensity and magnitude. Earthquake cycle. Elastic Rebound Theory. Models of earthquake recurrence.</p> <p>Ex1. Seismogram analysis, definition of spatial and surface seismic waves</p> <p>L2. Introduction to seismic hazard and risk in Croatia. Croatian Seismological Survey, seismograph network and Croatian Earthquake Catalogue. Gutenberg-Richter Relationship. Seismic hazard maps in Croatia and in neighbouring countries.</p> <p>Ex 2. Calculation of earthquake epicentre and magnitude based on seismicity data (Part 1)</p> <p>L3. An overview of geodetic methods to measure tectonic movements. Conceptual models of deformation and slip on faults and in fault zones. Trilateration network, Precise leveling: principles and examples. VLB Interferometry and GPS measurements: principles and examples. GPS data in Croatia and in surrounding region used in interpretation of geodynamics in circum Adriatic region and in the eastern Mediterranean.</p> <p>Ex 3. Calculation of earthquake epicentre and magnitude based on seismicity data (Part 2).</p> <p>L4. Type of stresses in the Earth's crust. Stress regimes at the tectonic plate boundaries and far - field stresses. World stress map database. Introduction to borehole breakouts. Fault plane solutions: basic theoretical principles and examples.</p> <p>Ex 4. Analysis of earthquake focal mechanisms (EFM) – interpretation of EFMs</p> <p>L5. Stress regimes and distribution and in circum-Adriatic region. Individual and composite seismogenic sources: definitions and characterization, examples from DISS and SHARE seismogenic databases.</p> <p>Ex 5. Analysis of earthquake focal mechanisms (EFM) - construction of EFM (Part 1).</p> <p>L6. Integration of geological and seismological data in identification and characterization of seismogenic faults/sources.</p>		

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	<p>Ex. 6. Analysis of earthquake focal mechanisms (EFM) - construction of EFM (Part 2). L7. Integration of geological and seismological data in construction of seismotectonic maps and profiles: basic principles. Ex. 7. Visit to Croatian Seismological Survey – Earthquake monitoring and analysis L8. Seismotectonics in extensional geodynamic settings. Global distribution of extensional settings. An overview of structural styles and potential seismogenic sources in extensional settings. Ex. 8. Integration of geological and seismological data for construction of seismotectonic profile – Construction of geological profile L9. Seismotectonics in continental graben structures: examples from the East African Rift, Rhone-Rhine Graben, Basin & Range Province. Seismotectonic properties of back-arc basin areas: examples from Aegean and Tyrrhenian sea. Ex. 9. Construction of seismotectonic profile – Construction of geological profile L10. Seismotectonics in compressional geodynamic settings. Global distribution of compressional settings. An overview of structural styles and potential seismogenic sources in compressional settings. Ex. 10. Construction of seismotectonic profile – Earthquake Catalogue analysis and delineation of earthquake series in the profile buffer 10 km wide L11. Seismotectonics in fold-thrust belts: examples from the Alps and External Dinarides. Ex. 11. Construction of seismotectonic profile – Earthquake hypocentre projection on geological profile and correction of structural framework corrections L12. Seismotectonics in strike-slip geodynamic settings. Global distribution of strike-slip settings. An overview of structural styles and potential seismogenic sources in strike-slip settings. Ex. 12. Construction of seismotectonic profile – Identification of seismogenic faults/sources along the profile L13. Seismotectonics in strike-slip geodynamic settings: examples from Dinarides, California, New Zealand and Eastern Mediterranean. Ex. 13. Student’s presentations of constructed seismotectonic profiles (Part 1). L14. An overview on seismotectonics in Croatia: key examples from Pannonian basin, Dinarides and Adriatic region. Ex. 14. Student’s presentations of constructed seismotectonic profiles (Part 2). L15 & Ex 15. Student’s seminar presentations</p>
<p>Learning outcomes of the curricular unit (knowledge, skills and competences to be developed by the students)</p>	<p>Knowledge: Distinguish stress type and its distribution in Earth’s crust in respect to tectonic plate boundary types, regional and local geodynamic processes Explain general terms in Seismology (seismicity, seismic waves, earthquake magnitude, earthquake hazard and risk, Earthquake Cycle and Elastic Rebound Theory) Describe basic properties of global and local seismicity Describe seismotectonic properties of the extensional, compressional and strike-slip tectonic regions Define geodetic methods that are used in measurements of tectonic movements Categorize seismotectonically active regions on Earth, in more detail Mediterranean area and Croatia</p>

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	<p>Skills: Compute earthquake epicentre location based on seismic station seismogram analysis Compute focal mechanism solutions based on geometric and kinematic features of investigated faults Compute values of moment magnitude and assess earthquake intensity Competences: , Construct and analyse seismotectonics maps and profiles. Integrate geological and seismic data in identification and categorization of seismogenic faults/seismogenic sources in seismotectonic active regions.</p>					
Assessment methods and criteria	<p>exam Teaching methodologies are: lectures, project and independent assignments and partial e-learning. Course attendance (minimum 70% attendance), tasks constructed and given for evaluation. Course evaluation: constructed programs, seminar paper, written exam and oral exam.</p> <p>Students will be introduced to seismotectonics via lectures, project work and independent assignments and partial e-learning.</p>					
Recommended readings	<p>Yeats, R. (2012): Active Faults of the World. Cambridge Univ. Press, 600 str. (selected chapters)</p>					
TU Coordinator	<p>Bruno Tomljenović/Bojan Matoš,</p>					
Contribution to EIT's Overarching Learning Outcomes (tick relevant box/es)*	OLO 1 Entrepreneurship	OLO2 Innovation	OLO3 Creativity	OLO4 Intercultural	OLO5 Value judgments / Sustainability	OLO6 Leadership
			<p>During the course students will construct seismotectonic profiles and have presentations.</p>		<p>Students will learn about importance of determining seismicity and about seismic hazards and tectonic activities and its impact.</p>	
Justification for OLO contribution						

EIT label – Teaching units <TIMREX – T-shaped Master Programme for Innovative Mineral Resource Exploration>

Course title	Regional Hydrogeology		
European Credits (ECTS)	4	Time (hours) given to the students	60
Type (Lecture, internship, exercise etc.)	Lectures: 2, Auditorium classes: , Lab. Classes: , Project classes: x, Practical classes: 2, Seminar classes: , Fieldwork:	Student whole working time (hours)	100
Description of content	<p>Hydrogeological interpretations on a regional scale and the acquisition of skills in presenting hydrogeological features and calculating groundwater reserves. The student will acquire basic knowledge about the aquifer systems of the Republic of Croatia and strategic groundwater reserves.</p> <p>Students acquire specific skills in the area of hydrogeological interpretation on regional scale.</p> <p>Energy conditions of groundwater movement, Basic concept of thermal regime. Map of the geothermal gradient of Croatia, geothermal potential analysis.</p> <p>Geochemical cycle, Hydrochemical facies. Examples of laboratory chemical analyzes of water, Piper diagrams</p> <p>Groundwater chemistry and its impact on water use (water supply, industry, agriculture) and legislation. Examples of water classifications depending on the intended use (Doneen, USDA).</p> <p>Regional hydrogeology, scale effect (spatial and temporal), the continuity equation. The concept of scales cartographic and physical, scale effect on permeability</p> <p>Hydrogeological parameters. Heterogeneity and anisotropy of hydraulic conductivity (example of parallel and vertical flow in relation to the position of layers)</p> <p>Basic flow of inclined aquifer systems and unit hydrograph, runoff coefficient and recovery coefficient. Hydrogeological significance of the recession coefficient on the example</p> <p>Radial flow, well hydraulics, direct integration of Darcy's law. Calculation (identification) of hydrogeological parameters</p> <p>Unconfined aquifer, flow below water surface, Dupit assumption. Flow through horizontally and vertically stratified aquifer</p> <p>Hydrogeological objects (wells, piezometers), construction and use. Examples of hydrogeological objects (question of aquifer heterogeneity)</p> <p>Hydrogeological maps and issues of graphical representation of hydrogeological properties, phenomena and relationships. Examples of hydrogeological maps of different scales</p> <p>Hydrogeology of the Republic of Croatia, division of territories by basins, catchment areas. Hydrogeological characteristics of the Sava River Basin, the valley part of the Sava River Basin, the basins of the left tributaries of the Sava. Analysis of the water level and flow of the Sava on significant water meter profiles, comparison of the Sava water level and groundwater level and conclusion on the hydraulic connection of the Sava and the banks, drainage, recharge.</p>		

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	<p>Basins of right tributaries of the Sava, Kupa basin, Dobra basin, Mrežnica basin, Korana basin, Una basin. Analysis of hydrographs of significant sources in the basins of the right tributaries of the Sava, definition of the equation of the recession part of the hydrograph, recession coefficient and dynamic reserves.</p> <p>Drava basin, valley part of the Drava basin, hilly and hilly area of the Drava basin. Analysis of water level and flow of the Drava on significant water meter profiles, comparison of Drava water level and groundwater level in the hinterland, inference about the hydraulic connection of the Drava and the hinterland, drainage and recharge.</p> <p>Hydrogeology of Istria, Croatian Littoral, Lika and Podvelebita (Gacka and Lika basins), Zrmanja basin, Krka basin. Analysis of hydrographs of significant sources in the Mirna, Gacka, Lika, Zrmanja and Krka basins, definition of the equation of the recession part of the hydrograph, recession coefficient and dynamic reserves.</p> <p>Cetina basin, lower Neretva basin, coastal basin from Neretva to Boka Kotorska, basins of significant coastal springs. Ranking of watersheds by quantity and quality of water, strategic reserves of Croatian groundwater from the first to the fifth level. Analysis of data on groundwater tracing carried out in the area of southern Dalmatia and conclusion on karst watersheds.</p>
<p>Learning outcomes of the curricular unit (knowledge, skills and competences to be developed by the students)</p>	<p>Knowledge: Define the concept of scale in hydrogeology and explain its effect through permeability properties Describe the basic concept of the Earth's thermal regime and relate it to the genesis and dynamics of thermal waters Describe the geochemical cycle Interpret the chemical composition of water Define and graphically represent hydrochemical facies Analyze the spring hydrograph Explain how to determine groundwater reserves Describe the hydrogeological systems of Croatia</p> <p>Skills: Apply hydrogeological maps in the description of hydrogeological features of the area Assess the significance of a particular hydrogeological system for a water supply</p> <p>Competences: ,</p>
<p>Assessment methods and criteria</p>	<p>exam</p> <p>Teaching methodologies are: lectures, project and independent assignments. Students will have to finish hidrogeological project for evaluation.</p> <p>Through the course students will learn about hydrogeological interpretations on a regional scale.</p>
<p>Recommended readings</p>	<p>Struckmeier, W.F. & Margat, J. (1995): Hydrogeological maps, A guide and a standard legend, pp. 177., International association of hydrogeologist, Verlag Heinz Heise, Hannover</p>

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TU Coordinator	Željko Duić/Jelena Parlov,					
Contribution to EIT’s Overarching Learning Outcomes (tick relevant box/es)*	OLO 1 Entrepreneurship	OLO2 Innovation	OLO3 Creativity	OLO4 Intercultural	OLO5 Value judgments / Sustainability	OLO6 Leadership
					Students will learn about importance of groundwater reserves and its preservation.	
Justification for OLO contribution						

EIT label – Teaching units <TIMREX – T-shaped Master Programme for Innovative Mineral Resource Exploration>

Course title	Industrial Mineral Deposits and Applications		
European Credits (ECTS)	5	Time (hours) given to the students	60
Type (Lecture, internship, exercise etc.)	Lectures: 2, Auditorium classes: , Lab. Classes: , Project classes: , Practical classes: 2, Seminar classes: x, Fieldwork:	Student whole working time (hours)	125
Description of content	<p>The objective of the course is to learn about the physicochemical and geological conditions of formation of deposits of the main industrial minerals and their application in industry.</p> <p>The course covers all important data about industrial minerals and its application.</p> <p>L1 - Definitions of terms: (1) ore mineral and (2) industrial mineral. Classifications of industrial minerals.</p> <p>L2 - Physicochemical conditions for the formation of clay deposits. Industrial clays: Kaolins, bentonites, sepiolites and palygorskites.</p> <p>L3 - Mineralogy and geology of kaolin deposits. Application of kaolin in industry.</p> <p>L4 - Mineralogy and geology of bentonite, sepiolite and palygorskite deposits. Application in industry.</p> <p>L5 - Construction clays and industrial applications.</p> <p>L6 - Physicochemical conditions of bauxite deposits. Laterite and karst bauxites. Application of bauxite in industry.</p> <p>L7 - Quartz mineral raw materials (quartz crystals, quartz sands and sandstones, SiO₂ as chemical and biogenic sediment, diatomite, flint). Feldspar deposits. Application of quartz mineral raw materials and feldspar in industry.</p> <p>L8 - Physicochemical conditions of evaporite formation. Deposits of gypsum and anhydrite.</p> <p>L9 - Deposits of halite, sylvine, soda, borate, Mg and Li salts.</p> <p>L10 - Physicochemical conditions of phosphate formation. Apatite and phosphorite deposits. Phosphate application in industry.</p> <p>L11 - Deposits of barite, fluorite and refractory materials. Application of barite, fluorite and refractory materials in industry.</p> <p>L12 - Deposits of pyrite and sulphur. Application of pyrite and sulphur in industry.</p> <p>L13 - Physicochemical conditions of zeolite formation. Zeolite deposits. Application of zeolite in industry.</p> <p>L14 - Pigments and their application in industry.</p> <p>L15 - Graphite deposits. Application of graphite in industry.</p>		
Learning outcomes of the curricular unit (knowledge, skills and competences to be developed by the students)	<p>Knowledge: Identify and describe the types of deposits of industrial minerals</p> <p>Analyse and argue the physicochemical and geological conditions for the formation of deposits of industrial minerals</p> <p>Prepare a plan for the exploration of industrial mineral deposits to determine the potential for industrial application</p> <p>Evaluate the quality of industrial mineral deposits</p>		

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	<p>Demonstrate the technological processes of manufacturing bricks, tiles, glass, cement and refractory materials. Evaluate and recommend the application of industrial minerals in agriculture and various industries. Skills: Competences: ,</p>					
Assessment methods and criteria	<p>exam Methodologies are: lectures, seminars, workshops and independent assignment. The examination will be taken orally. Requirements for taking the exam are: 1. committed and positively evaluated assignments in the internship 2. submitted and held seminar paper 3. submitted field report 4. positively evaluated both colloquia Main processes of forming industrial mineral and its application will be introduced to students through the lectures and practical work.</p>					
Recommended readings	<p>1. Manning, D.A.C. (1995): Introduction to industrial minerals, Chapman & Hall, 276s. 1. Manning, D.A.C. (1995): Introduction to industrial minerals, Chapman & Hall, 276s. 2. Evans, A. M. (1993): Ore geology and industrial minerals, Blackwell Science Publications, 389s. 3. Chang, L. L. Y. (2002): Industrial mineralogy, Prentice Hall, 472. 4. Harben, P. W. & Kužvart, M. (1997): Industrial minerals-A global geology, Industrial Minerals Information, 476s.</p>					
TU Coordinator	Goran Durn, goran.durn@rgn.hr					
Contribution to EIT's Overarching Learning Outcomes (tick relevant box/es)*	<p>OLO 1 Entrepreneurship</p>	<p>OLO2 Innovation</p>	<p>OLO3 Creativity</p>	<p>OLO4 Intercultural</p>	<p>OLO5 Value judgments / Sustainability</p>	<p>OLO6 Leadership</p>
	<p>Students will prepare a plan for the exploration of industrial mineral deposits to determine the potential for industrial application.</p>				<p>Students will learn about importance of Industrial Mineral Deposits and its Applications and applying of the regulations.</p>	
Justification for OLO contribution						

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Course title	Analytical methods in ore deposits		
European Credits (ECTS)	5	Time (hours) given to the students	60
Type (Lecture, internship, exercise etc.)	Lectures: 2, Auditorium classes: , Lab. Classes: x, Project classes: , Practical classes: 2, Seminar classes: , Fieldwork:	Student whole working time (hours)	125
Description of content	<p>The aim of this course is to review the most important analytical methods and applications in the mineral deposits investigation in order to determine mineralogical, geochemical and isotopic composition and reconstruction of genetic processes. The course covers: microscopy in transmitted and reflected light, electron microscopy and electron microprobe, microthermometry of fluid inclusions, ion chromatography, vitrinite reflection, crystallinity of chlorite, illite and graphite, atomic absorption and emission spectroscopy, inductively coupled plasma mass spectrometry (ICP-MS), stable and radiogenic isotopes.</p> <p>This course gives students knowledge about analytical methods in mineral deposits exploration.</p> <p>Polarised light microscopy - Contact-metamorphic reactions; Mineral stability fields; Alteration reactions. Reflected light microscopy - Fundamentals of ore microscopy (optical properties in reflected light); examples of the most important structures and textures; Interpretation. Electron microscopy / EMPA - Basics principles; Detectors; Application and interpretation; Geothermobarometric use in equilibrium systems; Sample preparation.</p> <p>Microthermometry of fluid inclusions - Basics principles; Application and interpretation; Sample preparation. Ion chromatography - Basics principles; Application in ore deposits; t / c conditions; Sample preparation. Vitrinite reflection / Crystallinity of chlorite / illite / graphite - Basics principles; Application in ore deposits; t / c conditions; Sample preparation (illiterate crystallinity); AAS; AES; ICP-MS; Stable isotopes (oxygen, hydrogen, carbon); Radiogenic isotopes (K / Ar; Rb / Sr; Sm / Nd; U / Th / Pb, fission-tracks) - Basics principles; Application in ore deposits; Data interpretation.</p>		
Learning outcomes of the curricular unit (knowledge, skills and competences to be developed by the students)	<p>Knowledge: To explain the application of individual method, principle, sample preparation and instrument characteristics</p> <p>To prepare a geological sample for selected methods (sawing, grinding, polishing, pulverizing, dissolving, diluting, etc)</p> <p>To determine mineral paragenesis, structures and textures in plane-polarised regular and reflected light</p> <p>To determine the succession (phases) of crystallization (pre-ore; ore and post-ore stage) and subsequent alterations</p> <p>To interpret obtained analytical data and determine composition of fluids, pressures and temperatures of formation of ore deposits and alterations.</p> <p>To interpret the micro, macro and trace element composition.</p> <p>To interpret the results of stable isotope analysis and conclude on the source fluid.</p> <p>To interpret the results of radiogenic isotopes in order to determine the age of the host rock, mineralization, and</p>		

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	subsequent events. Skills: Competences: ,					
Assessment methods and criteria	exam Students will have lectures, practicum, independent assignments, and at the end oral exam. Students will learn about most important analytical methods and applications in the mineral deposits investigation through practicum, and independent assignments.					
Recommended readings	Reed, S. J. B. (2010): Electron Microprobe Analysis and Scanning Electron Microscopy in Geology. Cambridge University Press, 201 p.					
TU Coordinator	Sibila Borojević Šoštarić, sibila.borojevic-sostaric@rgn.hr					
Contribution to EIT's Overarching Learning Outcomes (tick relevant box/es)*	OLO 1 Entrepreneurship	OLO2 Innovation	OLO3 Creativity	OLO4 Intercultural	OLO5 Value judgments / Sustainability	OLO6 Leadership
			Students will review the most important analytical methods and applications in the mineral deposits investigation.			
Justification for OLO contribution						

EIT label – Teaching units <TIMREX – T-shaped Master Programme for Innovative Mineral Resource Exploration>

Course title	Geophysical Exploration of Mineral Resources		
European Credits (ECTS)	3	Time (hours) given to the students	30
Type (Lecture, internship, exercise etc.)	Lectures: 2, Auditorium classes: , Lab. Classes: x, Project classes: , Practical classes: 0, Seminar classes: , Fieldwork:	Student whole working time (hours)	75
Description of content	<p>Mastering the specialist geophysical methods of measurement and interpretation applied in the exploration of construction materials deposits and solid raw mineral materials.</p> <p>The course goes through the key points of geophysical methods for prospection and exploration of mineral deposits.</p> <p>Magnetometric exploration. Magnetometric data interpretation methods.</p> <p>Aeromagnetometric exploration. Magnetometric exploration of solid raw materials.</p> <p>Field survey design for characteristic geological models.</p> <p>Gravity exploration. Gravity map transformations - goal, transformation methods, application.</p> <p>Microgravity exploration. Gravity modelling and application in raw minerals exploration.</p> <p>Electrical tomography. Theoretical foundations. Measurement geometry. Tomographic inversion. Electrical tomography instruments.</p> <p>Electrical tomography in the exploration of construction materials deposits.</p> <p>Electromagnetic exploration. TURAM method, Electromagnetic method using moving transmitter, VLF method, magnetotelluric method - theoretical foundations, instruments, data processing, interpretation and application.</p> <p>Georadar - theoretical foundations, field measurement methods, resolution and depth, instruments, application.</p> <p>Seismic measurements in wells. "Down-hole" and "Cross-hole" methods – measuring methods, instruments, application.</p> <p>Refraction seismics. Methods of refraction data interpretation: DTM, Delta – t – V, GRM and refraction tomography.</p> <p>High resolution reflection seismics (HRS method) – conducting exploration, data processing, interpretation.</p> <p>Seismic modelling. Synthetic seismogram - construction of synthetic seismogram, application of synthetic seismogram.</p>		
Learning outcomes of the curricular unit (knowledge, skills and competences to be developed by the students)	<p>Knowledge: To control principles of working with instruments for magnetometric exploration.</p> <p>To control principles of working with instruments for electric and electromagnetic exploration.</p> <p>Skills: To be able to interpret the obtained magnetometric measurements data.</p> <p>To be able to interpret the obtained gravimetric measurements data.</p> <p>To be able to interpret the obtained electrical tomography data.</p> <p>To be able to determine the first arrivals of the waves when measuring seismic velocities in a well.</p>		

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	<p>To be able to calculate mean and interval speeds and interpret the obtained data. To be able to choose the optimal geophysical exploration methods in the construction material deposits exploration. To be able to conduct geophysical exploration in the specific geological models in terms of solid raw materials exploration. Competences: ,</p>					
Assessment methods and criteria	<p>exam Students will have lectures, practicum, independent assignments, and at the end oral exam. By lectures, seminars and workshops students will study about specialistic geophysical methods in the exploration of materials deposits.</p>					
Recommended readings						
TU Coordinator	Franjo Šumanovac,					
Contribution to EIT's Overarching Learning Outcomes (tick relevant box/es)*	OLO 1 Entrepreneurship	OLO2 Innovation	OLO3 Creativity	OLO4 Intercultural	OLO5 Value judgments / Sustainability	OLO6 Leadership
			Students will have to interpret different geophysical data and make conclusions about mineral deposits and its main characteristics.			
Justification for OLO contribution						

EIT label – Teaching units <TIMREX – T-shaped Master Programme for Innovative Mineral Resource Exploration>

Course title	Field and laboratory practicum		
European Credits (ECTS)	6	Time (hours) given to the students	120
Type (Lecture, internship, exercise etc.)	Lectures: , Auditorium classes: , Lab. Classes: x, Project classes: , Practical classes: 128, Seminar classes: , Fieldwork: x	Student whole working time (hours)	150
Description of content	<p>Students will be introduced to various field and laboratory methods used in exploration of mineral deposits. Students will be trained to recognize mineralization, visualize 3D geological structures, and reconstruct geological history. Most of the activities will be related to proper geological fieldwork: observation, personal filed book, interpretation and sampling. Furthermore, students will analyse the collected geological samples of water, soil, rocks, sediments, minerals in the laboratories. Finally, they will learn to combine and interpret obtained field and laboratory results with previous geological research and produce and present geological expert reports.</p> <p>Through the course students will be introduced to various field and laboratory methods used in exploration of mineral deposits.</p> <p>The course consists of geophysical, geological and geochemical field exercises and laboratory analysis on sampled geological materials, and takes place in 15 terms of 8 hours. The field part of the course will be conducted jointly on two training grounds for the exploration of mineral deposits and two selected deposits of industrial minerals in the Republic of Croatia. At the training grounds for exploration of the mineral deposits, students will perform geophysical measurements, surface and underground mapping with the preparation of associated geological maps and profiles with indicated mineralization positions and conduct field geochemical prospecting on selected media. At selected deposits of industrial minerals, students will be introduced to the complete cycle of mineral raw materials, from geological prospecting and exploitation to the processing, final products and waste disposal. The laboratory part will include the preparation and analysis of sampled geological materials.</p> <p>Field days (13 days)</p> <p>Training grounds for exploration of mineral deposits (11 days of joint fieldwork)</p> <ol style="list-style-type: none"> 1) Geophysical prospecting (2 days) 2) Mapping of surface mineralization and preparation of geological map and profile (2 days) 3) Mapping of underground exploitation (3 days) 4) Sampling of host rocks and alteration zones proximal and distal to mineralization (2 days) 5) Geochemical prospecting - sampling of geological materials and in-situ measurement of basic geochemical 		

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	<p>parameters (1 day) 6) Additional independent work of students (1 day)</p> <p>Mineral raw materials cycle - industrial materials of the Republic of Croatia (2 days): 7) From ceramic clay and quartz sand to bricks (ceramic clay deposit, quartz sand deposit, brick factory; 1 day) 8) From natural gypsum to gypsum boards (gypsum bed, gypsum board factory; 1 day) Laboratory days (2 days) 1) Preparation and analysis of geological materials sampled during geochemical prospecting at the polygon for exploration of mineral deposits.</p>					
Learning outcomes of the curricular unit (knowledge, skills and competences to be developed by the students)	<p>Knowledge: To select a suitable geophysical method for exploration of the mineral deposit To prepare a geological map and the corresponding profile with the indicated types of mineralization To prepare laterally developed underground mine map To analyse chemical composition of the geological materials using standardised laboratory procedures and normative. To describe the overall process of mineral raw materials starting from exploration and exploitation to the processing and final product, highlighting the primary raw materials properties. Skills: To sample various geological materials (minerals, rocks, sediment, soil, water) for the purpose of exploration of the mineral deposits. To conduct field measurements of selected parameters in geological materials (eg pH, EC, redox potential, radioactivity) for the purpose of geochemical prospecting. Competences: ,</p>					
Assessment methods and criteria	<p>practical mark Students will have field and laboratory work, work with mentor, project assignments. Students will be introduced to various field and laboratory methods used in exploration of mineral deposits through field and laboratory work.</p>					
Recommended readings	<p>FOREGS Geochemical Mapping Field Manual. Geological Survey of Finland, Espo, 1998. Marjoribanks, R. (2010) Geological Methods in Mineral Exploration and Mining, Springer, 238 s.</p>					
TU Coordinator	<p>Sibila Borojevic Šoštarić, sibila.borojevic-sostaric@rgn.hr</p>					
Contribution to EIT's Overarching Learning Outcomes (tick relevant box/es)*	OLO 1 Entrepreneurship	OLO2 Innovation	OLO3 Creativity	OLO4 Intercultural	OLO5 Value judgments / Sustainability	OLO6 Leadership
	Students will be introduced to					

EIT label – Teaching units <TIMREX – T-shaped Master Programme for Innovative Mineral Resource Exploration>

	<p>various field and laboratory methods and work used in exploration of mineral deposits where all skills will be developed.</p>					
<p>Justification for OLO contribution</p>						

EIT label – Teaching units <TIMREX – T-shaped Master Programme for Innovative Mineral Resource Exploration>

Course title	Analyses of mineral paragenesis		
European Credits (ECTS)	3	Time (hours) given to the students	45
Type (Lecture, internship, exercise etc.)	Lectures: 1, Auditorium classes: , Lab. Classes: x, Project classes: , Practical classes: 2, Seminar classes: , Fieldwork:	Student whole working time (hours)	75
Description of content	<p>The goal of the course is to train the students in microscopic analysis of different generations of mineral parageneses in magmatic and metamorphic rocks and their interpretation in the light of petrogenesis and later evolution of these rocks in the certain geotectonic environment.</p> <p>Students will acquire knowledge about mineral paragenesis of magmatic and metamorphic rocks and its interpretation. The definition of the mineral paragenesis. Primary and secondary mineral parageneses in the magmatic rocks. Postequilibration and postconsolidation changes of primary magmatic minerals and the origin of secondary parageneses: (1) resorption and late magmatic subsolidus reactions; (2) hydrothermal alterations and (3) the changes caused by weathering. Phase relations in the crystallisation systems as the result of fractionation processes and reactions in the magmatic rocks. Phase diagrams (liquidus, solidus, binary and ternary eutectic, cotectic curves, solvus, peritectic point). Two-component systems with the eutectic point, with continuing solid solution crystal serie and the new compound which melts incongruently. Three-component systems with the clinopyroxene and plagioclase, with alkali feldspars and quartz, with plagioclase, clinopyroxene and olivine and forsterite, anorthite and quartz.. The influence of volatiles on the crystallisation of the system. The explanation of genesis of different magmatic textures, intergrowths and exsolutions by phase diagrams (ophitic texture, intergranular texture, graphic and myrmekitic intergrowths, perthite/antiperthite). The exsolution process in the different minerals (pyroxenes, feldspars, calcite, ilmenite, biotite). Disequilibrium state: a) the occurrence of zoning (concentric, patchy, sector, normal, reversal and oscillatory zoning) in different minerals; b) the occurrence of “sieve” texture. Enclaves in the magmatic rocks: xenoliths, xenocrystals and microgranitoid enclaves. The differences in the mineral parageneses and textures in the crust peridotites and mantle peridotites. Ophiolite and their metamorphic sole. Precise classification and nomenclature of magmatic rocks on the basis of microtexture, primary and secondary parageneses and petrogenetic interpretation of the sequence of the processes in the evolution of certain magmatic rocks.</p>		
Learning outcomes of the curricular unit (knowledge, skills and competences to be developed by the students)	<p>Knowledge: To explain the ways of the origin of primary and secondary mineral parageneses in magmatic rocks.</p> <p>To distinguish mineral parageneses and microtextures in crust peridotites from those in the mantle peridotites in the ophiolite complexes.</p> <p>To classify magmatic rocks on the basis of microtextures, primary and secondary mineral parageneses and reconstruct the sequence of processes in the evolution of certain magmatic rocks.</p>		

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	<p>To distinguish different mineral parageneses and the sequence of their formation in the metamorphic rocks.</p> <p>Skills: To apply phase diagrams in the interpretation of genesis of different microtextures, intergrowths and exsolutions inside of minerals in magmatic rocks.</p> <p>To use evident signs of disequilibrium in minerals and rocks in the interpretation of their crystallisation and later evolution and petrogenesis, respectively. To apply different types of mineral recrystallization and their deformations to deduce the p-T evolution of the metamorphic rocks.</p> <p>Competences: ,</p>					
Assessment methods and criteria	<p>exam</p> <p>Teaching methodologies are: lectures, laboratory, independent assignments and exercises with petrographic microscope. At the end students will have oral exam.</p> <p>Main emphasis is on application of determining mineral paragenesis in determining different samples through exercises and independent assignments.</p>					
Recommended readings						
TU Coordinator	Vesnica Garašić, vesnica.garasic@rgn.hr					
Contribution to EIT's Overarching Learning Outcomes (tick relevant box/es)*	OLO 1 Entrepreneurship	OLO2 Innovation	OLO3 Creativity	OLO4 Intercultural	OLO5 Value judgments / Sustainability	OLO6 Leadership
			Students will have to interpret mineral paragenesis and make conclusions about genesis of rocks.			
Justification for OLO contribution						

EIT label – Teaching units <TIMREX – T-shaped Master Programme for Innovative Mineral Resource Exploration>

Course title	MSc thesis					
European Credits (ECTS)	20	Time (hours) given to the students			15	
Type (Lecture, internship, exercise etc.)	Lectures: , Auditorium classes: , Lab. Classes: , Project classes 1: , Practical classes: , Seminar classes: , Fieldwork:	Student whole working time (hours)			500	
Description of content	<p>The master thesis for the student aims to prove the ability of independent analysing and solving complex engineering tasks/problems in the field of geology related to the master thesis topic.</p> <p>The master thesis is a paper in which the student must demonstrate the ability of independent analysis and solving a given engineering problem/task in the field of geology using the knowledge acquired through graduate study from a theoretical and practical point of view.</p>					
Learning outcomes of the curricular unit (knowledge, skills and competences to be developed by the students)	<p>Knowledge: To define a professional problem / task To summarise master thesis in English To apply the methodology of writing a professional and scientific paper To write master thesis linguistically and ethically correct To apply the acquired knowledge and general competencies acquired through graduate study To interpret research results</p> <p>Skills: To solve a complex practical problem / task. To argue the results of the conducted research in an expert discussion</p> <p>Competences: To respect ethical norms and rules of citing literature, To design and conduct research.</p>					
Assessment methods and criteria	<p>practical mark</p> <p>The student is obliged to apply for one of the offered topics, make a plan of activities with the mentor and submit the master thesis for evaluation within the given deadlines, prepare a presentation and defend the master thesis in front of the committee.</p>					
Recommended readings	Selected literature based on the topic of master thesis and according to the mentor's recommendation.					
TU Coordinator	All teachers in the scientific-teaching profession					
Contribution to EIT's Overarching Learning Outcomes (tick relevant)	OLO 1 Entrepreneurship	OLO2 Innovation	OLO3 Creativity	OLO4 Intercultural	OLO5 Value judgments /	OLO6 Leadership

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box(es)*					Sustainability	
	The student will develop all skills through work on the master thesis and through solving complex engineering tasks/problems.					
Justification for OLO contribution						

Semester 4
WUST

EIT label – Teaching units <TIMREX – T-shaped Master Programme for Innovative Mineral Resource Exploration>

Course title	Applied field exploration					
European Credits (ECTS)	3	Time (hours) given to the students			45	
Type (Lecture, internship, exercise etc.)	Lectures: , Auditorium classes: , Lab. Classes: , Project classes: , Practical classes: , Seminar classes: , Fieldwork: 3	Student whole working time (hours)			75	
Description of content	The goal of the course is that students should acquire a hands-on understanding of different field exploration methodologies, and how they can be integrated for targeting VMS deposits. Geological, geophysical and geochemical exploration methods in VMS exploration. Practical field mapping exercises in structural geology, stratigraphy, hydrothermal alteration. Practical geophysical surveying using UAV technology. GIS-based data synthesis for exploration target selection. Drill core logging and assaying.					
Learning outcomes of the curricular unit (knowledge, skills and competences to be developed by the students)	<p>Knowledge: when passed the student is expected to have:</p> <ul style="list-style-type: none"> -knowledge about different field methods and their use during an exploration program. -knowledge about drilling and sampling methods. -knowledge about different methods for field mapping. <p>Skills: when passed the student is expected to have the ability to</p> <ul style="list-style-type: none"> - acquire in-depth structural, volcanological and alteration data from outcrops in the field - contextualize field observations in relation to ore genetic model for VMS deposits. - synthesize different types of geological and geophysical data for targeting a VMS deposit. <p>Competences: ,</p>					
Assessment methods and criteria	<p>Exercises U G# 1.20 Project work G U 3 4 5 1.80 The course is mainly presented via practicals in the field, but also with complementary lectures and exercises, in addition to project work.</p>					
Recommended readings	Online compendium in Canvas room					
TU Coordinator	Nils Jansson, Nils.Jansson@ltu.se					
Contribution to EIT's Overarching Learning Outcomes (tick relevant box/es)*	OLO 1 Entrepreneurship	OLO2 Innovation	OLO3 Creativity	OLO4 Intercultural	OLO5 Value judgments / Sustainability	OLO6 Leadership

EIT label – Teaching units <TIMREX – T-shaped Master Programme for Innovative Mineral Resource Exploration>

Justification for OLO contribution	
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EIT label – Teaching units <TIMREX – T-shaped Master Programme for Innovative Mineral Resource Exploration>

Course title	SOC Internship		
European Credits (ECTS)	2	Time (hours) given to the students	30
Type (Lecture, internship, exercise etc.)	Lectures:, Auditorium classes: , Lab. Classes: , Project classes: 2 , Practical classes:, Seminar classes: , Fieldwork: x	Student whole working time (hours)	50
Description of content	<p>The aim of the course is to enable students to work in socially responsible workplaces, and apply their skills and knowledge to promote social good. While this develops them to become work-ready professionals, it also nurtures them to become advocates who help build a better world.</p> <p>EDUCATIONAL GOALS:</p> <ol style="list-style-type: none"> 1. To actively participate in the affairs of the community and in concrete actions on the ground that aim to promote the public interest, equality and solidarity. 2. To reflect on social license to operate issues 3. To work in direct contact with the beneficiaries of the civic activities undertaken e.g.: reception, facilitation, support, social assistance, etc. <p>EXAMPLES OF SOCIAL AND CIVIC ISSUES IN MINERALS INDUSTRIES:</p> <ul style="list-style-type: none"> • Depletion of natural capital (degradation of air, land and water quality), land use conflicts, health impacts • Digitalization and automation generate particular challenges for well-being in mining regions. Limited job opportunities for local workforce and skills mismatches. • High and continuous transparency and accountability standards of the industry, effective methods of information sharing and dialogue • A more equitable value-sharing, Corporate Social Responsibility issues • Facilitation of environmental awareness • Preservation and restoring of historic sites, 		
Learning outcomes of the curricular unit (knowledge, skills and competences to be developed by the students)	<p>Knowledge: to understand that social responsibility incorporates an ethical, social and environmentally-friendly perspective to our personal and professional activities</p> <p>Skills: To be able to engage in an informal professional discussion and business communication</p> <p>Competences: To cope with complexity, uncertainty and change in global contexts</p>		

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Assessment methods and criteria	Criterion: Submission of a project report					
Recommended readings						
TU Coordinator	Supervisors of the student’s Master thesis					
Contribution to EIT’s Overarching Learning Outcomes (tick relevant box/es)*	OLO 1 Entrepreneurship	OLO2 Innovation	OLO3 Creativity	OLO4 Intercultural	OLO5 Value judgments / Sustainability	OLO6 Leadership
	Students will be engaged in professional discussion and business communication				Students will be able to understand that social responsibility incorporates an ethical, social and environmentally-friendly perspective to our personal and professional activities	
Justification for OLO contribution						

Course title	Exploration entrepreneurship		
European Credits (ECTS)	4	Time (hours) given to the students	60
Type (Lecture, internship, exercise etc.)	Lectures: 1, Auditorium classes: , Lab. Classes: , Project classes: 1, Practical classes: 3, Seminar classes: 2, Fieldwork:	Student whole working time (hours)	100
Description of content	<p>To equip students with the professional skills to increase their employability and entrepreneurship skills to meet the current market demands. The EFGeoMentoring scheme aims at improving international networking and supporting the life-long learning and CPD requirements of experienced geology professionals. In addition, it allows students to benefit from insider knowledge about international work perspectives in different sectors of geological profession and countries.</p> <p>Mentoring within the course is a process during which an experienced professional with and EurGeol title (mentor) accompanies the student in a targeted way. Mentoring contributes to developing personal, entrepreneurial, networking, social and professional skills regarding the mineral prospecting and exploration activity. It allows learning from professional experiences that can only be acquired through practice and can't be found in any textbook. Mentoring improves the opportunities of career beginners by providing career-enhancing contacts and involvement in professional networks.</p> <p>At the beginning of the mentoring cooperation, students formulate clear goals and communicate them to their mentor. In consultation with the mentor, concrete topics and the respective roles within the mentoring process will be defined. Since the student is at the centre of the process, it is their task to become aware of their own plans and their support needs.</p> <p>OBJECTIVES OF THE MODULE:</p> <ul style="list-style-type: none"> • Intensify international networking among geologists all across Europe and beyond • Provide young professionals with contacts helping them to think through, plan and access their short, medium or long-term career development • Contribute on internship positions • Improve gender balance and increase diversity in leadership positions by providing targeted support to women and under-represented minorities • Facilitate life-long learning and Continuing Professional Development (CPD) <p>The EFG mentors are professionals who have acquired a high level of industrial and/or academic experience and work in industrial practice, business, academia, education or administration.</p> <ul style="list-style-type: none"> • Coaching: The mentor actively guides and encourages the student to develop essential skills and attitudes for the future ("How do I assert myself? How do I behave in negotiations? What do I do in challenging work contexts?") • Advice: The mentor advises the student in concrete situations, in current questions and difficulties. Mentors support students in solving problems and assist them in making tough decisions. 		

	<ul style="list-style-type: none"> • Help: The mentor can help open otherwise locked doors that allow the student to pursue their goals. • Support: The mentor supports the student in essential decisions without deciding. Mentors assist in the development of professional strategies, as well as in career planning and review of possible obstacles. • Inform: The mentor informs the student about (informal) rules and processes applied in organisations or professional life in general. According to the student's background, mentors can also inform about seminars or conferences that they consider helpful. • Participation: Mentors allow students to participate in parts of their professional career, experiences and strategic decisions. They allow students to share their professional life and invite them, for instance, to participate in meetings or appointments. • Give feedback: Mentor and student provide each other with constructive feedback about their appearance and public perception. • Networking: Mentors give the students hints on maintaining and using contacts. They introduce the students into active networks and provide professional contacts. The mentor provides the student with the chance to create a successful CV and take a chance on social networks such as LinkedIn.
<p>Learning outcomes of the curricular unit (knowledge, skills and competences to be developed by the students)</p>	<p>Knowledge: to provide background training to support the learning process; make students aware of broad professional issues; provide business and entrepreneurship skills to develop an awareness of business management and commercial practices regarding mineral prospecting and exploration.</p> <p>Skills: Develop relationships with other persons and maintain them. Can talk frankly about his ideas, fears and weaknesses. Identifying investment opportunities in the mineral resources sector.</p> <p>Competences: To define professional targets, wants to succeed and is actively committed to implementing these targets. Not afraid of making mistakes and experimenting with new ideas. Willing to question himself critically, accept external advice, and implement it.</p>
<p>Assessment methods and criteria</p>	<p>Practical mark</p> <p>At the end of the mentoring process, students will a) reflect their mentoring experience on a two-page report highlighting benefits and potential gaps for future implementation b) prepare a small business plan for an identified innovative idea of their own.</p> <p>Slack channel will allow for student-mentor exchange and networking within the whole cohort of participants.</p> <p>Mentoring is a one-to-one relationship between a mentor and a student.</p> <ul style="list-style-type: none"> • Mentoring takes place beyond a dependent relationship (e.g. supervisor-subordinate or professor-student relationships). • During the mentoring process, learning and experimentation occur in a protected environment. • An integral part of mentoring is the development of professional skills and competencies. <p>Mentoring is a reciprocal process of "give and take". Both sides learn from each</p>

	other because even the mentor will have the opportunity to critically question his professional perspective and discover new perspectives, software and applications, and previously unperceived situations.					
Recommend ed readings	<p>Mentoring Mindset, Skills and Tools 4th Edition: Make it easy for mentors and students, 2020, Synergetic People Development Pty Ltd, 252 pages, ISBN 0980356458</p> <p>The Mentoring Guide: Helping Mentors and Students Succeed, 2019, Michigan Publishing Services, ISBN: 1607855399.</p> <p>Wang, J., Shibayama, S., 2022. Mentorship and creativity: Effects of mentor creativity and mentoring style. Research Policy 51, 104451. doi:10.1016/j.respol.2021.104451</p> <p>Entrepreneurship: A Guide To Success For Entrepreneurs And Aspiring Entrepreneurs, 2018, ISBN 978-1720221654</p> <p>Entrepreneurship: Successfully Launching New Ventures, Global Edition, 2018, Pearson, ISBN: 9781292255330</p>					
TU Coordinator	Pavlos Tyrologou, pavlos.tyrologou@gmail.com					
Contribution to EIT's Overarching Learning Outcomes (tick relevant box/es)*	OLO 1 Entrepreneurship	OLO2 Innovation	OLO3 Creativity	OLO4 Intercultural	OLO5 Value judgments / Sustainability	OLO6 Leadership
	XX		X	XX	XX	XX
Justification for OLO contribution						

COURSE DESCRIPTIONS/ KARTY PRZEDMIOTÓW

**second-level studies/ studia II stopnia
main field of study/ kierunek studiów:
Mining and Geology/ Górnictwo I Geologia**

**specjalność/specialisation:
Mineral Resources Exploration
- Track UNI ZAGREB -WUST**

Semester 1 and 2
UNI ZG

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University of Zagreb, RGNF

Course title	Sedimentology		
European Credits (ECTS)	5	Time (hours) given to the students	75
Type (Lecture, internship, exercise etc.)	Lectures: 2, Auditorium classes: , Lab. Classes: , Project classes: , Practical classes: 3, Seminar classes: , Fieldwork: x	Student whole working time (hours)	125
Description of content	<p>to acquire the main techniques in defining sedimentary facies, to recognize sedimentation processes, to recognize the basic features of modern and palaeo- depositional environments, to recognize and interpret characteristic sedimentary sequences, to analyse all elements present in the sedimentary environment and interpret possible depositional environment</p> <p>This course gives students knowledge about sedimentary processes and its interpretation.</p> <p>L1 - DEFINITION OF FACIES CYCLES AND SEDIMENTARY SEQUENCES L2 - WAYS OF VERTICAL SUCCESSIONS DISPLAY (SEDIMENTARY COLUMNS); WAYS AND POSSIBILITIES OF CORRELATION L3 - SEDIMENTARY ENVIRONMENT OF ALUVIAL FANS; TECTONIC SETTINGS, PROCESSES, CHARACTERISTIC SEQUENCES L4 - DEPOSITIONAL ENVIRONMENT OF BRAIDED, MEANDRING AND ANASTOMOSING RIVERS; TECTONIC SETTINGS, PROCESSES, CHARACTERISTIC SEQUENCES L5 - DELTAIC SEDIMENTARY ENVIRONMENT; PROCESSES, TYPES OF DELTAS; PARTS OF THE DELTA; CHARACTERISTIC SEQUENCE L6 – SILICICLASTIC SHORELINE; SILICICLASTIC SHELF / RAMP DEPOSITIONAL ENVIRONMENT; NEARSHORE SHELF / RAMP PROCESSES L7 – WAVE- TIDE- STORM-INFLUENCED SILICICLASTIC SHORELINE (SHELF/ RAMP) L8 – SHALLOW-MARINE CARBONATE ENVIRONMENTS; DEPOSITION ON CARBONATE PLATFORM (processes), CARBONATE RAMP / SHELF L9 - CHARACTERISTICS AND FACIES OF CARBONATE PLATFORM (according to Flügel, 2004) L10 - CHARACTERISTICS AND FACIES OF CARBONATE RAMP / SHELF (according to Flügel, 2004) L11 - EVAPORITIC SEDIMENTARY ENVIRONMENTS L12 - CARBONATE DIAGENESIS – DOLOMITES, KARST FORMATION L13 - DEEPWATER SEDIMENTARY ENVIRONMENTS - PELAGIC DEPOSITION IN THE OCEANS L14 - DEEPWATER SEDIMENTARY ENVIRONMENTS – RESEDIMENTED, MASS-FLOW DEPOSITS: DEBRITES, TURBIDITY</p>		

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	CURRENTS; CHARACTERISTICS OF TURBIDITE FANS L15 - MIXED (SILICLASTIC-CARBONATE) SEDIMENTARY ENVIRONMENTS - CHARACTERISTIC SEQUENCES					
Learning outcomes of the curricular unit (knowledge, skills and competences to be developed by the students)	<p>Knowledge: To conduct complex sedimentological investigations, including the construction of strata sequences, facies differentiation and interpretation of sedimentary environments.</p> <p>Skills: To construct general and thematic geological maps, as well as geological profiles with accompanying descriptions</p> <p>Competences: To engage in informed professional discussion and business communication,</p>					
Assessment methods and criteria	<p>exam</p> <p>During the semester the requirement for signature is attendance of lectures and practicum. Students will participate in research and practical work as part of practicum. At the end oral exam will be organized.</p> <p>Theoretical part is complemented by research work, practical work and field works where students will learn about sedimentology processes and depositional environment.</p>					
Recommended readings	Flügel, E., (2004): Microfacies of Carbonate Rocks; Analysis, Interpretation and Application. Springer (976 pp)					
TU Coordinator	Dunja Aljinović, dunja.aljinovic@rgn.hr					
Contribution to EIT's Overarching Learning Outcomes (tick relevant box/es)*	OLO 1 Entrepreneurship	OLO2 Innovation	OLO3 Creativity	OLO4 Intercultural	OLO5 Value judgments / Sustainability	OLO6 Leadership
	Students will be engaged in informed professional discussion and business communication		Students will have to construct general and thematic geological maps and profiles with accompanying descriptions			

EIT label – Teaching units <TIMREX – T-shaped Master Programme for Innovative Mineral Resource Exploration>

Justification for OLO contribution	
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EIT label – Teaching units <TIMREX – T-shaped Master Programme for Innovative Mineral Resource Exploration>

Course title	Mineral Deposits Exploration		
European Credits (ECTS)	5	Time (hours) given to the students	75
Type (Lecture, internship, exercise etc.)	Lectures: 2, Auditorium classes: , Lab. Classes: , Project classes: , Practical classes: 3, Seminar classes: x, Fieldwork:	Student whole working time (hours)	125
Description of content	<p>The objective of the course is to get acquainted with geological methods of exploring mineral deposits and their evaluation.</p> <p>The course contributes to skills of students which should be applied during geological part of exploration of mineral resources.</p> <p>L1 - Classification of mineral deposits. Economic aspects of mineral deposits.</p> <p>L2 - Nature and morphology of orebodies.</p> <p>L3 - Metallogeny, metallogenetic provinces and periods.</p> <p>L4 - Geological criteria in the exploration of mineral deposits. Magmatic control factor.</p> <p>L5 - Structural control factor.</p> <p>L6 - Geological models of mineral deposits as a basis for exploration planning. Reconnaissance. Selection and definition of areas for exploration of a mineral deposit.</p> <p>L7 - Application of geophysical methods and remote sensing in the exploration of mineral deposits.</p> <p>L8 - Prospecting indications (alteration, alteration mineral assemblages, ore outcrops and remains of old mining).</p> <p>L9 - Prospecting indications (indicator elements, indicator minerals).</p> <p>L10 - Geochemical prospecting methods.</p> <p>L11 - Sampling media (stream sediments, soil, lake sediments, sediment cover, water, gases, vegetation, rocks).</p> <p>L12 - Statistical processing of geochemical prospecting results.</p> <p>L13 - Sampling of mineral resources.</p> <p>L14 - Mining legislation. Categorisation and classification of mineral reserves.</p> <p>L15 - Calculation of mineral reserves. Preparation of a mineral reserves study.</p>		
Learning outcomes of the curricular unit (knowledge, skills and competences to be developed by the students)	<p>Knowledge: To describe all phases of raw materials exploration, from prospecting of deposits to the preparation of reports on raw materials reserves. To select basic geological, geochemical, geophysical, and statistical methods in exploration of selected mineral raw materials deposits.</p> <p>Skills: To apply statistical methods and spatial analyses in interpretation of laboratory and field measurements. To use information technology in computation and modelling of geological phenomena and processes. To identify the properties of geological materials and processes within hydrogeological, engineering geological and petroleum</p>		

EIT label – Teaching units <TIMREX – T-shaped Master Programme for Innovative Mineral Resource Exploration>

	<p>engineering investigation and mineral exploration. Competences: , To apply standards and (legal) regulations related to geological research, geohazards, environmental protection, water exploitation, exploitation of mineral resources or construction conditions. To interpret and summarize the results of field, laboratory and office research and prepare and present a geological expert report using other relevant data sources. To create geological reports for the economy and strategic documents.</p>					
Assessment methods and criteria	<p>exam The requirement for signature is attendance of lectures and practicum. Students will have to write seminar on specific topic, and have independent assignments. At the end oral exam will be organized. Through seminars and workshops, independent assignments and field works students will learn about mineral deposits and importance and methods of its exploration.</p>					
Recommended readings	<p>1. Moon, C.J., Whateley, M.G.K. & Evans, A.M. (2009): Introduction to mineral exploration, Blackwell Science, 496 s. 2. Anells, A.E. (1991): Mineral Deposits Evaluation, Chapman & Hall, 436 s</p>					
TU Coordinator	Goran Durn, goran.durn@rgn.hr					
Contribution to EIT's Overarching Learning Outcomes (tick relevant box/es)*	OLO 1 Entrepreneurship	OLO2 Innovation	OLO3 Creativity	OLO4 Intercultural	OLO5 Value judgments / Sustainability	OLO6 Leadership
	Students will create geological reports for the economy and strategic documents.	Students will apply statistical methods and spatial analyses in interpretation of laboratory and field measurements.	Students will apply statistical methods and spatial analyses in interpretation of laboratory and field measurements.		Students will apply standards and (legal) regulations.	
Justification for OLO contribution						

EIT label – Teaching units <TIMREX – T-shaped Master Programme for Innovative Mineral Resource Exploration>

Course title	Petroleum Geology		
European Credits (ECTS)	5	Time (hours) given to the students	75
Type (Lecture, internship, exercise etc.)	Lectures: 2, Auditorium classes: , Lab. Classes: , Project classes: , Practical classes: 3, Seminar classes: x, Fieldwork: x	Student whole working time (hours)	125
Description of content	<p>The goal is to acquire specific knowledge and skills in the field of petroleum geology, which are intended to prepare the students, future engineers for all aspects of exploration and exploitation of oil, gas, condensate and geothermal waters as well as for professional interaction with engineers of related professions in teamwork. Students acquire specific skills in the area of exploration and exploitation of oil and gas.</p> <p>Lectures (30 hours)</p> <p>Abiogenic theories of petroleum origin and biogenic theory of petroleum origin (presentation of arguments and guided discussion)</p> <p>Biomarkers as indicators of origin of source rocks and deposition conditions</p> <p>Types of kerogen (conditions of deposition of organic matter, composition and structure of kerogen)</p> <p>Pyrolysis of source rocks (generation and maturation parameters)</p> <p>Differences in porosity of clastic and carbonate sediments. Permeability of clastic and carbonate sediments. Correlations of porosity and permeability.</p> <p>Directions and ranges of primary and secondary migration in different stratigraphic-tectonic conditions</p> <p>Diagenetic processes important for the migration and accumulation of hydrocarbons</p> <p>Diapirism. Origin and processes during diapir movement. The significance of diapirism in petroleum geology. Diapirs in the Adriatic s</p> <p>An overview of the types of traps in the world</p> <p>Theoretical foundations of basin modelling</p> <p>Oil and natural gas reserves in conventional accumulations in the world</p> <p>Reflective seismic surveys - significance in petroleum geological exploration and limitations with regard to reservoir type</p> <p>Drilling of a deep exploratory well (TDC laboratory, Master Log)</p> <p>Application of the results of interpretation of well logging. Measurement systems with respect to energy sources: electrical, radioactive, sound. Influences on the results of geophysical measurements in wells: temperature, well diameter, influence of mud</p> <p>Specifics of exploration of unconventional oil and natural gas accumulations (ultra-deep accumulations, oil and natural</p>		

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	<p>gas in shales, natural gas in coal seams) Practical Exercises Comparison of effective porosity differences based on a simple experiment (weighing two dry samples of different effective porosity, immersing the samples in water for 15 minutes after which the samples are weighed again, and their porosity is estimated based on the change in mass) Luminescence of oil and natural gas (observation and description) Preparation of samples taken in the field (separation of fossil content by wet sieving, preparation of samples for analysis of total organic carbon content) Microscopy of fossil contents, discussion of observation results in terms of interpretation of sediment characteristics Analysis of total organic carbon content Project work (15 hours) Systematization of input data Shale volume analysis by interpreting the spontaneous potential curve Calculation of the share of rock thickness with reservoir properties within the total rock thickness (Net / Gross) Porosity analysis of reservoir rocks by interpretation of well - logs in a specialized computer program Making a contour map of the top of the reservoir in a computer software Making a contour map of the bottom of the reservoir in a computer software Making a map of the spatial distribution of the share of rock thickness with collector properties within the total rock thickness in a computer software Making a map of the spatial distribution of reservoir porosity in a computer software Making a cross-section through the reservoir Calculation of reserves based on the constructed reservoir model Making a simple 1D basin model</p> <p>Fieldwork (15 hours) Construction of geological column in clastic sedimentary rocks of Neogene age and sampling for assessment of generative potential of source rocks Construction of a geological column of a characteristic transgressive cycle of Neogene rocks Reconstruction of the circumstances that led to natural hydrocarbon outcrops</p>
<p>Learning outcomes of the curricular unit (knowledge, skills and competences to be developed by the students)</p>	<p>Knowledge: Interpret the results of analyses and measurements: laboratory and field (from outcrops and from wells) Bring conclusions about the generative-maturation properties of source rocks based on the results of pyrolysis Discuss the interconnectedness of the elements of the petrogeological system Describe the main elements of the drilling rig and the work of geologists during the drilling of deep wells Skills: Analyse the role of biomarkers in determining the origin of hydrocarbons (origin of organic matter and</p>

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	sedimentation environment). Estimate geological (total) reserves of hydrocarbon based on a simple reservoir model constructed in a computer software Competences: Assess the significance of petrophysical properties of reservoir and cap rocks for hydrocarbon accumulation and production. Compare research on conventional and unconventional hydrocarbon accumulations,					
Assessment methods and criteria	exam The requirement for signature is attendance of lectures and practicum. Students will have to write seminar on specific topic, and have independent assignments. At the end oral exam will be organized. Theoretical part is complemented by practical work through seminars and workshops, independent assignments and field works where students will learn about importance of geology in petroleum exploration.					
Recommended readings	Selected chapters: Velić, J. (2007): Geologija ležišta nafte i plina [Geology of Oil and Gas Reservoirs], Zagreb, Sveučilište u Zagrebu, Rudarsko-geološko-naftni fakultet, 2007 (university textbook)					
TU Coordinator	Marko Cvetković, Iva Kolenković Močilac, marko.cvetkovic@rgn.hr iva.kolenkovic@rgn.hr					
Contribution to EIT's Overarching Learning Outcomes (tick relevant box/es)*	OLO 1 Entrepreneurship	OLO2 Innovation	OLO3 Creativity	OLO4 Intercultural	OLO5 Value judgments / Sustainability	OLO6 Leadership
	Student will learn how to have professional interaction with engineers of related professions.					Student will work in teamwork.
Justification for OLO contribution						

EIT label – Teaching units <TIMREX – T-shaped Master Programme for Innovative Mineral Resource Exploration>

Course title	Engineering Geological Investigations		
European Credits (ECTS)	5	Time (hours) given to the students	60
Type (Lecture, internship, exercise etc.)	Lectures: 2, Auditorium classes: , Lab. Classes: , Project classes: , Practical classes: 2, Seminar classes: , Fieldwork:	Student whole working time (hours)	125
Description of content	<p>The objective is to adopt basic knowledge about engineering geological investigations for the purpose of design in civil engineering and mining.</p> <p>This course covers all important aspects of engineering geological investigations.</p> <p>Course content elaborated according to the schedule of lectures and exercises:</p> <p>T1: Lectures - Types of engineering geological investigations; Exercises - Review of geotechnical reports</p> <p>T2: Lectures - Engineering geological investigations in site investigations; Exercises - Description of natural characteristics of the investigated area</p> <p>T3: Lectures – Methods of detailed engineering geological investigations; Exercises - Geomechanical classification and engineering description of coarse grained soil</p> <p>T4: Lectures - Genetic classification of soil and rock mass, rock mass weathering and engineering geological profile; Exercises – Geomechanical classification and engineering description of fine grained soil</p> <p>T5: Lectures - Classification and categorization of rock mass; Exercises - Engineering geological description of rock mass – clastic rocks</p> <p>T6: Lectures - Methods of engineering geological investigations for site investigations related to foundation construction; Exercises – Engineering geological description of rock mass – carbonate rocks</p> <p>T7: Lectures - Methods of engineering geological investigations for site investigations related to slope constructions; Exercises - Classification and categorization of rock mass</p> <p>T8: Lectures - Methods of engineering geological investigations for site investigations related to dam construction; Exercises – Construction of borehole log</p> <p>T9: Lectures - Methods of engineering geological investigations for site investigations related to tunnel construction; Exercises - Correlation of exploration boreholes</p> <p>T10: Lectures - Methods of engineering geological investigations of active geomorphological and geodynamic processes; Exercises - Construction of engineering geological profile</p> <p>T11: Lectures - Engineering geological investigations and potential problems in soluble and clastic rocks; Exercises - Engineering geological mapping of tunnels – 1st Par</p> <p>T12: Lectures - Engineering geological investigations and potential problems in magmatic and metamorphic rocks;</p>		

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	<p>Exercises - Engineering geological mapping of tunnels – 2nd Part T13: Lectures - Review of the results of engineering geological investigations and preparation of technical documentation; Exercises - Engineering geological mapping of the road route – 1st Part T14: Lectures - Methods and results of regional engineering geological investigations; Exercises - Engineering geological mapping of the road route – 2nd Part T15: Lectures – Application of results of regional engineering geological investigations; Exercises - Reconnaissance engineering geological mapping in scale 1:5000</p>					
<p>Learning outcomes of the curricular unit (knowledge, skills and competences to be developed by the students)</p>	<p>Knowledge: Select appropriate level of site investigations for the purpose of different types of studies and projects from geotechnical engineering. Select appropriate type of regional engineering geological investigations for the purpose of different types of studies and projects. To make concept of detailed engineering geological investigations for different types of structures/constructions. Identify causes of active geomorphological processes (sliding, erosion, subsidence, etc.) and consequences of geodynamic processes (earthquakes) and to apply appropriate methods of engineering geological investigations. Identify weathering profiles in different rock types and to apply appropriate methods of engineering geological investigations. Identify potential geotechnical problems in different rock types for the purpose of performing engineering constructions in geotechnical engineering. Classify and to describe soil and rock mass according to different recommendations and standards in engineering. Skills: Evaluate the results of conducted research and testing. Construct an engineering geological profile and technical tunnel drawings Conduct reconnaissance engineering geological mapping Competences: ,</p>					
<p>Assessment methods and criteria</p>	<p>exam During the semester the requirement for signature is attendance of lectures. Students will participate in research and practical work as part of practicum. Students will have preliminary exam, written and oral exam. Theoretical part is complemented by practical work through project work and independent assignments.</p>					
<p>Recommended readings</p>	<p>Selected chapters from: De Vallejo, L.G., Ferrer, M., de Freitas, M. (2011): Geological Engineering. CRC Press, 700 p.</p>					
<p>TU Coordinator</p>	<p>Snježana Mihalić Arbanas, snjezana.mihalic-arbanas@rgn.hr</p>					
<p>Contribution to EIT's Overarching</p>	<p>OLO 1</p>	<p>OLO2 Innovation</p>	<p>OLO3 Creativity</p>	<p>OLO4</p>	<p>OLO5 Value</p>	<p>OLO6 Leadership</p>

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Learning Outcomes (tick relevant box/es)*	Entrepreneurship			Intercultural	judgments / Sustainability	
		Students will conduct reconnaissance engineering geological mapping.	Students will construct an engineering geological profile and technical tunnel drawings.		Students will apply standards and (legal) regulations.	
Justification for OLO contribution						

EIT label – Teaching units <TIMREX – T-shaped Master Programme for Innovative Mineral Resource Exploration>

Course title	Exploration Geochemistry		
European Credits (ECTS)	4	Time (hours) given to the students	45
Type (Lecture, internship, exercise etc.)	Lectures: 2, Auditorium classes: , Lab. Classes: , Project classes: x, Practical classes: 1, Seminar classes: , Fieldwork:	Student whole working time (hours)	100
Description of content	<p>Students will be introduced to the basic principles of geochemical prospecting, i.e., finding the geochemical anomaly caused by the weathering of the ore deposit. Students will be introduced to the behavior of trace elements in surface environments, sampling media (soil, water, sediment, plant rocks), chemical analysis of geological materials (AAS, ICP), statistical methods and interpretation of geochemical data. Students will develop their communication skills through oral presentation and writing reports related to project assignments. Students will acquire a basic knowledge about importance of geochemical prospecting.</p> <p>LECTURES</p> <ol style="list-style-type: none"> 1. Introduction to the course, basic principles of geochemical prospecting 2. Primary dispersion 3. Secondary dispersion 4. Sampling media, sampling and sample preparation for analysis 5. Instrumental analytical methods 6. Statistical methods in geochemical prospecting; background and threshold determination. 7. Construction of geochemical maps 8. Types of geochemical research and report writing 9-10. Principles of geochemical prospecting in environmental protection <p>EXERCISES (5 blocks of 3 hours)</p> <p>The 15 hours of exercises will include a series of individual tasks that students will have to solve independently and present orally and in the form of an essay. In addition to individual assignments, students will receive a geochemical prospecting project on which they will work throughout the semester in synergy with exercises from two other courses (Remote Mineral Exploration and GIS in Mineral Exploration) and prepare an geological report.</p>		
Learning outcomes of the curricular unit (knowledge, skills and competences to be developed by the students)	<p>Knowledge: To explain the behaviour of chemical elements in surface environments and the processes that control the geochemical anomaly.</p> <p>To select a suitable sampling medium, the proper sample preparation procedure, and the analytical method, as well as analyte in order to find the geochemical anomaly caused by the weathering of the ore body.</p>		

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	<p>Skills: To apply univariate, bivariate and multivariate statistical methods in the interpretation of geochemical data. To construct geochemical maps. Design preliminary, regional and detailed geochemical survey of mineral resources. Competences: To systematize and combine the results of geochemical prospecting with other data and prepare and present a geological report.,</p>					
Assessment methods and criteria	<p>exam Students are required to attend classes, solve independent project tasks, participate in a team project and pass the written exam. Through practical work and independent assignments students will be introduced to the basic principles of geochemical prospecting,</p>					
Recommended readings	<p>1. Moon, C.J. (2006): Exploration Geochemistry (pp 155-178). In: Introduction to Mineral Exploration; 2nd Edition; Charles J. Moon, Michael K.G. Whateley & Anthony M. Evans (Editors); Blackwell Publishing, 2006, 469p.</p>					
TU Coordinator	<p>Marta Mileusnić, marta.mileusnic@rgn.hr</p>					
Contribution to EIT's Overarching Learning Outcomes (tick relevant box/es)*	OLO 1 Entrepreneurship	OLO2 Innovation	OLO3 Creativity	OLO4 Intercultural	OLO5 Value judgments / Sustainability	OLO6 Leadership
		<p>Students will develop communication skills through oral presentation and writing reports related to project assignments.</p>				<p>Students will develop communication skills through oral presentation and writing reports related to project assignments.</p>
Justification for OLO contribution						

EIT label – Teaching units <TIMREX – T-shaped Master Programme for Innovative Mineral Resource Exploration>

Course title	Remote sensing of mineral resources		
European Credits (ECTS)	3	Time (hours) given to the students	30
Type (Lecture, internship, exercise etc.)	Lectures: 1, Auditorium classes: , Lab. Classes: x, Project classes: x, Practical classes: 1, Seminar classes: , Fieldwork:	Student whole working time (hours)	75
Description of content	<p>Students will acquire basic knowledge from remote sensing, with an emphasis on their application in mineral exploration. To enable students to independently collect and analyse multispectral, hyperspectral and radar satellite images required for analysis at surface mineral resources. Introduce students to the automatic supervised and unsupervised classification of satellite images in the analysis of surface mineral raw materials. Through the course students will acquire basic knowledge about application of remote sensing in mineral raw materials exploration.</p> <p>P-1. Introduction, review and definition of remote sensing of mineral resources P-2. Electromagnetic radiation. Active and passive sensors for remote sensing. P-3. Electromagnetic radiation. Active and passive sensors for remote sensing of mineral resources. P-4. Satellite missions, sensors, accessories and equipment of existing satellite systems for remote sensing of mineral resources. P-5. Spatial, spectral, radiometric and temporal resolution of satellite images used in the analysis of mineral resources P-6. Use of software tools and programming languages for remote sensing of mineral resources 1 P-7. Use of software tools and programming languages for remote sensing of mineral resources 2. P-8. Pre-processing of satellite images. P-9. Elimination of geometric errors in sensor operation P-10. Elimination of atmospheric and morphological influences on the quality of satellite images 1 P-11. Elimination of atmospheric and morphological influences on the quality of satellite images 2 P-12. Supervised and unsupervised classification on the example of mineral resources research 1. P-13. Supervised and unsupervised classification on the example of mineral exploration 2. P-14. Use of Synthetic Antenna Radar (InSAR) for mineral analysis 1 P-15. Use of Synthetic Antenna Radar (InSAR) for mineral analysis 2</p>		

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<p>Learning outcomes of the curricular unit (knowledge, skills and competences to be developed by the students)</p>	<p>Knowledge: Describe the basic principles and methods of remote sensing for surface mineral raw materials. Use multispectral and hyperspectral images for analysis at surface raw materials Describe the characteristics of electromagnetic radiation for the purposes of remote sensing of mineral resources.</p> <p>Skills: Develop a controlled and uncontrolled classification of mineral resources from satellite images Apply at least one software tool for interpretation and processing in remote sensing of mineral resources.</p> <p>Competences: ,</p>					
<p>Assessment methods and criteria</p>	<p>exam Students will have lectures and project work. Students are required to attend classes and solve project tasks independently and / or in a team. Students will learn about remote sensing, with an emphasis on their application in mineral exploration through lessons and practical work.</p>					
<p>Recommended readings</p>						
<p>TU Coordinator</p>	<p>Ivan Medved, ivan.medved@rgn.hr</p>					
<p>Contribution to EIT’s Overarching Learning Outcomes (tick relevant box/es)*</p>	<p>OLO 1 Entrepreneurship</p>	<p>OLO2 Innovation Students will independently collect and analyse mineral resources via remote sensing.</p>	<p>OLO3 Creativity</p>	<p>OLO4 Intercultural</p>	<p>OLO5 Value judgments / Sustainability</p>	<p>OLO6 Leadership</p>
<p>Justification for OLO contribution</p>						

EIT label – Teaching units <TIMREX – T-shaped Master Programme for Innovative Mineral Resource Exploration>

Course title	GIS in Exploration of Mineral Resources		
European Credits (ECTS)	3	Time (hours) given to the students	30
Type (Lecture, internship, exercise etc.)	Lectures: 1, Auditorium classes: , Lab. Classes: x, Project classes: x, Practical classes: 1, Seminar classes: , Fieldwork:	Student whole working time (hours)	75
Description of content	<p>Master all significant options in GIS software while solving specific examples from the profession. Acquiring the knowledge needed to develop your own GIS projects. Advanced use of geoinformatics on computer and mobile platform. Visualization of GIS projects for the purpose of making cartographic contents of diploma theses. Through the course students will acquire basic knowledge about application of GIS software in mineral exploration.</p> <p>P1 Introductory lecture on the subject. Overview of teaching topics. V1 Curriculum in the semester. Merlin, ArcMap, networking, computer usage rules.</p> <p>P2 Basics of GIS (repetition of undergraduate material). V2 Reminder to ArcView, advantages and disadvantages.</p> <p>P3 Scanning and image processing. V3 Handling maps in paper and digital form.</p> <p>P4 Raster georeferencing. V4 Georeferencing three sheets with known points on geological maps.</p> <p>P5 Raster georeferencing V5 Raster georeferencing over vectors.</p> <p>P6 Raster georeferencing V6 Raster georeferencing over a raster.</p> <p>P7 Review projects and quick maps. V7 Development of an overview project and GIS map for each location.</p> <p>P8 Vectorization of geological map, part 1. V8 Vectorization of a geological map within a given area, Part 1.</p> <p>P9 Vectorization of geological map, part 2. V9 Vectorization of geological map within a given area, part 2.</p> <p>P10 Stages of GIS project development on the example of making a map of mineral resources of western Slavonia, introductory part. V10 Stages of GIS project development on the example of making a map of mineral resources of Western Slavonia, making a GIS project</p> <p>P11 Geotransformation of vector and raster GIS in HTRS96 / TM and WGS84, in general. V11 Geotransformation of vector and raster GIS in HTRS96 / TM and WGS84, data table.</p> <p>P12 SGA Geoportal data, in general. V12 Data from SGA Geoportal, use in GIS project.</p> <p>P13 Geoconversions of point data in Geotrans, in general. V13 Geoconversions of point data in Geotrans, task.</p> <p>P14 Geodetic transformations, parameters and test data, in general. V14 Geodetic transformations, parameters and test data, task.</p> <p>P15 Description of the RGNF WEBGIS system. V15 Work in RGNF WEBGIS system.</p>		

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<p>Learning outcomes of the curricular unit (knowledge, skills and competences to be developed by the students)</p>	<p>Knowledge: To apply statistical methods and spatial analyses in interpretation of laboratory and field measurements To use information technology in computation and modelling of geological phenomena and processes To interpret the results of geological and geochemical prospecting, geophysical and remote sensing investigation of mineral deposits using geographic information system in the analysis of spatial data. Skills: To construct general and thematic geological maps, as well as geological cross-sections with accompanying descriptions To interpret and summarize the results of field, laboratory and office research and prepare and present a geological expert report using other relevant data sources Competences: ,</p>					
<p>Assessment methods and criteria</p>	<p>practical mark The student is obliged to do all the exercises and attend 80% of the lectures. It is necessary to complete all project tasks and submit the final GIS projects for review and evaluation. Knowledge is evaluated based on assessment from project assignments, attendance at exercises and overall commitment to teaching. Students will learn about GIS softwers with an emphasis on their application in mineral exploration through lessons and project exercise and independent assignments.</p>					
<p>Recommended readings</p>	<p>1. De Smith, M., Longley, P., Goodchild, M.: Geospatial Analysis - A comprehensive guide (online + PDF format), https://spatialanalysisonline.com/ 2. ESRI: Free eBooks as part of its “Best Practices” series, (online + PDF format), https://www.gislounge.com/free-gis-books/ 3. The Rutgers Center on Public Security (PDF format), https://www.rutgerscps.org/gis-book.html</p>					
<p>TU Coordinator</p>	<p>Dario Perković, dario.perkovic@rgn.hr</p>					
<p>Contribution to EIT’s Overarching Learning Outcomes (tick relevant box/es)*</p>	<p>OLO 1 Entrepreneurship</p>	<p>OLO2 Innovation Students will independently collect and analyse mineral resources via GIS softwares.</p>	<p>OLO3 Creativity Students will independently collect and analyse mineral resources via GIS softwares.</p>	<p>OLO4 Intercultural</p>	<p>OLO5 Value judgments / Sustainability</p>	<p>OLO6 Leadership</p>

EIT label – Teaching units <TIMREX – T-shaped Master Programme for Innovative Mineral Resource Exploration>

Justification for OLO contribution	
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EIT label – Teaching units <TIMREX – T-shaped Master Programme for Innovative Mineral Resource Exploration>

Course title	Seismotectonics		
European Credits (ECTS)	4	Time (hours) given to the students	45
Type (Lecture, internship, exercise etc.)	Lectures: 2, Auditorium classes: , Lab. Classes: , Project classes: x, Practical classes: 1, Seminar classes: , Fieldwork:	Student whole working time (hours)	100
Description of content	<p>To describe the basics on seismotectonics in different geodynamic settings on Earth, in particular in Croatia, in circum Adriatic region and in the Eastern Mediterranean, and to provide students general knowledge on field and lab methods used in evaluation of seismicity and seismic hazard, assessment of recent tectonic movements on local and regional scale, active stress regimes in the Earth's crust, and in identification and characterization of active, seismogenic faults and seismogenic sources.</p> <p>The course cover all the important data and seismotectonic properties of certain areas.</p> <p>L1. Introduction to Seismology. Seismicity in Croatia and in neighbouring countries. Global seismicity. Seismic waves, seismometers and seismograms. Earthquake intensity and magnitude. Earthquake cycle. Elastic Rebound Theory. Models of earthquake recurrence.</p> <p>Ex1. Seismogram analysis, definition of spatial and surface seismic waves</p> <p>L2. Introduction to seismic hazard and risk in Croatia. Croatian Seismological Survey, seismograph network and Croatian Earthquake Catalogue. Gutenberg-Richter Relationship. Seismic hazard maps in Croatia and in neighbouring countries.</p> <p>Ex 2. Calculation of earthquake epicentre and magnitude based on seismicity data (Part 1)</p> <p>L3. An overview of geodetic methods to measure tectonic movements. Conceptual models of deformation and slip on faults and in fault zones. Trilateration network, Precise leveling: principles and examples. VLB Interferometry and GPS measurements: principles and examples. GPS data in Croatia and in surrounding region used in interpretation of geodynamics in circum Adriatic region and in the eastern Mediterranean.</p> <p>Ex 3. Calculation of earthquake epicentre and magnitude based on seismicity data (Part 2).</p> <p>L4. Type of stresses in the Earth's crust. Stress regimes at the tectonic plate boundaries and far - field stresses. World stress map database. Introduction to borehole breakouts. Fault plane solutions: basic theoretical principles and examples.</p> <p>Ex 4. Analysis of earthquake focal mechanisms (EFM) – interpretation of EFMs</p> <p>L5. Stress regimes and distribution and in circum-Adriatic region. Individual and composite seismogenic sources: definitions and characterization, examples from DISS and SHARE seismogenic databases.</p> <p>Ex 5. Analysis of earthquake focal mechanisms (EFM) - construction of EFM (Part 1).</p> <p>L6. Integration of geological and seismological data in identification and characterization of seismogenic faults/sources.</p>		

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	<p>Ex. 6. Analysis of earthquake focal mechanisms (EFM) - construction of EFM (Part 2). L7. Integration of geological and seismological data in construction of seismotectonic maps and profiles: basic principles. Ex. 7. Visit to Croatian Seismological Survey – Earthquake monitoring and analysis L8. Seismotectonics in extensional geodynamic settings. Global distribution of extensional settings. An overview of structural styles and potential seismogenic sources in extensional settings. Ex. 8. Integration of geological and seismological data for construction of seismotectonic profile – Construction of geological profile L9. Seismotectonics in continental graben structures: examples from the East African Rift, Rhone-Rhine Graben, Basin & Range Province. Seismotectonic properties of back-arc basin areas: examples from Aegean and Tyrrhenian sea. Ex. 9. Construction of seismotectonic profile – Construction of geological profile L10. Seismotectonics in compressional geodynamic settings. Global distribution of compressional settings. An overview of structural styles and potential seismogenic sources in compressional settings. Ex. 10. Construction of seismotectonic profile – Earthquake Catalogue analysis and delineation of earthquake series in the profile buffer 10 km wide L11. Seismotectonics in fold-thrust belts: examples from the Alps and External Dinarides. Ex. 11. Construction of seismotectonic profile – Earthquake hypocentre projection on geological profile and correction of structural framework corrections L12. Seismotectonics in strike-slip geodynamic settings. Global distribution of strike-slip settings. An overview of structural styles and potential seismogenic sources in strike-slip settings. Ex. 12. Construction of seismotectonic profile – Identification of seismogenic faults/sources along the profile L13. Seismotectonics in strike-slip geodynamic settings: examples from Dinarides, California, New Zealand and Eastern Mediterranean. Ex. 13. Student’s presentations of constructed seismotectonic profiles (Part 1). L14. An overview on seismotectonics in Croatia: key examples from Pannonian basin, Dinarides and Adriatic region. Ex. 14. Student’s presentations of constructed seismotectonic profiles (Part 2). L15 & Ex 15. Student’s seminar presentations</p>
<p>Learning outcomes of the curricular unit (knowledge, skills and competences to be developed by the students)</p>	<p>Knowledge: Distinguish stress type and its distribution in Earth’s crust in respect to tectonic plate boundary types, regional and local geodynamic processes Explain general terms in Seismology (seismicity, seismic waves, earthquake magnitude, earthquake hazard and risk, Earthquake Cycle and Elastic Rebound Theory) Describe basic properties of global and local seismicity Describe seismotectonic properties of the extensional, compressional and strike-slip tectonic regions Define geodetic methods that are used in measurements of tectonic movements Categorize seismotectonically active regions on Earth, in more detail Mediterranean area and Croatia</p>

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	<p>Skills: Compute earthquake epicentre location based on seismic station seismogram analysis Compute focal mechanism solutions based on geometric and kinematic features of investigated faults Compute values of moment magnitude and assess earthquake intensity Competences: , Construct and analyse seismotectonics maps and profiles. Integrate geological and seismic data in identification and categorization of seismogenic faults/seismogenic sources in seismotectonic active regions.</p>					
Assessment methods and criteria	<p>exam Teaching methodologies are: lectures, project and independent assignments and partial e-learning. Course attendance (minimum 70% attendance), tasks constructed and given for evaluation. Course evaluation: constructed programs, seminar paper, written exam and oral exam.</p> <p>Students will be introduced to seismotectonics via lectures, project work and independent assignments and partial e-learning.</p>					
Recommended readings	<p>Yeats, R. (2012): Active Faults of the World. Cambridge Univ. Press, 600 str. (selected chapters)</p>					
TU Coordinator	<p>Bruno Tomljenović/Bojan Matoš,</p>					
Contribution to EIT's Overarching Learning Outcomes (tick relevant box/es)*	OLO 1 Entrepreneurship	OLO2 Innovation	OLO3 Creativity	OLO4 Intercultural	OLO5 Value judgments / Sustainability	OLO6 Leadership
			<p>During the course students will construct seismotectonic profiles and have presentations.</p>		<p>Students will learn about importance of determining seismicity and about seismic hazards and tectonic activities and its impact.</p>	
Justification for OLO contribution						

EIT label – Teaching units <TIMREX – T-shaped Master Programme for Innovative Mineral Resource Exploration>

Course title	Regional Hydrogeology		
European Credits (ECTS)	4	Time (hours) given to the students	60
Type (Lecture, internship, exercise etc.)	Lectures: 2, Auditorium classes: , Lab. Classes: , Project classes: x, Practical classes: 2, Seminar classes: , Fieldwork:	Student whole working time (hours)	100
Description of content	<p>Hydrogeological interpretations on a regional scale and the acquisition of skills in presenting hydrogeological features and calculating groundwater reserves. The student will acquire basic knowledge about the aquifer systems of the Republic of Croatia and strategic groundwater reserves.</p> <p>Students acquire specific skills in the area of hydrogeological interpretation on regional scale.</p> <p>Energy conditions of groundwater movement, Basic concept of thermal regime. Map of the geothermal gradient of Croatia, geothermal potential analysis.</p> <p>Geochemical cycle, Hydrochemical facies. Examples of laboratory chemical analyzes of water, Piper diagrams</p> <p>Groundwater chemistry and its impact on water use (water supply, industry, agriculture) and legislation. Examples of water classifications depending on the intended use (Doneen, USDA).</p> <p>Regional hydrogeology, scale effect (spatial and temporal), the continuity equation. The concept of scales cartographic and physical, scale effect on permeability</p> <p>Hydrogeological parameters. Heterogeneity and anisotropy of hydraulic conductivity (example of parallel and vertical flow in relation to the position of layers)</p> <p>Basic flow of inclined aquifer systems and unit hydrograph, runoff coefficient and recovery coefficient. Hydrogeological significance of the recession coefficient on the example</p> <p>Radial flow, well hydraulics, direct integration of Darcy's law. Calculation (identification) of hydrogeological parameters</p> <p>Unconfined aquifer, flow below water surface, Dupit assumption. Flow through horizontally and vertically stratified aquifer</p> <p>Hydrogeological objects (wells, piezometers), construction and use. Examples of hydrogeological objects (question of aquifer heterogeneity)</p> <p>Hydrogeological maps and issues of graphical representation of hydrogeological properties, phenomena and relationships. Examples of hydrogeological maps of different scales</p> <p>Hydrogeology of the Republic of Croatia, division of territories by basins, catchment areas. Hydrogeological characteristics of the Sava River Basin, the valley part of the Sava River Basin, the basins of the left tributaries of the Sava. Analysis of the water level and flow of the Sava on significant water meter profiles, comparison of the Sava water level and groundwater level and conclusion on the hydraulic connection of the Sava and the banks, drainage, recharge.</p>		

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	<p>Basins of right tributaries of the Sava, Kupa basin, Dobra basin, Mrežnica basin, Korana basin, Una basin. Analysis of hydrographs of significant sources in the basins of the right tributaries of the Sava, definition of the equation of the recession part of the hydrograph, recession coefficient and dynamic reserves.</p> <p>Drava basin, valley part of the Drava basin, hilly and hilly area of the Drava basin. Analysis of water level and flow of the Drava on significant water meter profiles, comparison of Drava water level and groundwater level in the hinterland, inference about the hydraulic connection of the Drava and the hinterland, drainage and recharge.</p> <p>Hydrogeology of Istria, Croatian Littoral, Lika and Podvelebita (Gacka and Lika basins), Zrmanja basin, Krka basin. Analysis of hydrographs of significant sources in the Mirna, Gacka, Lika, Zrmanja and Krka basins, definition of the equation of the recession part of the hydrograph, recession coefficient and dynamic reserves.</p> <p>Cetina basin, lower Neretva basin, coastal basin from Neretva to Boka Kotorska, basins of significant coastal springs. Ranking of watersheds by quantity and quality of water, strategic reserves of Croatian groundwater from the first to the fifth level. Analysis of data on groundwater tracing carried out in the area of southern Dalmatia and conclusion on karst watersheds.</p>
<p>Learning outcomes of the curricular unit (knowledge, skills and competences to be developed by the students)</p>	<p>Knowledge: Define the concept of scale in hydrogeology and explain its effect through permeability properties Describe the basic concept of the Earth's thermal regime and relate it to the genesis and dynamics of thermal waters Describe the geochemical cycle Interpret the chemical composition of water Define and graphically represent hydrochemical facies Analyze the spring hydrograph Explain how to determine groundwater reserves Describe the hydrogeological systems of Croatia</p> <p>Skills: Apply hydrogeological maps in the description of hydrogeological features of the area Assess the significance of a particular hydrogeological system for a water supply</p> <p>Competences: ,</p>
<p>Assessment methods and criteria</p>	<p>exam</p> <p>Teaching methodologies are: lectures, project and independent assignments. Students will have to finish hidrogeological project for evaluation.</p> <p>Through the course students will learn about hydrogeological interpretations on a regional scale.</p>
<p>Recommended readings</p>	<p>Struckmeier, W.F. & Margat, J. (1995): Hydrogeological maps, A guide and a standard legend, pp. 177.,International association of hydrogeologist, Verlag Heinz Heise, Hannover</p>

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TU Coordinator	Željko Duić/Jelena Parlov,					
Contribution to EIT’s Overarching Learning Outcomes (tick relevant box/es)*	OLO 1 Entrepreneurship	OLO2 Innovation	OLO3 Creativity	OLO4 Intercultural	OLO5 Value judgments / Sustainability	OLO6 Leadership
					Students will learn about importance of groundwater reserves and its preservation.	
Justification for OLO contribution						

EIT label – Teaching units <TIMREX – T-shaped Master Programme for Innovative Mineral Resource Exploration>

Course title	Industrial Mineral Deposits and Applications		
European Credits (ECTS)	5	Time (hours) given to the students	60
Type (Lecture, internship, exercise etc.)	Lectures: 2, Auditorium classes: , Lab. Classes: , Project classes: , Practical classes: 2, Seminar classes: x, Fieldwork:	Student whole working time (hours)	125
Description of content	<p>The objective of the course is to learn about the physicochemical and geological conditions of formation of deposits of the main industrial minerals and their application in industry.</p> <p>The course covers all important data about industrial minerals and its application.</p> <p>L1 - Definitions of terms: (1) ore mineral and (2) industrial mineral. Classifications of industrial minerals.</p> <p>L2 - Physicochemical conditions for the formation of clay deposits. Industrial clays: Kaolins, bentonites, sepiolites and palygorskites.</p> <p>L3 - Mineralogy and geology of kaolin deposits. Application of kaolin in industry.</p> <p>L4 - Mineralogy and geology of bentonite, sepiolite and palygorskite deposits. Application in industry.</p> <p>L5 - Construction clays and industrial applications.</p> <p>L6 - Physicochemical conditions of bauxite deposits. Laterite and karst bauxites. Application of bauxite in industry.</p> <p>L7 - Quartz mineral raw materials (quartz crystals, quartz sands and sandstones, SiO₂ as chemical and biogenic sediment, diatomite, flint). Feldspar deposits. Application of quartz mineral raw materials and feldspar in industry.</p> <p>L8 - Physicochemical conditions of evaporite formation. Deposits of gypsum and anhydrite.</p> <p>L9 - Deposits of halite, sylvine, soda, borate, Mg and Li salts.</p> <p>L10 - Physicochemical conditions of phosphate formation. Apatite and phosphorite deposits. Phosphate application in industry.</p> <p>L11 - Deposits of barite, fluorite and refractory materials. Application of barite, fluorite and refractory materials in industry.</p> <p>L12 - Deposits of pyrite and sulphur. Application of pyrite and sulphur in industry.</p> <p>L13 - Physicochemical conditions of zeolite formation. Zeolite deposits. Application of zeolite in industry.</p> <p>L14 - Pigments and their application in industry.</p> <p>L15 - Graphite deposits. Application of graphite in industry.</p>		
Learning outcomes of the curricular unit (knowledge, skills and competences to be developed by the students)	<p>Knowledge: Identify and describe the types of deposits of industrial minerals</p> <p>Analyse and argue the physicochemical and geological conditions for the formation of deposits of industrial minerals</p> <p>Prepare a plan for the exploration of industrial mineral deposits to determine the potential for industrial application</p> <p>Evaluate the quality of industrial mineral deposits</p>		

EIT label – Teaching units <TIMREX – T-shaped Master Programme for Innovative Mineral Resource Exploration>

	<p>Demonstrate the technological processes of manufacturing bricks, tiles, glass, cement and refractory materials. Evaluate and recommend the application of industrial minerals in agriculture and various industries. Skills: Competences: ,</p>					
Assessment methods and criteria	<p>exam Methodologies are: lectures, seminars, workshops and independent assignment. The examination will be taken orally. Requirements for taking the exam are: 1. committed and positively evaluated assignments in the internship 2. submitted and held seminar paper 3. submitted field report 4. positively evaluated both colloquia Main processes of forming industrial mineral and its application will be introduced to students through the lectures and practical work.</p>					
Recommended readings	<p>1. Manning, D.A.C. (1995): Introduction to industrial minerals, Chapman & Hall, 276s. 1. Manning, D.A.C. (1995): Introduction to industrial minerals, Chapman & Hall, 276s. 2. Evans, A. M. (1993): Ore geology and industrial minerals, Blackwell Science Publications, 389s. 3. Chang, L. L. Y. (2002): Industrial mineralogy, Prentice Hall, 472. 4. Harben, P. W. & Kužvart, M. (1997): Industrial minerals-A global geology, Industrial Minerals Information, 476s.</p>					
TU Coordinator	Goran Durn, goran.durn@rgn.hr					
Contribution to EIT's Overarching Learning Outcomes (tick relevant box/es)*	<p>OLO 1 Entrepreneurship</p>	<p>OLO2 Innovation</p>	<p>OLO3 Creativity</p>	<p>OLO4 Intercultural</p>	<p>OLO5 Value judgments / Sustainability</p>	<p>OLO6 Leadership</p>
	<p>Students will prepare a plan for the exploration of industrial mineral deposits to determine the potential for industrial application.</p>				<p>Students will learn about importance of Industrial Mineral Deposits and its Applications and applying of the regulations.</p>	
Justification for OLO contribution						

EIT label – Teaching units <TIMREX – T-shaped Master Programme for Innovative Mineral Resource Exploration>

Course title	Analytical methods in ore deposits		
European Credits (ECTS)	5	Time (hours) given to the students	60
Type (Lecture, internship, exercise etc.)	Lectures: 2, Auditorium classes: , Lab. Classes: x, Project classes: , Practical classes: 2, Seminar classes: , Fieldwork:	Student whole working time (hours)	125
Description of content	<p>The aim of this course is to review the most important analytical methods and applications in the mineral deposits investigation in order to determine mineralogical, geochemical and isotopic composition and reconstruction of genetic processes. The course covers: microscopy in transmitted and reflected light, electron microscopy and electron microprobe, microthermometry of fluid inclusions, ion chromatography, vitrinite reflection, crystallinity of chlorite, illite and graphite, atomic absorption and emission spectroscopy, inductively coupled plasma mass spectrometry (ICP-MS), stable and radiogenic isotopes.</p> <p>This course gives students knowledge about analytical methods in mineral deposits exploration.</p> <p>Polarised light microscopy - Contact-metamorphic reactions; Mineral stability fields; Alteration reactions. Reflected light microscopy - Fundamentals of ore microscopy (optical properties in reflected light); examples of the most important structures and textures; Interpretation. Electron microscopy / EMPA - Basics principles; Detectors; Application and interpretation; Geothermobarometric use in equilibrium systems; Sample preparation. Microthermometry of fluid inclusions - Basics principles; Application and interpretation; Sample preparation. Ion chromatography - Basics principles; Application in ore deposits; t / c conditions; Sample preparation. Vitrinite reflection / Crystallinity of chlorite / illite / graphite - Basics principles; Application in ore deposits; t / c conditions; Sample preparation (illiterate crystallinity); AAS; AES; ICP-MS; Stable isotopes (oxygen, hydrogen, carbon); Radiogenic isotopes (K / Ar; Rb / Sr; Sm / Nd; U / Th / Pb, fission-tracks) - Basics principles; Application in ore deposits; Data interpretation.</p>		
Learning outcomes of the curricular unit (knowledge, skills and competences to be developed by the students)	<p>Knowledge: To explain the application of individual method, principle, sample preparation and instrument characteristics</p> <p>To prepare a geological sample for selected methods (sawing, grinding, polishing, pulverizing, dissolving, diluting, etc)</p> <p>To determine mineral paragenesis, structures and textures in plane-polarised regular and reflected light</p> <p>To determine the succession (phases) of crystallization (pre-ore; ore and post-ore stage) and subsequent alterations</p> <p>To interpret obtained analytical data and determine composition of fluids, pressures and temperatures of formation of ore deposits and alterations.</p> <p>To interpret the micro, macro and trace element composition.</p> <p>To interpret the results of stable isotope analysis and conclude on the source fluid.</p> <p>To interpret the results of radiogenic isotopes in order to determine the age of the host rock, mineralization, and</p>		

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	subsequent events. Skills: Competences: ,					
Assessment methods and criteria	exam Students will have lectures, practicum, independent assignments, and at the end oral exam. Students will learn about most important analytical methods and applications in the mineral deposits investigation through practicum, and independent assignments.					
Recommended readings	Reed, S. J. B. (2010): Electron Microprobe Analysis and Scanning Electron Microscopy in Geology. Cambridge University Press, 201 p.					
TU Coordinator	Sibila Borojević Šoštarić, sibila.borojevic-sostaric@rgn.hr					
Contribution to EIT's Overarching Learning Outcomes (tick relevant box/es)*	OLO 1 Entrepreneurship	OLO2 Innovation	OLO3 Creativity	OLO4 Intercultural	OLO5 Value judgments / Sustainability	OLO6 Leadership
			Students will review the most important analytical methods and applications in the mineral deposits investigation.			
Justification for OLO contribution						

EIT label – Teaching units <TIMREX – T-shaped Master Programme for Innovative Mineral Resource Exploration>

Course title	Geophysical Exploration of Mineral Resources		
European Credits (ECTS)	3	Time (hours) given to the students	30
Type (Lecture, internship, exercise etc.)	Lectures: 2, Auditorium classes: , Lab. Classes: x, Project classes: , Practical classes: 0, Seminar classes: , Fieldwork:	Student whole working time (hours)	75
Description of content	<p>Mastering the specialist geophysical methods of measurement and interpretation applied in the exploration of construction materials deposits and solid raw mineral materials.</p> <p>The course goes through the key points of geophysical methods for prospection and exploration of mineral deposits.</p> <p>Magnetometric exploration. Magnetometric data interpretation methods.</p> <p>Aeromagnetometric exploration. Magnetometric exploration of solid raw materials.</p> <p>Field survey design for characteristic geological models.</p> <p>Gravity exploration. Gravity map transformations - goal, transformation methods, application.</p> <p>Microgravity exploration. Gravity modelling and application in raw minerals exploration.</p> <p>Electrical tomography. Theoretical foundations. Measurement geometry. Tomographic inversion. Electrical tomography instruments.</p> <p>Electrical tomography in the exploration of construction materials deposits.</p> <p>Electromagnetic exploration. TURAM method, Electromagnetic method using moving transmitter, VLF method, magnetotelluric method - theoretical foundations, instruments, data processing, interpretation and application.</p> <p>Georadar - theoretical foundations, field measurement methods, resolution and depth, instruments, application.</p> <p>Seismic measurements in wells. "Down-hole" and "Cross-hole" methods – measuring methods, instruments, application.</p> <p>Refraction seismics. Methods of refraction data interpretation: DTM, Delta – t – V, GRM and refraction tomography.</p> <p>High resolution reflection seismics (HRS method) – conducting exploration, data processing, interpretation.</p> <p>Seismic modelling. Synthetic seismogram - construction of synthetic seismogram, application of synthetic seismogram.</p>		
Learning outcomes of the curricular unit (knowledge, skills and competences to be developed by the students)	<p>Knowledge: To control principles of working with instruments for magnetometric exploration.</p> <p>To control principles of working with instruments for electric and electromagnetic exploration.</p> <p>Skills: To be able to interpret the obtained magnetometric measurements data.</p> <p>To be able to interpret the obtained gravimetric measurements data.</p> <p>To be able to interpret the obtained electrical tomography data.</p> <p>To be able to determine the first arrivals of the waves when measuring seismic velocities in a well.</p>		

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	<p>To be able to calculate mean and interval speeds and interpret the obtained data. To be able to choose the optimal geophysical exploration methods in the construction material deposits exploration. To be able to conduct geophysical exploration in the specific geological models in terms of solid raw materials exploration. Competences: ,</p>					
Assessment methods and criteria	<p>exam Students will have lectures, practicum, independent assignments, and at the end oral exam. By lectures, seminars and workshops students will study about specialistic geophysical methods in the exploration of materials deposits.</p>					
Recommended readings						
TU Coordinator	Franjo Šumanovac,					
Contribution to EIT's Overarching Learning Outcomes (tick relevant box/es)*	OLO 1 Entrepreneurship	OLO2 Innovation	OLO3 Creativity	OLO4 Intercultural	OLO5 Value judgments / Sustainability	OLO6 Leadership
			Students will have to interpret different geophysical data and make conclusions about mineral deposits and its main characteristics.			
Justification for OLO contribution						

EIT label – Teaching units <TIMREX – T-shaped Master Programme for Innovative Mineral Resource Exploration>

Course title	Field and laboratory practicum		
European Credits (ECTS)	6	Time (hours) given to the students	120
Type (Lecture, internship, exercise etc.)	Lectures: , Auditorium classes: , Lab. Classes: x, Project classes: , Practical classes: 128, Seminar classes: , Fieldwork: x	Student whole working time (hours)	150
Description of content	<p>Students will be introduced to various field and laboratory methods used in exploration of mineral deposits. Students will be trained to recognize mineralization, visualize 3D geological structures, and reconstruct geological history. Most of the activities will be related to proper geological fieldwork: observation, personal filed book, interpretation and sampling. Furthermore, students will analyse the collected geological samples of water, soil, rocks, sediments, minerals in the laboratories. Finally, they will learn to combine and interpret obtained field and laboratory results with previous geological research and produce and present geological expert reports.</p> <p>Through the course students will be introduced to various field and laboratory methods used in exploration of mineral deposits.</p> <p>The course consists of geophysical, geological and geochemical field exercises and laboratory analysis on sampled geological materials, and takes place in 15 terms of 8 hours. The field part of the course will be conducted jointly on two training grounds for the exploration of mineral deposits and two selected deposits of industrial minerals in the Republic of Croatia. At the training grounds for exploration of the mineral deposits, students will perform geophysical measurements, surface and underground mapping with the preparation of associated geological maps and profiles with indicated mineralization positions and conduct field geochemical prospecting on selected media. At selected deposits of industrial minerals, students will be introduced to the complete cycle of mineral raw materials, from geological prospecting and exploitation to the processing, final products and waste disposal. The laboratory part will include the preparation and analysis of sampled geological materials.</p> <p>Field days (13 days)</p> <p>Training grounds for exploration of mineral deposits (11 days of joint fieldwork)</p> <ol style="list-style-type: none"> 1) Geophysical prospecting (2 days) 2) Mapping of surface mineralization and preparation of geological map and profile (2 days) 3) Mapping of underground exploitation (3 days) 4) Sampling of host rocks and alteration zones proximal and distal to mineralization (2 days) 5) Geochemical prospecting - sampling of geological materials and in-situ measurement of basic geochemical 		

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	<p>parameters (1 day) 6) Additional independent work of students (1 day)</p> <p>Mineral raw materials cycle - industrial materials of the Republic of Croatia (2 days): 7) From ceramic clay and quartz sand to bricks (ceramic clay deposit, quartz sand deposit, brick factory; 1 day) 8) From natural gypsum to gypsum boards (gypsum bed, gypsum board factory; 1 day) Laboratory days (2 days) 1) Preparation and analysis of geological materials sampled during geochemical prospecting at the polygon for exploration of mineral deposits.</p>					
Learning outcomes of the curricular unit (knowledge, skills and competences to be developed by the students)	<p>Knowledge: To select a suitable geophysical method for exploration of the mineral deposit To prepare a geological map and the corresponding profile with the indicated types of mineralization To prepare laterally developed underground mine map To analyse chemical composition of the geological materials using standardised laboratory procedures and normative. To describe the overall process of mineral raw materials starting from exploration and exploitation to the processing and final product, highlighting the primary raw materials properties. Skills: To sample various geological materials (minerals, rocks, sediment, soil, water) for the purpose of exploration of the mineral deposits. To conduct field measurements of selected parameters in geological materials (eg pH, EC, redox potential, radioactivity) for the purpose of geochemical prospecting. Competences: ,</p>					
Assessment methods and criteria	<p>practical mark Students will have field and laboratory work, work with mentor, project assignments. Students will be introduced to various field and laboratory methods used in exploration of mineral deposits through field and laboratory work.</p>					
Recommended readings	<p>FOREGS Geochemical Mapping Field Manual. Geological Survey of Finland, Espo, 1998. Marjoribanks, R. (2010) Geological Methods in Mineral Exploration and Mining, Springer, 238 s.</p>					
TU Coordinator	<p>Sibila Borojevic Šoštarić, sibila.borojevic-sostaric@rgn.hr</p>					
Contribution to EIT's Overarching Learning Outcomes (tick relevant box/es)*	OLO 1 Entrepreneurship	OLO2 Innovation	OLO3 Creativity	OLO4 Intercultural	OLO5 Value judgments / Sustainability	OLO6 Leadership
	Students will be introduced to					

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	<p>various field and laboratory methods and work used in exploration of mineral deposits where all skills will be developed.</p>					
<p>Justification for OLO contribution</p>						

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Course title	Analyses of mineral paragenesis		
European Credits (ECTS)	3	Time (hours) given to the students	45
Type (Lecture, internship, exercise etc.)	Lectures: 1, Auditorium classes: , Lab. Classes: x, Project classes: , Practical classes: 2, Seminar classes: , Fieldwork:	Student whole working time (hours)	75
Description of content	<p>The goal of the course is to train the students in microscopic analysis of different generations of mineral parageneses in magmatic and metamorphic rocks and their interpretation in the light of petrogenesis and later evolution of these rocks in the certain geotectonic environment.</p> <p>Students will acquire knowledge about mineral paragenesis of magmatic and metamorphic rocks and its interpretation. The definition of the mineral paragenesis. Primary and secondary mineral parageneses in the magmatic rocks. Postequilibration and postconsolidation changes of primary magmatic minerals and the origin of secondary parageneses: (1) resorption and late magmatic subsolidus reactions; (2) hydrothermal alterations and (3) the changes caused by weathering. Phase relations in the crystallisation systems as the result of fractionation processes and reactions in the magmatic rocks. Phase diagrams (liquidus, solidus, binary and ternary eutectic, cotectic curves, solvus, peritectic point). Two-component systems with the eutectic point, with continuing solid solution crystal serie and the new compound which melts incongruently. Three-component systems with the clinopyroxene and plagioclase, with alkali feldspars and quartz, with plagioclase, clinopyroxene and olivine and forsterite, anorthite and quartz.. The influence of volatiles on the crystallisation of the system. The explanation of genesis of different magmatic textures, intergrowths and exsolutions by phase diagrams (ophitic texture, intergranular texture, graphic and myrmekitic intergrowths, perthite/antiperthite). The exsolution process in the different minerals (pyroxenes, feldspars, calcite, ilmenite, biotite). Disequilibrium state: a) the occurrence of zoning (concentric, patchy, sector, normal, reversal and oscillatory zoning) in different minerals; b) the occurrence of “sieve” texture. Enclaves in the magmatic rocks: xenoliths, xenocrystals and microgranitoid enclaves. The differences in the mineral parageneses and textures in the crust peridotites and mantle peridotites. Ophiolite and their metamorphic sole. Precise classification and nomenclature of magmatic rocks on the basis of microtexture, primary and secondary parageneses and petrogenetic interpretation of the sequence of the processes in the evolution of certain magmatic rocks.</p>		
Learning outcomes of the curricular unit (knowledge, skills and competences to be developed by the students)	<p>Knowledge: To explain the ways of the origin of primary and secondary mineral parageneses in magmatic rocks.</p> <p>To distinguish mineral parageneses and microtextures in crust peridotites from those in the mantle peridotites in the ophiolite complexes.</p> <p>To classify magmatic rocks on the basis of microtextures, primary and secondary mineral parageneses and reconstruct the sequence of processes in the evolution of certain magmatic rocks.</p>		

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	<p>To distinguish different mineral parageneses and the sequence of their formation in the metamorphic rocks.</p> <p>Skills: To apply phase diagrams in the interpretation of genesis of different microtextures, intergrowths and exsolutions inside of minerals in magmatic rocks.</p> <p>To use evident signs of disequilibrium in minerals and rocks in the interpretation of their crystallisation and later evolution and petrogenesis, respectively. To apply different types of mineral recrystallization and their deformations to deduce the p-T evolution of the metamorphic rocks.</p> <p>Competences: ,</p>					
Assessment methods and criteria	<p>exam</p> <p>Teaching methodologies are: lectures, laboratory, independent assignments and exercises with petrographic microscope. At the end students will have oral exam.</p> <p>Main emphasis is on application of determining mineral paragenesis in determining different samples through exercises and independent assignments.</p>					
Recommended readings						
TU Coordinator	Vesnica Garašić, vesnica.garasic@rgn.hr					
Contribution to EIT's Overarching Learning Outcomes (tick relevant box/es)*	OLO 1 Entrepreneurship	OLO2 Innovation	OLO3 Creativity	OLO4 Intercultural	OLO5 Value judgments / Sustainability	OLO6 Leadership
			Students will have to interpret mineral paragenesis and make conclusions about genesis of rocks.			
Justification for OLO contribution						

EIT label – Teaching units <TIMREX – T-shaped Master Programme for Innovative Mineral Resource Exploration>

Course title	MSc thesis					
European Credits (ECTS)	20	Time (hours) given to the students			15	
Type (Lecture, internship, exercise etc.)	Lectures: , Auditorium classes: , Lab. Classes: , Project classes 1: , Practical classes: , Seminar classes: , Fieldwork:	Student whole working time (hours)			500	
Description of content	<p>The master thesis for the student aims to prove the ability of independent analysing and solving complex engineering tasks/problems in the field of geology related to the master thesis topic.</p> <p>The master thesis is a paper in which the student must demonstrate the ability of independent analysis and solving a given engineering problem/task in the field of geology using the knowledge acquired through graduate study from a theoretical and practical point of view.</p>					
Learning outcomes of the curricular unit (knowledge, skills and competences to be developed by the students)	<p>Knowledge: To define a professional problem / task To summarise master thesis in English To apply the methodology of writing a professional and scientific paper To write master thesis linguistically and ethically correct To apply the acquired knowledge and general competencies acquired through graduate study To interpret research results</p> <p>Skills: To solve a complex practical problem / task. To argue the results of the conducted research in an expert discussion</p> <p>Competences: To respect ethical norms and rules of citing literature, To design and conduct research.</p>					
Assessment methods and criteria	<p>practical mark</p> <p>The student is obliged to apply for one of the offered topics, make a plan of activities with the mentor and submit the master thesis for evaluation within the given deadlines, prepare a presentation and defend the master thesis in front of the committee.</p>					
Recommended readings	Selected literature based on the topic of master thesis and according to the mentor's recommendation.					
TU Coordinator	All teachers in the scientific-teaching profession					
Contribution to EIT's Overarching Learning Outcomes (tick relevant)	OLO 1 Entrepreneurship	OLO2 Innovation	OLO3 Creativity	OLO4 Intercultural	OLO5 Value judgments /	OLO6 Leadership

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box(es)*					Sustainability	
	The student will develop all skills through work on the master thesis and through solving complex engineering tasks/problems.					
Justification for OLO contribution						

Semester 3
WUST

FACULTY OF GEOENGINEERING, MINING AND GEOLOGY

SUBJECT CARD

Name of subject in Polish ... Geofizyka inżynierska
Name of subject in English Engineering Geophysics
Main field of study: Mining and geology
Specialization: Mining Engineering,
 Geotechnical and Environmental Engineering,
 Geomatics for Mineral Resource Management
 Mineral Resource Exploration
Level and form of studies: 2nd level, full-time
Kind of subject: obligatory
Subject code W06GIG-SM3004....
Group of courses NO

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15			15	
Number of hours of total student workload (CNPS)	25			50	
Form of crediting	crediting with grade			crediting with grade	
For group of courses mark (X) final course					
Number of ECTS points	1			2	
including number of ECTS points for practical classes (P)				2	
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	0,8			0,9	

*delete as not necessary

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. has knowledge of fundamentals of applied geophysics, physics and geology.
2. knows fundamentals of soil and rock mechanics.
3. is able to use MS Office software.
4. is able to work in a team.

SUBJECT OBJECTIVES

- C1 familiarize with physical phenomena in geosphere of the Earth
 C2 familiarize with engineering problems solved by means of geophysical surveying
 C3 familiarize with various geophysical surveys.
 C4 acquisition of skills to plan geophysical field surveying and to interpret its results.
 C5 development of skills to work in a group.

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge:

- PEU_W01 recognizes, names and explains engineering problems in different fields.
 PEU_W02 identifies, describes and chooses geophysical surveying methods.
 PEU_W03 analyses and assesses case studies from solving the engineering problems.

relating to skills:

PEU_U01 is able to coordinate team work, create field research plans and manage the work progress.

PEU_U02 is able to independently create solutions for complex practical problems in engineering and geoenvironmental applying knowledge about geophysical surveying, mining geophysics, utilizing modern methods in geophysical data acquisition and interpretation.

PEU_U03 is able to critically assess, process and interpreted results of the geophysical surveying and provide recommendations related to engineering problems in mining, civil engineering, engineering geology, municipal waste site, archeology, engineering properties of soil and rocks, hydrogeology, monitoring seepage in river dykes or dams.

PEU_U04 is able to solve geophysical problems.

PEU_U05 is able to conduct auto-didactical education related to detailed handling of typical software.

relating to social competences:

PEU_K01 understands the need to create and transfer to the society – among others by mass media- information and opinions related to mining engineering achievements and other activities of mining engineer; tries to transfer the information in commonly understood way, presenting different points of view; is aware of the quality and need to shape the work safety culture in mining and the responsibility for the health and life of other employees.

PROGRAMME CONTENT

Lecture		Number of hours
Lec 1	Physical properties of rocks. Inter-relationships between the various subdisciplines of applied geophysics. Overview of geophysical methods, their physical principles and applications. Methodology of geophysical surveying.	1
Lec 2	Engineering problems solved with geophysical surveying. Case studies.	2
Lec 3	Electrical resistivity methods. Tomography and VSE. IP method. Physical principles. Equipment. Methods of field surveying. Interpretation and application. Case studies.	2
Lec 4	Electromagnetic methods. FDEM and TDEM methods. Magnetotelluric methods. Physical principles. Methods of field surveying. Equipment. Interpretation and application. Case studies.	2
Lec 5	GPR surveying. Physical principles. Methods of field surveying. Equipment. Interpretation and application. Case studies.	2
Lec 6	Seismic tomography. Seismic interferometry. Physical principles. Applications. Case studies.	2
Lec 7	Mine geophysics. Seismology. Seismic methods. Active and passive seismic tomography. Microgravimetry. Case studies.	2
Lec 8	Gravity and magnetic surveying. Equipment. Methods of field surveying. Interpretation and application. Case studies.	2
	Total hours	15
Project		Number of hours

Proj 1	One selected geophysical technique. Fundamentals and equipment. Field surveying	4
Proj 2	Processing and interpretation of field data.	3
Proj 3	Solving the geophysical problems.	8
	Total hours	15

TEACHING TOOLS USED

N1. N1.Lecture aided by presentation.
N2.Demonstration.
N3.Discussion and consultations
N3Calculations
N5Practical field surveying

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT

Evaluation (F – forming during semester), P – concluding (at semester end)	Learning outcomes code	Way of evaluating learning outcomes achievement
P1	W01-W03	Test related to lecture content. Final grade.
F1	U01-U02, U05	Test. Project 1. Report on Project 1
F2	U03, U05	Test. Project 2. Report on Project 2
F3	U04, U05	Test. Solving geophysical problems
F1-F3, P2	U01-U05 K02	Grades are given for each of three project tasks including tests and reports. The final grade P2 for the project course is the weighted average grade of F1-F3.

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

- [1] Aki, K., Richards P.G., 1980. Quantitative Seismology: Theory and Methods. W.H. Freeman Co.. San Francisco.
- [2] Burger, H.R., Sheehan, A.F., Jones, C.H., 2006. Introduction to Applied Geophysics: Exploring the Shallow Subsurface. W.W. Norton & Company, Inc.
- [3] Mendecki, A.J. (ed.), 1997. Seismic Monitoring in Mines. Chapman & Hall.
- [4] Reynolds, J.M., 2011. An Introduction to Applied and Environmental Geophysics. Wiley – Blackwell. John Wiley & Sons.
- [5] Sharma, Prem V., 2002. Environmental and engineering geophysics. Cambridge University Press.
- [6] Torge, W., 1989. Gravimetry. Water de Gruyter. Berlin. New York.
- [7] Selected Journal Publications (for example journals: Progress in Geophysics, Engineering Geophysics Journal, Environmental and Engineering Geophysics, Journal of Geophysics and Engineering, Pure and Applied Geophysics).

SECONDARY LITERATURE:

- [1] Lowrie, W., 2007. Fundamentals of Geophysics. Cambridge University Press.
- [2] Milsom, J., 2003. Field Geophysics. John Wiley & Sons Ltd.
- [3] Telford, W.M., Geldart, L.P., Sheriff, R.E., 1990. Applied Geophysics. Cambridge University Press.

SUBJECT SUPERVISOR (NAME AND SURNAME, E-MAIL ADDRESS)

ANNA BARBARA GOGOLEWSKA, anna.gogolewska@pwr.edu.pl

FACULTY OF GEOENGINEERING, MINING AND GEOLOGY SUBJECT CARD	
Name of subject in Polish Wspomagane komputerowo modelowanie geologiczne i geostatystyka.)	
Name of subject in English: Computer Aided Geological Modelling and Geostatistics	
Main field of study (if applicable): Górnictwo i geologia.	
Specialization (if applicable): Mining Engineering, Geotechnical and Environmental Engineering, Geomatics for Mineral Resource Management Mineral Resource Exploration	
Profile: academic	
Level and form of studies: 2nd level, full-time	
Kind of subject: obligatory	
Subject code	W06GIG-SM3002
Group of courses	No

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15		45		
Number of hours of total student workload (CNPS)	50		75		
Form of crediting	crediting with grade	Examination / crediting with grade*	crediting with grade	Examination / crediting with grade*	Examination / crediting with grade*
For group of courses mark (X) final course					
Number of ECTS points	2		3		
including number of ECTS points for practical classes (P)			3		
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	0,8		1,9		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Mathematical Statistics,
2. Fundamentals of Geology and Mineral Deposits

SUBJECT OBJECTIVES

- C1 Developing basic skills in computer modelling of 3-D objects.
C2 Introduction of the principles of digital modelling of typical geological structures.
C3 Introduction to the methods of deposit parameters estimation and resources evaluation.

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge:

PEU_W01 Estimation methods, principles of geostatistics, kriging estimators

PEU_W02 Geostatistical modelling of the selected deposit parameters (domain analysis, variogram modelling,

PEU_W03 Creating and validating 3-D models of various geological structures in the comprehensive dedicated software environment.

relating to skills:

PEU_U01 Application of relevant estimation methods for quality modelling of a deposit

PEU_U02 Evaluating 3-D objects against structural and quality block models (volumes, tonnages, grades)

PEU_U03 Describing the interpretation and applied approach, creating models, evaluation results, recommendations for possible enhancements

relating to social competences:

PEK_K01 The student can think and act in a creative and enterprising way

PROGRAMME CONTENT

Lecture		Number of hours
Lec 1	Introduction to the course. Geological database and validation of the geological data.	2
Lec 2	Geology of the seam.	2
Lec 3	Structural model of the stratified deposit. Methods of the prediction of the surface layer parameters.	2
Lec 4	Spatial distribution of samples values. Regionalized variable.	2
Lec 5	BLUE Estimator of the mean value: Kriging.	2
Lec 6	Quality model of the deposit – block model of the parameter layers. Estimation and evaluation of the block model.	2
Lec 7	Reserves modelling and evaluation.	2
Lec 8	Mineral resources. International reporting. The JORC Code	1
	Total hours	15

Laboratory		Number of hours
La1	Determining the rules of work at the laboratory.	3
La2	Assignment of the individual dataset for the exercises and creating initial data files.	3
La3	Data validation and creating initial geological database.	3
La4	Construction of the structural wireframe model of stratigraphy layers.	3
La5	Construction of the block model of the deposit and overburden layers. Thickness and stripping ratio analysis.	3
La6	Data preparation to geostatistical analysis. Compositing of the samples.	3
La7	Domain analysis with the use of the statistical methods.	3
La8	Determination of the empirical variogram. Anisotropy analysis.	3
La9	Variogram modelling.	3
La10	Kriging Neighborhood Analysis - defining optimal parameters of the	3

	estimation procedure.	
La11	Estimation of quality parameters in block model of the deposit layers. Validation of the estimation quality.	3
La12	Validation of the quality model and classification of the resources. Balance resources evaluation.	3
La13	Preparation of data for continuous surface mining ultimate pit design. Ultimate pit outlines generation	3
La14	Wireframe and block modelling of the ultimate pit	3
La15	Reserves evaluation, visualization and interrogation of created models	3
	Total hours	45

TEACHING TOOLS USED

N1. Form of lectures - traditional, multimedia presentations using specialized software and demonstrations of its application "live", individual development of specialist topics covered during the lecture,
N2. individual development of project tasks within the laboratories frames, individual development of electronic reports concerning project tasks within the laboratories frames,
N3. evaluation of laboratory tasks reports with multipoint grade of student's work, group analysis of the results obtained during laboratory tasks; preparation of conclusions concerning data dependencies and constraints of mining projects, skill control tests, duty hours in laboratory.

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT

Evaluation (F – forming during semester), P – concluding (at semester end)	Learning outcomes code	Way of evaluating learning outcomes achievement
F1	PEU_W01, PEU_W02	Lecture grade on the basis of the written examination
F2	PEU_W03,	Laboratory task assessment: “structural modelling assessment
F3	PEU_U01	Laboratory task assessment: “geostatistical modelling”
F4	PEU_U02, PEU_U03	Laboratory task assessment: “reserves evaluation”.
P average of F1, F2, F3, F4		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

- [1] M. Armstrong, Basic Linear Geostatistics, Springer Verlag, 1998.
- [2] P. Goovaerts: "Geostatistics for Natural Resource Evaluation", Oxford University Press, 1997.
- [3] R. H. Grishong, Jr., 3-D Structural Geology, Springer Verlag, 2008
- [4] K. Hefferan, J. O'Brien, Earth materials, Willey-Blacwell, Chichester U.K., 2010
- [5] W. Hustrulid, M. Kuchta, Open pit mine planning and design. Chapter 3. Orebody description, Taylor&Francis, 2013.
- [6] A. G. Journel, and C.J. Huijbregts, Mining Geostatistics, Academic Press, 1978.
- [7] Ch.C. Plummer, D.H. Carlson, L. Hammersley, Physical geology, McGraw-Hill I.E. N.Y. 2010
- [8] D.R. Prothero, R.H. Dott Jr., Evolution of the Earth, McGraw-Hill I.E. N.Y., 2010
- [9] M.W. Rossi, C.V. Deutsch, Mineral Resources Estimation, Springer Verlag 2014.

SECONDARY LITERATURE:

- [10] Handouts, tutorials.

SUBJECT SUPERVISOR (NAME AND SURNAME, E-MAIL ADDRESS)

Dr inż. Krzysztof Hołodnik
Dr inż. Witold Kawalec

FACULTY OF GEOENGINEERING, MINING AND GEOLOGY	
SUBJECT CARD	
Name in Polish:	Cyfrowa kopalnia
Name in English:	Digital Mine.....
Main field of study:	Mining and geology
Specialization:	Mining Engineering, Geotechnical and Environmental Engineering, Mineral Resource Exploration
Level and form of studies:	2nd level, full-time
Kind of subject:	obligatory
Subject code:	W06GIG-SM3006
Group of courses:	No

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15		15		
Number of hours of total student workload (CNPS)	25		25		
Form of crediting	crediting with grade		crediting with grade		
For group of courses mark (X) final course					
Number of ECTS points	1		1		
including number of ECTS points for practical (P) classes			1		
Including number of ECTS points for direct teacher-student contact (BK) classes	0,8		0,8		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Computer literacy skills
2. Basic knowledge related to Mining Engineering and Mineral Processing
3. Programming

SUBJECT OBJECTIVES

- C1. Acquisition of the ability to create utility applications in the C / C ++ and LabVIEW environment
- C2. Providing students with knowledge about embedded systems, their construction, selection of components, designing, programming and their exploitation.
- C3. Familiarizing with the advances of technology & methods of future mining operations.
- C4. Acquisition and consolidation of social competencies including emotional intelligence skills involving the cooperation in the group of students aiming to effectively solve problems.
- Responsibility, honesty and fairness in the proceedings; observance force in academia and society

SUBJECT EDUCATIONAL EFFECTS**relating to knowledge:**

PEU_W01 A student has knowledge related to automation systems, control systems and measurement systems in various aspects of the mining industry.

PEU_W02 The student has knowledge of the importance of automation and robotics systems in modern mining.

relating to skills:

PEU_U01 A student is able to select and integrate elements of a specialized measuring and control system including: control unit, executive system, measuring system as well as peripheral and communication modules

PEU_U02 A student can design improvements in the existing design solutions for automation and robotics components and systems

relating to social competences:

PEU_K01 A student is aware of the need for a professional approach to technical issues, meticulous reading of documentation and knows environmental conditions in which devices and their components can function

PEU_K02 The student has knowledge concerning the benefits of creation and implementation new solutions&technologies into mining industry

PROGRAMME CONTENT		
Form of classes - lecture		Number of hours
Lec 1	Terminology (process, automation, robots, measurement devices, control systems). Definition of digital mine	2
Lec 2	Aims, benefits, drawbacks of automation. Industrial revolutions. Definition of industry 4.0. Overview of components of the 4th industrial revolution. Industry 4.0 and mining	2
Lec 3	Elements of technological process in mining. Automation of cyclic processes Measuring technologies in industry 4.0. Sensors systems. Data transmission and data storage technologies. Analytics in industry 4.0. Industrial BigData, Cloud Computing	2
Lec 4	Industrial Internet of Things. M2M communication, anti-collision systems, location of people underground	2
Lec 5	Virtual and augmented realities for industry. Simulators. Digital Twin. Digital models of processes and objects. Management information creation systems, reporting	2
Lec 6	Case study: Automation in open pit lignite mining (KTZ, Autonomous haulage (use case from Australia))	1
Lec 7	Case study: underground mine (Rock Vader – Sandvik project, other use cases from Sandvik, Epiroc, MineMaster, Zanam, AOT from ZGPS KGHM, KIC project on shaft inspection, ... etc)	2
Lec 8	Case study: mineral processing (ConVis, FlowVis) in KGHM, OPMO project	2
Total hours		15

Form of classes - laboratory		Number of hours
Lab1	Scope of the course, teaching purpose, crediting conditions, literature, data. Introduction to ARDUINO	3
Lab2	Basic sensors for physical parameters measurements	3
Lab3	Measurements in Labview	3
Lab4	Analysis and Visualization in Labview	3
Lab5	Control in labview	3
	Total hours	15

TEACHING TOOLS USED
<p>N1. Type of lectures - traditional, illustrated with multimedia presentations with the usage of audio- visual equipment.</p> <p>N2. Discussion concerning lectures and laboratory.</p> <p>N3 Configuration on laboratory classes measuring systems (hardware and software), performing of measurements, teamwork</p> <p>N4. Projects defence - oral and written form.</p> <p>N5. Duty hours.</p>

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT

Evaluation (F – forming (during semester), P – concluding (at the end of semester))	Educational effect number	Way of evaluating educational effect achievement
F1, P1	PEK_U02- PEK_U04	<p>F1.1 Grade from laboratory work's performance and its merits</p> <p>F.1.2 Grade from laboratory work's oral or written defence</p> <p>P1.Final grade (weighted average of F1.1 - 60% and F1.2 - 40%).</p>
F2, P2	PEK_U02- PEK_U04	<p>F2.1 Grade from activity during the lecture (questions, discussions etc)</p> <p>F.2.2 Grade from written exam</p> <p>P2.Final grade (weighted average of F2.1 - 20% and F2.2 - 80%).</p>

LITERATURE

PRIMARY LITERATURE:

- [1] LabVIEW™ Getting Started with LabVIEW
<http://www.ni.com/pdf/manuals/373427j.pdf>
- [2] Monk Simon: Arduino dla początkujących. Podstawy i szkice, Anderson R., Cervo D., Helion, 2018
- [3] Monk Simon: Arduino dla początkujących. Kolejny krok, Anderson R., Cervo D., Helion, 2015

ONLINE LITERATURE:

- [1] LabVIEW Tutorial
- [2] ARDUINO Tutorial
- [3] Materials prepared by Tutor
- [4] Internet websites

SUBJECT SUPERVISOR (NAME AND SURNAME, E-MAIL ADDRESS)

**Prof. dr hab. inż. Radosław Zimroz, radoslaw.zimroz@pwr.edu.pl
dr inż. Anna.Nowak-Szpak**

FACULTY OF GEOENGINEERING, MINING AND GEOLOGY

SUBJECT CARD

Name in Polish: Zarządzanie Środowiskiem
Name in English: Environmental Management
Faculty of studies (if applicable): Mining and Geology
Specialisation (if applicable): Mining Engineering
 Mineral Resource Exploration
Level and form of studies: 2nd level, full-time
Subject Type: Obligatory
Subject code: W06GIG-SM3001
Group of courses: No

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in the University (ZZU)	30				15
Number of hours of total student workload (CNPS)	50				25
Form of crediting	Crediting with grade				Crediting with grade
For a group of courses mark (X) for the final course					
Number of ECTS points	2				1
including number of ECTS points for practical (P) classes					
including number of ECTS points for direct teacher-student contact (BU) classes	1,3				0,8

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge of issues related to ecology and environmental protection.

SUBJECT OBJECTIVES

- C1. To get students acquainted with systems of environmental management both in Poland and other EU countries.
- C2. To prepare students for rational and sustainable management of environmental components.
- C3. To get students acquainted with the genesis of environmental management systems in Poland, review and standardization of environmental management systems.
- C4. To get students acquainted with benefits and obligations arising from the implementation of an environmental management system.
- C5. To present the relationship between an environmental management system and a quality

management system.

C6. To provide an overview of informative methods of supporting the implementation of environmental management systems (possibilities and practical usage of computerised systems of environmental information management, decision support in the area of environmental protection and choice of methods and tools used to support the implementation of an environmental management system).

SUBJECT LEARNING OUTCOMES

relating to knowledge:

PEU_W01 – Possesses systematic knowledge of the origins of environmental management systems, review and standardization of environmental management systems.

PEU_W02 - Possesses knowledge of the possibilities and practical applications of tools supporting the implementation of the environmental management system.

PEU_W03 - knows basic formal and legal regulations regarding the implementation and functioning of management systems, tools and instruments of environmental management.

PEU_W04 - Possesses knowledge for rational and sustainable management of environmental components.

relating to skills:

PEU_U01 – Possesses linguistic resources appropriate for specialised language and is able to use it in linguistic activities in order to communicate in the professional environment regarding the field of studies; is able to obtain necessary information and interpret and critically evaluate it, reads and understands professional literature, is able to formulate and comprehensively justify opinions, provide presentations of problems related to a studied discipline and also participate in scientific and professional discussions.

PEU_U02 – Is able to use methods and appropriate IT tools in system management of environmental components.

relating to social competencies:

PEU_K01 - Is able to think and act in a creative and enterprising way.

PROGRAMME CONTENT

Form of classes - lecture		Number of hours
Lec.1	Basic concepts: - Environment, characteristics of individual elements of the environment - Characteristics of hazards for the natural environment which are a result of human activities - Environmental Management - The Environmental Management System	2
Lec.2	Legal aspects of environmental management	2
Lec.3	History and development of environmental management systems	2
Lec.4	Environmental management systems:	6
Lec.5	- Business Charter for Sustainable Development of the International	
Lec.6	Chamber of Commerce - ICC Business Charter for Sustainable	

	<p>Development</p> <ul style="list-style-type: none"> - EMAS – Directive of the European Community Commission regarding the approval for voluntary participation by organisations in a community eco-management and eco-audit scheme - CP - Clean Production - BS 7750 - Specification for Environmental Management Systems - ISO 9000 - ISO 14000 - ISO 14001 <p>Characteristics of selected Environmental Management Systems. The benefits of the implementation of the EMS for a company. Experiences of Polish enterprises from the implementation of EMS. Process of implementation of the selected EMS in a company with an example of EMAS.</p>	
Lec.7 Lec.8	<p>Basic tools of environmental management:</p> <ul style="list-style-type: none"> - Legal and administrative instruments (laws, standards, licenses and permits) - Economic instruments (fees, taxes, deposit and refund systems, transferable rights, subsidies, liens, fines) - Instruments (techniques) social impact (ecological education, ecological propaganda) <p>Examples of basic tools of environmental management:</p> <ul style="list-style-type: none"> - Procedure for an assessment of environmental impact - Integrated permits - Audits - Safety Reports - Monitoring of the Environment 	4
Lec.9 Lec.10	Design of an environmental management system	4
Lec.11 Lec.12	<p>IT systems supporting environmental management:</p> <ul style="list-style-type: none"> - Decision Support Systems - Expert systems - Simulation Models - Geographical Information Systems <p>Selected types of information systems which support environmental management, their characteristics, examples of implementation both in Poland and in the world</p>	4
Lec.13	The benefits of an implemented and functioning environmental management system	2
Lec.14	Costs of implementation and functioning of an environmental management system	1
Lec.14 Lec.15	Environmental management systems in practice	3
	Total hours	30
Form of classes - seminar		Number of hours
Se1	The scope and form of an essay and presentation, terms of crediting and literature.	2

	Assignment of seminar topics for individual students.	
Se2	Student speeches with the use of multimedia presentations on the following issues: environmental management systems - specified examples, formal and legal conditions of administrative procedures (eg. receiving a decision on the environmental conditions of a project, an integrated decision etc.), life-cycle analysis of a selected company; fees, taxes, surcharges and environmental deposits; litter management systems, mineral resource management, renewable energy sources, selected monitoring systems, the institution of environmental protection in Poland and in the world and also alternative energy sources, etc. Group discussion on the content and form of speeches.	13
Se3		
Se4		
Se5		
Se6		
Se7		
Se8		
	Total hours	15

TEACHING TOOLS USED

- N1. Informative lecture with elements of problematic lectures.
N2. Multimedia presentations
N3. Didactic discussion during lectures and seminars
N4. Preparation of an essay in the form of a report
N5. Presentation of the essay
N6. Consultations

EVALUATION OF SUBJECT EDUCATIONAL OUTCOME ACHIEVEMENTS

Evaluation F – forming (during semester), P – concluding (at semester end)	Educational outcome number	Method of evaluating educational outcome achievement
F1- Grade from content value of an essay	PEU_U01 PEU_U02 PEU_K01	Text and graphical form of essay
F2 – Grade from presentation and issues included in an essay	PEU_U01 PEU_U02 PEU_K01	Presentation of essay
F3 – Grade from a written or oral test	PEU_W01 PEU_W02 PEU_W03 PEU_W04	Positive grade
final grade from the subject (the weighted average, respectively: 35% for the substantive content of the essay, 25% for the presentation, 40% for the lecture)		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

- [1] Ejdys J., 1998, Zarządzanie środowiskowe w przedsiębiorstwie – koszty i korzyści, Sterowanie ekorozwojem, t.2, Wyd. Politechniki Białostockiej, Białystok,
- [2] Lukashev A. F., Droste R. L., Warith M. A., 2001, Review of Expert System (ES), Geographic Information System (GIS), Decision Support System (DSS), and their applications in landfill design and management. W: Waste Management & Research nr 19,
- [3] Łunarski J. (red.), 2002, Zarządzanie środowiskiem”, Oficyna Wydawnicza Politechniki Rzeszowskiej, Rzeszów
- [4] Nowak Z., 2001, Zarządzanie środowiskiem, Wyd. Politechniki Śląskiej, Gliwice,
- [5] Matuszak-Flejszman A., 2001: Jak skutecznie wdrożyć system zarządzania środowiskowego wg normy ISO 14001. PZLiTS, Poznań
- [6] Pochyluk R. i inni, 1999, Zasady wdrażania systemu zarządzania środowiskowego zgodnego z wymaganiami normy ISO 14001, Eco-Konsult, Gdansk,
- [7] Poskrobko B., Poskrobko T., 2012, Zarządzanie środowiskiem w Polsce, Polskie Wydawnictwo Ekonomiczne, Warsaw
- [8] Poskrobko B., 1998: Zarządzanie środowiskiem. Polskie Wydawnictwo Ekonomiczne, Warsaw
- [9] Przybyłowski P. (red.), 2005, Podstawy zarządzania środowiskowego, Wyd. Akademii Morskiej, Gdynia.

SECONDARY LITERATURE

- [1] Jeżowski P. (red.), 2007: Ekonomiczne problemy ochrony środowiska i rozwoju zrównoważonego w XXI wieku. Szkoła Główna Handlowa, Warsaw
- [2] Lemański J. F., Matuszak-Flejszman A., Zabawa S. (red.), 2000: Efektywność funkcjonowania wdrożonego systemu zarządzania środowiskowego wg normy ISO 14001. PZLiTS, AE, Poznań – Pila
- [3] Websites given during lectures and seminars

SUBJECT SUPERVISOR (NAME AND SURNAME, E-MAIL ADDRESS)

Dr hab. inż. Justyna Woźniak
Dr hab. Inz. Katarzyna Pactwa,
Dr inż. Danuta Szyszka

FACULTY OF GEOENGINEERING, MINING AND GEOLOGY SUBJECT CARD
Name of subject in Polish Bezpieczeństwo i higiena pracy Name of subject in English: Occupational Health and Safety Main field of study (if applicable): Górnictwo i geologia. Specialization (if applicable): Mining Engineering, <b style="padding-left: 40px;">Geotechnical and Environmental Engineering, <b style="padding-left: 40px;">Mineral Resource Exploration
Profile: academic Level and form of studies: 2nd level, full-time Kind of subject: obligatory Subject code W06GIG-SM3005 Group of courses No

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15			15	
Number of hours of total student workload (CNPS)	25			25	
Form of crediting	crediting with grade			crediting with grade	
For group of courses mark (X) final course					
Number of ECTS points	1			1	
including number of ECTS points for practical classes (P)				1	
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	0,7			0,8	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Possesses basic knowledge of technologies used in open-pit mines and underground mines.
2. Is able to use Microsoft Office environment to prepare documents in Word, multimedia presentations in Power Point and work with Excel spreadsheets.
3. Is able to identify harmful, dangerous and nuisance factors in the workplace environment.

SUBJECT OBJECTIVES

- C1. To introduce the principles of occupational risk assessment in accordance with relevant standards
- C2 To present the principles of occupational risk assessment and the determination of admissibility with the use of STER software and the RISC SCORE method.

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge:

PEU_W01 Possesses general knowledge of rules of occupational risk assessment formulation

PEU_W02 – Possesses knowledge of evaluating and determining the admissibility of occupational risk.

PEU_W03 – Possesses general knowledge of corrective and preventive actions regarding hazards of typical work posts in the mining industry....

relating to skills:

PEU_U01 Is able to identify hazards of harmful, dangerous and nuisance factors of typical work posts in the mining industry

PEU_U02 Is able to estimate and determine risk acceptability with methods according to STER software and the RISC SCORE method.

PEU_U03 - Is able to plan corrective and preventive actions for hazards of typical work posts in the mining industry....

relating to social competences:

PEU_K01 - Is able to work in a team and together complete occupational risk assessment and develop its results and the required documentation in the form of a team report

PROGRAMME CONTENT

Lecture		Number of hours
Lec 1	Definition of occupational risk. Legal basics of occupational risk assessment. Risk assessment methods. Course of occupational risk assessment. Information necessary for occupational risk assessment. Identification of harmful, dangerous and nuisance factors in the work environment.	3
Lec 2	Estimation of occupational risk assessment and determination of admissibility. Corrective and preventive actions. Familiarising employees with the results of occupational risk assessment. Implementation of agreed corrective and preventive actions. Monitoring the effectiveness of implemented actions. Periodic occupational risk assessment. Harmful factors – identification and assessment of risks.	3
Lec 3	Dangerous factors - identification and assessment of risks.	3
Lec 4	Nuisance factors in occupational risk assessment: psychological burden, static burden, monotony.	3
Lec 5	Methods of occupational risk assessment: STER software, the RISC SCORE method, written test	3
	Total hours	15

Project		Number of hours
Pr1	Occupational risk assessment with the use of STER software for two work posts – description of work post, identification of hazards. Occupational risk assessment with the use of STER software for two work posts – estimation of occupational risk and determination of admissibility of harmful factors (dust, noise)	3
Pr2	Occupational risk assessment with the use of STER software for two work posts – estimation of occupational risk and determination of admissibility of	3

	harmful factors (vibration, chemical agents)	
Pr3	Occupational risk assessment with the use of STER software for two work posts – estimation of occupational risk and determination of admissibility of dangerous factors (slippery or uneven surfaces, falling elements, moving parts, moving machinery and transported items)	3
Pr4	Occupational risk assessment with the use of STER software for two work posts – estimation of occupational risk and determination of admissibility for nuisance factors (psychological burden, static burden, monotony)	3
Pr 5	Occupational risk assessment for a selected work post with the use of the RISC SCORE method, presentation of executed exercises, test	3
	Suma godzin	15

TEACHING TOOLS USED

N1. Informative lecture with elements of problematic lectures.
 N2 Multimedia presentations.
 N3 Didactic discussions during lectures.
 N4 Didactic discussions during laboratory classes.
 N5 Computer presentation of executed occupational risk assessments.
 N6 Consultation.

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT

Evaluation (F – forming during semester), P – concluding (at semester end)	Learning outcomes code	Way of evaluating learning outcomes achievement
F1	PEU_W01-W03	grade from a test
F2	PEU_W01-W03 PEU_U01- U03	grade from a presentation
P2	PEU_W01-W03 PEU_U01- U03	final grade from project classes (arithmetic average of F1 and F2)

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

- [1] Occupational Safety and Health in Mining. Anthology on the situation in 16 mining countries. Ed.: Kaj Elgstrand and Eva Vingård. University of Gothenburg nr 2013;47(2) ([gupea.ub.gu.se > bitstream > gupea_2077_32882_1](http://gupea.ub.gu.se/bitstream/gupea_2077_32882_1))
- [2] Boyle, Tony: Health and safety: Risk management. IOSH, 2001. (<http://www.iosh.co.uk/index.cfm?go=publications.main>)
- [3] Encyclopaedia of occupational health and safety. Fourth edition Stellman, Jeanne M. (ed.). International Labour Organization, 1998 (<http://www.ilo.org/public/english/support/publ/xtextre.htm#b103>)
<http://www.ilo.org/public/english/support/publ/encyc/>)
- [4] McKeown, Céline; Twiss, Michael: Workplace ergonomics: A practical guide, IOSH, 2001, 160 p. <http://www.iosh.co.uk/index.cfm?go=publications.main>

SECONDARY LITERATURE:

Handouts, articles

OPIEKUN PRZEDMIOTU (IMIE, NAZWISKO, ADRES E-MAIL)

Dr inż. Żaklina Konopacka

FACULTY OF GEOENGINEERING, MINING AND GEOLOGY

SUBJECT CARD**Name in Polish: Modele Decyzyjne w Zarządzaniu****Name in English: Operations Research****Main field of study (if applicable): Mining and Geology****Specialization (if applicable): Mining Engineering,
Mineral Resource Exploration****Level and form of studies: 2nd, full-time****Kind of subject: obligatory****Subject code: W06GIG-SM3000****Group of courses: NO**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15		15		
Number of hours of total student workload (CNPS)	25		50		
Form of crediting	crediting with grade		Crediting with grade		
For group of courses mark (X) final course					
Number of ECTS points	1		2		
including number of ECTS points for practical (P) classes of practical character (P)			2		
including number of ECTS points for direct teacher-student contact (BU) classes	0,8		0,7		

*delete as applicable

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. The student has basic knowledge of mining systems, technological and organizational systems in mining
2. The student has basic knowledge concerning economics in mining
3. The student has basic knowledge concerning mathematical analysis necessary to understand mathematical issues in science having engineering and economic character.
4. The student has basic knowledge and skills of using probability theory models and mathematical statistics
5. The student can use Excel spreadsheet
6. The student understands the need and knows the possibilities of lifelong learning, improving professional, personal and social skills

SUBJECT OBJECTIVES

C1 Acquiring basic knowledge, taking into consideration its applicational aspects concerning mathematical decision models used in management:

C1.1 Linear programming models

<p>C1.2 Models of planning, deposits and costs of projects</p> <p>C1.3 Queuing system models</p> <p>C1.4 Digital simulation models</p> <p>C2. Learning of qualitative understanding, interpretation and quantitative analysis with applications of selected issues concerning optimization</p> <p>C2.1. Production systems:</p> <p>C2.2. Transport issues</p> <p>C2.3. Flows in networks.</p> <p>C2.4. Project schedules</p> <p>C2.5. Queuing system models</p> <p>C3. Acquiring and consolidating the competencies of thinking and acting in a system way.</p>

SUBJECT LEARNING OUTCOMES	
Subject educational effect (knowledge)	
PEU_W01	The student has knowledge concerning basic decision models in management
PEU_W02	The student has knowledge concerning line programming models.
PEU_W03	The student has knowledge concerning models for planning and monitoring of activities, deposits, and costs of projects
PEU_W04	The student has knowledge concerning queuing system models
PEU_W05	The student has knowledge concerning simulation models.
Subject educational effect (skills)	
PEU_U01	The student has the ability to apply and interpret models using linear programming applications
PEU_U02	The student has the ability to apply and interpret models of planning and monitoring of activities, deposits, and costs of projects with the use of programming applications
PEU_U03	The student has the ability to apply and interpret queuing system models using programming applications
PEU_U04	The student has the ability to apply and interpret simulation models using programming applications
Subject educational effect (social)	
PEU_K01	The student can think and act in a system, creative and enterprising way
PEU_K02	The student is able to identify and solve problems with the use of decision models and applications

PROGRAMME CONTENT		
Form of classes - lecture		Number of hours
Le1	Introduction to modelling systems	2
Le2	Linear programming issues - optimization of production	2
Le3	Linear programming issues - flow in networks optimization (optimal allocation issues, the issue of transportation, maximum flow, minimizing costs)	2
Le4	Projects scheduling using critical path	2
Le5	Planning and balancing of deposits in projects	2
Le6	Optimization issues of queuing systems	2
Le7	Monte Carlo methods and digital simulation	3
Total hours		15

Form of classes - laboratory		Number of hours
La1	Defining and solving linear programming issues (Microsoft Excel-Solver)	2
La2	Production optimization (Microsoft Excel - Solver)	2
La3	Flows in networks optimization (Microsoft Excel - Solver)	2
La4	Projects scheduling (Microsoft Project)	2
La5	Planning and balancing of deposits in projects (Microsoft Project)	2
La6	Optimization issues of queuing systems (Microsoft Excel)	2
La7	Elements of Monte Carlo methods and digital simulation (Microsoft Excel)	3
Total hours		15

TEACHING TOOLS USED
N1. Interactive lecture with slides and discussion
N2. Laboratory exercises with the use of IT applications - discussion concerning solutions
N3. Laboratory exercises - short written tests (calculating tasks, tests of knowledge)
N4. Duty hours
N5. Own work - preparation for laboratory classes, solving additional tasks
N6. Own work - own literature studies.

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT

Evaluation (F – forming (during semester), P – concluding (at the end of semester))	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01-04	short written test.
PEU_U01-04 written test (counting exercise)		
PEU_W01-05; PEU_K01-02 Written test (knowledge test)		

PRIMARY AND SECONDARY LITERATURE
<u>PRIMARY LITERATURE</u>
[1] Ignasiak E., Borucki W., Badania operacyjne, PWE, 2001
[2] Krawczyk S., Badania operacyjne dla menedżerów, PWE
[3] Baranowska B, Badania operacyjne w zarządzaniu, PWSBIA, 1996
<u>SECONDARY LITERATURE</u>
[1] Szapiro T., Decyzje menedżerskie z Excelem, PWE 2000
[2] Trzaskalik T., Modelowanie optymalizacyjne, Absolwent
[3] Trzaskalik T., Badania operacyjne z komputerem, PWE
<u>SUBJECT SUPERVISOR (NAME AND SURNAME, E-MAIL ADDRESS)</u>
Dr inż. Witold Kawalec
Dr hab. inż. Leszek Jurdziak
Dr inż. Zbigniew Krysa

FACULTY OF GEOENGINEERING, MINING AND GEOLOGY

SUBJECT CARD**Name of subject in Polish ... Zarządzanie projektami, ocena ich opłacalności i ryzyka..****Name of subject in English: Project Management, Appraisal and Risk Evaluation.****Main field of study (if applicable): Mining and Geology****Specialization (if applicable): Mining Engineering,****Geotechnical and Environmental Engineering,****Geomatics for Mineral Resource Management**..... **Mineral Resource Exploration****Profile: academic****Level and form of studies: 2nd level, full-time****Kind of subject: obligatory****Subject code ... W06GIG-SM3003G****Group of courses YES**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15		30	15	
Number of hours of total student workload (CNPS)	25		50	25	
Form of crediting	Examination				
For group of courses mark (X) final course	X				
Number of ECTS points	4				
including number of ECTS points for practical classes (P)	3				
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	3,1				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge of basic mathematical analysis, probability and statistical models
2. Skills in using Excel spreadsheets
3. Understanding of the need of lifelong learning and the importance of application of Economics, Management and Social Sciences in engineering.

SUBJECT OBJECTIVES

The course combines two groups of topics: basics of mineral economics and financial management and introduction to project management.

Part A: The purpose of the course is

C1 to introduce basic concepts of Microeconomics and financial management

C2 to introduce the concept of time value of money and present the methods used to evaluate investment projects. Different techniques are illustrated by examples and case studies. The range of application as well as the advantages and disadvantages of each method are discussed. The issues of inflation and risk analysis are included.

Part B:

C3 Introduction to project management basic concepts, methods and tools.

C4 Presentation of given project management areas: Project scope management, Project time management, Project cost management, Project risk management. Project planning, scheduling and control using Microsoft Project.

C5 Presentation of the issues of effective communication in project teams, group behaviour and leadership.

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge:

PEU_W01 knows the concepts of demand, supply and price elasticities, understands how they affect markets

PEU_W02 knows the concepts of costs in economics and accounting, understands how they differ

PEU_W03 knows the main cost categories and cost accounting methods

PEU_W04 has basic knowledge about the contents of financial statements

PEU_W05 has basic knowledge about the method of ratio analysis of financial statements

PEU_W06 knows and understands the concepts of Present Value and Future Value for simple cash flows and annuities.

PEU_W07 knows the capital budgeting methods (NPV, IRR, PBP) and understand how to interpret the results

PEU_W08 has basic knowledge about the project risk evaluation methods

relating to skills:

PEU_U01 is able to analyze the causes and effects of demand and supply changes

PEU_U02 is able to interpret and use information presented in financial statements also by means of ratio analysis

PEU_U03 is able to use different cost analysis methods and make decisions based on the results

PEU_U03 can calculate Future and Present value, also for annuities and solve simple calculation problems

PEU_U04 is able to perform discounted cash flow analysis and draw conclusions based on the results

PEU_U05 is able to carry out sensitivity analysis and scenario analysis using a financial model of an investment

PEU_U06 is able to work out basic project documentation and initiate a project

PEU_U07 is able to use basic methods of project management, monitoring and project risk management

PEU_U08 is able to implement basic conflict management methods in a project group

PEU_U09 is able to use basic group management methods, can undertake and shape the leadership position

relating to social competences:

PEU_K01 is able to think and act in a systematic, creative and entrepreneurial way

PEU_K02 has an established attitude of economic operation and decision-making based on available financial information and forecasts

PROGRAMME CONTENT		
Lecture		Number of hours
Lec.1	Supply and demand, equilibrium price, changes in demand and supply. Stock and commodity markets used by mineral industries	2
Lec.2	Costs in economics and in accounting. Cost and money outflow. Relevant cost, incremental cost, marginal cost, alternative cost. Short-term decision making.	2
Lec.3	Costs as the subject of cost accounting, different systems of cost accounting Different methods of cost data presentation (by types, divided into direct and indirect costs). Cost allocation	2
Lec.4	Variable and fixed costs. Break even point. Cost-volume –profit analysis.	1
Lec.5	Basics of financial accounting. Income statement and cash flow statement. Balance sheet. Working capital. Examples of financial statements of mining companies	2
Lec.6	Financial ratio analysis. Liquidity, profitability, activity and debt ratios. Financial and operating leverage.	2
Lec.7	The concept of time value of money. Computation of future and present value of money by means of spreadsheet functions. Basics of capital budgeting. Evaluation of different methods.	2
Lec.8	The concept of risk and return. Quantification of risk. Risk analysis in project evaluation: sensitivity analysis, scenario analysis, other methods.	2
	Total hours	15

Project		Number of hours
Pr 1	Issues of understanding communication: Definitions Models (Schramm model, Berlo’s SMCR (source, message, channel, receiver) model, McCroskey model, Reusch and Bateson model, Westley-MacLean model)	3
Pr 2	Conflict Sources of conflicts Kilmann and Thomas classification of conflict Kilmann and Thomas test Different styles of conflict solving Roles of conflict in group development.	3
Pr3	Team roles Team roles Belbin perspective Discussion group roles Effective managerial behaviour in the context of team roles	3
Pr4	Leadership Hersey and Blanchard theory Black and Mouton approach to leadership Fiedler theory and his Least Preferred Coworker Scale Situational leadership self-assessment	3
Pr5	Summary;	3

	Effective managerial behaviour from the different contexts.	
	Total hours	15

Laboratory		Number of hours
Part A		
La1	Supply and Demand curves. Elasticity of demand.	2
La2	Economic costs. Cost curves. Profit maximization cases.	2
La3	Managerial cost accounting. Decision making cases.	2
La4	Basic financial accounting. Creation of simple Balance Sheet, Profit and Loss Statement and Cash Flow Statement	2
La5	Ratio analysis based on financial statements of companies	2
La6	Time value of money and capital budgeting – calculation by means of Excel functions	2
La7	Financial model of an investment. Sensitivity and Scenario analysis.	3
Part B		
La8	Basic concepts (process, project, project management, management by projects, critical factors for project success, competences). Preparing and initiation of the project. Project analysis (project environment, stakeholders, project objectives).	3
La9	Planning and estimating of the project. Project phases and life cycle	3
La10	Project organization. Project scope management. Planning of activities, resources and costs.	3
La11	Project risk management. Project monitoring. Project management methodologies.	3
La12	Quality management. Change control. Project closing.	3
	Suma godzin	30

TEACHING TOOLS USED
N1. Interactive lecture with the use of multimedia and discussion N2. Laboratory classes: individual problem solving with the use of Excel spreadsheet N3. Laboratory classes part B and project classes: case studies solving in groups and individually. Project presentations, discussion N4. Consultation N5. Self-study: solving assigned problems, literature studies

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT

Evaluation (F – forming during semester), P – concluding (at semester end)	Learning outcomes code	Way of evaluating learning outcomes achievement
F1	PEU_W01-W08 PEU_K01-K02	Assesment of student class activity
F2	PEU_U01-U10 PEU_K01-K02	Evaluation of student's assignments
P1	PEU_W01-W08 PEU_U01-U10 PEU_K01-K02	Written test

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

1. Erhardt M., Brigham E.: Financial Management Theory and Practice. South-Western Cengage Learning, USA
2. Brigham E., Glapenski L.: Financial Management, 1997
3. Johnson H.: Making Capital Budgeting Decisions – Maximising the Value of the Firm. Financial Times/Prentice Hall (April 15, 1999)
4. Jonson H.: Strategic Capital Budgeting: Developing and Implementing the Corporate Capital Allocation Program, January 1994.
5. Lock Dennis, Project Management, Published April 11, 2013 by Routledge

SECONDARY LITERATURE:

1. Jonson H.: Determining Cost of Capital: The Key to Firm Value. Apr 1999.
2. A Guide to Project Management Body of Knowledge (PMBOK®Guide Fourth Edition), Project Management Institute, 2008 (2004). wydanie polskie, MT&DC Warszawa, 2009 (2006)
3. Johnson H.: Global Financial Institutions and Markets. December 1999

SUBJECT SUPERVISOR (NAME AND SURNAME, E-MAIL ADDRESS)

Dr inż. Gabriela Paszkowska, Gabriela.paszowska@pwr.wroc.pl

FACULTY OF GEOENGINEERING, MINING AND GEOLOGY

SUBJECT CARD

Name in Polish: *Zasady i zastosowania InSAR oraz GIS w górnictwie*
Name in English: *Principles and Application of InSAR and GIS in mining*
Main field of study: Mining and geology
Specialization: Geomatics for Mineral Resources Management
Mineral Resource Exploration
Level and form of studies: 2nd level, full-time
Kind of subject: obligatory
Subject code: W06GIG-SM3007
Group of courses: No

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30		45		
Number of hours of total student workload (CNPS)	50		75		
Form of crediting	Examination		crediting with grade		
For group of courses mark (X) final course					
Number of ECTS points	2		3		
including number of ECTS points for practical (P) classes			3		
Including number of ECTS points for direct teacher-student contact (BU) classes	1,4		2,0		

*niepotrzebne skreślić

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge of C ++ and Python programming language.
2. Basic knowledge of GIS functions and spatial data acquisition techniques
3. Ability to use GIS software package
4. Basic knowledge of databases

SUBJECT OBJECTIVES

- C1 Presentation of knowledge of satellite radar interferometry, as well as the possibility of using it in the ground deformation measurements.
- C2 Acquiring the ability to determine surface displacements based on satellite radar data.
- C3 Presentation of information on the use of GIS in advanced analysis of objects, phenomena and processes occurring in space.
- C4 Acquiring the ability to formulate and solve tasks using GIS analytical functions.
- C5 Acquiring skills to use spatial data and services in accordance with the INSPIRE Directive

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge:

PEK_W01 Has expanded knowledge in the field of using geoinformation systems to collect and process data used in modeling of both natural and anthropogenic phenomena and processes

PEK_W02 Knows the principles of construction and functioning of geoinformation systems in the mining industry and public administration

relating to skills:

PEK_U01 has the ability to use advanced GIS tools in mining, studies of natural phenomena, the impact of mining on the environment and space development,

PEK_U02 has the ability to formulate and solve spatial tasks in the GIS environment

PEK_U03 has the ability to interpret the results obtained and draw conclusions

relating to social competences:

PEU_K01 has the ability to formulate and transfer knowledge on the use of geoinformation systems in spatial analysis and presentation of their results

PROGRAMME CONTENT

Lecture		Number of hours
Lec 1	Discussion of syllabus, requirements for passing the course, literature	2
Lec 2	Introduction to Microwave Signals for Earth Observation	2
Lec 3	Principles and Applications of Passive and Active Microwave Remote Sensing	2
Lec 4	Acquisition and processing of SAR data	2
Lec 5	SAR image theory (geometric properties, polarization)	2
Lec 6	Basics of SAR data calculation using the DInSAR and SBAS methods	2
Lec 7	Principles and Applications of Interferometric SAR (monitoring surface activity, natural and anthropogenic phenomena)	2
Lec 8	Fundamental concepts of geographical information systems	2
Lec 9	Data modelling in GIS. Representation of spatial data. Spatial databases. Current status and development trends	2
Lec 10	Methods of spatial analysis in GIS	2
Lec 11	Spatial data interpolation	2
Lec 12	Map algebra. Surface analysis, local and zonal functions	2
Lec 13	Basics of spatial statistics	2
Lec 14	Spatial Information Infrastructure. Inspire Directive. Open Data	2
Lec 15	Examples of applications of geoinformation systems in mining and environmental protection	2
	Total hours	30

Laboratory		Number of hours
La1	Configuration of the environment for SAR calculations	3
La2-3	Introduction to radar data calculations - calculation tasks	6
La4	Acquiring radar data and calculating the interferogram - DInSAR method	3
La5	Unwrapping of the interferometric phase - calculations	3
La6-7	Presentation of results in the GMT environment	6
La8	Discrete data interpolation. Preparation of input data for analysis (e.g. deformation measurements in the mining area)	3
La9	Discrete data interpolation. Development mining area terrain deformation maps with various interpolation methods.	3
La10	Discrete data interpolation. Analysis and assessment of the quality and uncertainty of interpolation. Prediction map. Development of maps of changes between two periods using a raster calculator.	3
La11	Spatial analysis - assessment of the suitability of the area for the location	3
La12	of mining operation. Construction of a database of spatial location criteria	3
La13	Spatial analysis - assessment of the suitability of the area for the location	3
La14	of mining operation. Selection of analytical procedures and conducting analytical operations.	3
La15	Spatial analysis - assessment of the suitability of the area for the location	3
Total hours		45

TEACHING TOOLS USED
N1. Lectures N2. Multimedia presentations N3. Preparation of individual written term paper on a given topic N4. Multimedia materials (MOOC) N5. Laboratory instructions N6. Reports from laboratory exercises N7. Consultations

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT

Evaluation (F – forming during semester), P – concluding (at semester end)	Learning outcomes code	Way of evaluating learning outcomes achievement
F, P	PEU_W01 – 02 PEU_U01 – 03 PEU_K01	F1 Final mark for the written examination F2 Mark for the written report, P Final mark for the lecture (weighted average of F1 and F2, where F1 – 80% and F2 - 20%)
F, P	PEU_W01 – 02 PEU_U01 – 03 PEU_K01	F3 Mark for the written assignment reports F4 Mark from written tests, P2 Final mark for the laboratory (weighted average of F3 and F4, where F3 – 80% and F4 - 20%)

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

- [1] Longley P. A., Goodchild M. F., Maguire D. J., Rhind D. 2015: Geographic Information Science and Systems, 4th Edition, John Wiley & Sons;
- [2] Maguire D., Batty M., Goodchild M., 2005. GIS Spatial Analysis and Modelling. ESRI Press
- [3] Berry J., 2007-2013. Beyond Mapping IV — GIS Modelling
- [4] Satellite InSAR Data: Reservoir Monitoring from Space, A. Ferretti, EAGE; 1st edition, 2014
- [5] GMTSAR: An InSAR Processing System Based on Generic Mapping Tools (Second Edition), D. Sandwell i in., Scripps Institution of Oceanography, University of California, San Diego, La Jolla, CA, USA, 2016
- [6] InSAR Principles - Guidelines for SAR Interferometry Processing and Interpretation, ESA Publications, 2008

SECONDARY LITERATURE:

- [1] Directive 2007/2/EC of the European Parliament and of the Council of 14 March 2007 establishing an Infrastructure for Spatial Information in the European Community (INSPIRE)
- [2] Kennedy M., 2009: Introducing Geographic Information Systems with ArcGIS: A Workbook Approach to Learning GIS, Second Edition, John Wiley and Sons;
- [3] Longley P. A., Goodchild M. F., Maguire D. J., Rhind D. W., 2006. GIS. Teoria i praktyka. Wydawnictwo Naukowe PWN, Warszawa
- [4] Urbański J., 2010. GIS w badaniach przyrodniczych, Wydawnictwo Uniwersytetu Gdańskiego
- [5] Dokumentacja środowiska GMT (Generic Mapping Tools) - <http://gmt.soest.hawaii.edu/projects/gmt/wiki/Documentation>

SUBJECT SUPERVISOR (NAME AND SURNAME, E-MAIL ADDRESS)

Wojciech Milczarek, wojciech.milczarek@pwr.edu.pl
Jan Blachowski, jan.blachowski@pwr.edu.pl

Semester 4
WUST

EIT label – Teaching units <TIMREX – T-shaped Master Programme for Innovative Mineral Resource Exploration>

Course title	Applied field exploration					
European Credits (ECTS)	3	Time (hours) given to the students			45	
Type (Lecture, internship, exercise etc.)	Lectures: , Auditorium classes: , Lab. Classes: , Project classes: , Practical classes: , Seminar classes: , Fieldwork: 3	Student whole working time (hours)			75	
Description of content	The goal of the course is that students should acquire a hands-on understanding of different field exploration methodologies, and how they can be integrated for targeting VMS deposits. Geological, geophysical and geochemical exploration methods in VMS exploration. Practical field mapping exercises in structural geology, stratigraphy, hydrothermal alteration. Practical geophysical surveying using UAV technology. GIS-based data synthesis for exploration target selection. Drill core logging and assaying.					
Learning outcomes of the curricular unit (knowledge, skills and competences to be developed by the students)	Knowledge: when passed the student is expected to have: -knowledge about different field methods and their use during an exploration program. -knowledge about drilling and sampling methods. -knowledge about different methods for field mapping. Skills: when passed the student is expected to have the ability to - acquire in-depth structural, volcanological and alteration data from outcrops in the field - contextualize field observations in relation to ore genetic model for VMS deposits. - synthesize different types of geological and geophysical data for targeting a VMS deposit. Competences: ,					
Assessment methods and criteria	Exercises U G# 1.20 Project work G U 3 4 5 1.80 The course is mainly presented via practicals in the field, but also with complementary lectures and exercises, in addition to project work.					
Recommended readings	Online compendium in Canvas room					
TU Coordinator	Nils Jansson, Nils.Jansson@ltu.se					
Contribution to EIT's Overarching Learning Outcomes (tick relevant box/es)*	OLO 1 Entrepreneurship	OLO2 Innovation	OLO3 Creativity	OLO4 Intercultural	OLO5 Value judgments / Sustainability	OLO6 Leadership

EIT label – Teaching units <TIMREX – T-shaped Master Programme for Innovative Mineral Resource Exploration>

Justification for OLO contribution	
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EIT label – Teaching units <TIMREX – T-shaped Master Programme for Innovative Mineral Resource Exploration>

Course title	SOC Internship		
European Credits (ECTS)	2	Time (hours) given to the students	30
Type (Lecture, internship, exercise etc.)	Lectures:, Auditorium classes: , Lab. Classes: , Project classes: 2 , Practical classes:, Seminar classes: , Fieldwork: x	Student whole working time (hours)	50
Description of content	<p>The aim of the course is to enable students to work in socially responsible workplaces, and apply their skills and knowledge to promote social good. While this develops them to become work-ready professionals, it also nurtures them to become advocates who help build a better world.</p> <p>EDUCATIONAL GOALS:</p> <ol style="list-style-type: none"> 1. To actively participate in the affairs of the community and in concrete actions on the ground that aim to promote the public interest, equality and solidarity. 2. To reflect on social license to operate issues 3. To work in direct contact with the beneficiaries of the civic activities undertaken e.g.: reception, facilitation, support, social assistance, etc. <p>EXAMPLES OF SOCIAL AND CIVIC ISSUES IN MINERALS INDUSTRIES:</p> <ul style="list-style-type: none"> • Depletion of natural capital (degradation of air, land and water quality), land use conflicts, health impacts • Digitalization and automation generate particular challenges for well-being in mining regions. Limited job opportunities for local workforce and skills mismatches. • High and continuous transparency and accountability standards of the industry, effective methods of information sharing and dialogue • A more equitable value-sharing, Corporate Social Responsibility issues • Facilitation of environmental awareness • Preservation and restoring of historic sites, 		
Learning outcomes of the curricular unit (knowledge, skills and competences to be developed by the students)	<p>Knowledge: to understand that social responsibility incorporates an ethical, social and environmentally-friendly perspective to our personal and professional activities</p> <p>Skills: To be able to engage in an informal professional discussion and business communication</p> <p>Competences: To cope with complexity, uncertainty and change in global contexts</p>		

EIT label – Teaching units <TIMREX – T-shaped Master Programme for Innovative Mineral Resource Exploration>

Assessment methods and criteria	Criterion: Submission of a project report					
Recommended readings						
TU Coordinator	Supervisors of the student’s Master thesis					
Contribution to EIT’s Overarching Learning Outcomes (tick relevant box/es)*	OLO 1 Entrepreneurship	OLO2 Innovation	OLO3 Creativity	OLO4 Intercultural	OLO5 Value judgments / Sustainability	OLO6 Leadership
	Students will be engaged in professional discussion and business communication				Students will be able to understand that social responsibility incorporates an ethical, social and environmentally-friendly perspective to our personal and professional activities	
Justification for OLO contribution						

Course title	Exploration entrepreneurship		
European Credits (ECTS)	4	Time (hours) given to the students	60
Type (Lecture, internship, exercise etc.)	Lectures: 1, Auditorium classes: , Lab. Classes: , Project classes: 1, Practical classes: 3, Seminar classes: 2, Fieldwork:	Student whole working time (hours)	100
Description of content	<p>To equip students with the professional skills to increase their employability and entrepreneurship skills to meet the current market demands. The EFGGeoMentoring scheme aims at improving international networking and supporting the life-long learning and CPD requirements of experienced geology professionals. In addition, it allows students to benefit from insider knowledge about international work perspectives in different sectors of geological profession and countries.</p> <p>Mentoring within the course is a process during which an experienced professional with and EurGeol title (mentor) accompanies the student in a targeted way. Mentoring contributes to developing personal, entrepreneurial, networking, social and professional skills regarding the mineral prospecting and exploration activity. It allows learning from professional experiences that can only be acquired through practice and can't be found in any textbook. Mentoring improves the opportunities of career beginners by providing career-enhancing contacts and involvement in professional networks.</p> <p>At the beginning of the mentoring cooperation, students formulate clear goals and communicate them to their mentor. In consultation with the mentor, concrete topics and the respective roles within the mentoring process will be defined. Since the student is at the centre of the process, it is their task to become aware of their own plans and their support needs.</p> <p>OBJECTIVES OF THE MODULE:</p> <ul style="list-style-type: none"> • Intensify international networking among geologists all across Europe and beyond • Provide young professionals with contacts helping them to think through, plan and access their short, medium or long-term career development • Contribute on internship positions • Improve gender balance and increase diversity in leadership positions by providing targeted support to women and under-represented minorities • Facilitate life-long learning and Continuing Professional Development (CPD) <p>The EFG mentors are professionals who have acquired a high level of industrial and/or academic experience and work in industrial practice, business, academia, education or administration.</p> <ul style="list-style-type: none"> • Coaching: The mentor actively guides and encourages the student to develop essential skills and attitudes for the future ("How do I assert myself? How do I behave in negotiations? What do I do in challenging work contexts?") • Advice: The mentor advises the student in concrete situations, in current questions and difficulties. Mentors support students in solving problems and assist them in making tough decisions. 		

	<ul style="list-style-type: none"> • Help: The mentor can help open otherwise locked doors that allow the student to pursue their goals. • Support: The mentor supports the student in essential decisions without deciding. Mentors assist in the development of professional strategies, as well as in career planning and review of possible obstacles. • Inform: The mentor informs the student about (informal) rules and processes applied in organisations or professional life in general. According to the student's background, mentors can also inform about seminars or conferences that they consider helpful. • Participation: Mentors allow students to participate in parts of their professional career, experiences and strategic decisions. They allow students to share their professional life and invite them, for instance, to participate in meetings or appointments. • Give feedback: Mentor and student provide each other with constructive feedback about their appearance and public perception. • Networking: Mentors give the students hints on maintaining and using contacts. They introduce the students into active networks and provide professional contacts. The mentor provides the student with the chance to create a successful CV and take a chance on social networks such as LinkedIn.
<p>Learning outcomes of the curricular unit (knowledge, skills and competences to be developed by the students)</p>	<p>Knowledge: to provide background training to support the learning process; make students aware of broad professional issues; provide business and entrepreneurship skills to develop an awareness of business management and commercial practices regarding mineral prospecting and exploration.</p> <p>Skills: Develop relationships with other persons and maintain them. Can talk frankly about his ideas, fears and weaknesses. Identifying investment opportunities in the mineral resources sector.</p> <p>Competences: To define professional targets, wants to succeed and is actively committed to implementing these targets. Not afraid of making mistakes and experimenting with new ideas. Willing to question himself critically, accept external advice, and implement it.</p>
<p>Assessment methods and criteria</p>	<p>Practical mark</p> <p>At the end of the mentoring process, students will a) reflect their mentoring experience on a two-page report highlighting benefits and potential gaps for future implementation b) prepare a small business plan for an identified innovative idea of their own.</p> <p>Slack channel will allow for student-mentor exchange and networking within the whole cohort of participants.</p> <p>Mentoring is a one-to-one relationship between a mentor and a student.</p> <ul style="list-style-type: none"> • Mentoring takes place beyond a dependent relationship (e.g. supervisor-subordinate or professor-student relationships). • During the mentoring process, learning and experimentation occur in a protected environment. • An integral part of mentoring is the development of professional skills and competencies. <p>Mentoring is a reciprocal process of "give and take". Both sides learn from each</p>

	other because even the mentor will have the opportunity to critically question his professional perspective and discover new perspectives, software and applications, and previously unperceived situations.					
Recommend ed readings	<p>Mentoring Mindset, Skills and Tools 4th Edition: Make it easy for mentors and students, 2020, Synergetic People Development Pty Ltd, 252 pages, ISBN 0980356458</p> <p>The Mentoring Guide: Helping Mentors and Students Succeed, 2019, Michigan Publishing Services, ISBN: 1607855399.</p> <p>Wang, J., Shibayama, S., 2022. Mentorship and creativity: Effects of mentor creativity and mentoring style. Research Policy 51, 104451. doi:10.1016/j.respol.2021.104451</p> <p>Entrepreneurship: A Guide To Success For Entrepreneurs And Aspiring Entrepreneurs, 2018, ISBN 978-1720221654</p> <p>Entrepreneurship: Successfully Launching New Ventures, Global Edition, 2018, Pearson, ISBN: 9781292255330</p>					
TU Coordinator	Pavlos Tyrologou, pavlos.tyrologou@gmail.com					
Contribution to EIT's Overarching Learning Outcomes (tick relevant box/es)*	OLO 1 Entrepreneurship	OLO2 Innovation	OLO3 Creativity	OLO4 Intercultural	OLO5 Value judgments / Sustainability	OLO6 Leadership
	XX		X	XX	XX	XX
Justification for OLO contribution						

COURSE DESCRIPTIONS/ KARTY PRZEDMIOTÓW

**second-level studies/ studia II stopnia
main field of study/ kierunek studiów:
Mining and Geology/ Górnictwo I Geologia**

**specjalność/specialisation:
Mineral Resources Exploration
- Track UNI MISKOLC-WUST**

Semester 1 and 2
UNI MISKOLC

Course descriptions – Earth Science Engineering MSc

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Core part

Numerical methods and optimization

Course Title: Numerical methods and optimization		ECTS: 2
Type of course (C/E):	Course code: GEMAK712MA	
Type (lec./sem./lab./consult.) and Number of Contact Hours per Week: 1 lectures, 1 seminars		
The degree of <u>theoretical</u> or practical nature of the course: (in ECTS%)		
Type of Assessment (exam. / pr. mark. / other): P		
Grading scale:		
% value	Grade	
90 -100%	5 (excellent)	
80 – 89%	4 (good)	
70 - 79%	3 (satisfactory)	
60 - 69%	2 (pass)	
0 - 59%	1 (failed)	
Position in Curriculum (which semester): 1.	Pre-requisites (<i>if any</i>): -	
Course Description:		
<u>Objectives of the course:</u>		
Upon completing the course, students shall understand the relation between engineering and mathematics; comprehend important concept of solution methods using both analytical and numerical techniques when the problems can be formulated using differential equations, system of linear equations and system of nonlinear equations. In addition, students shall be able to apply the optimization techniques to various engineering problems.		
<u>Course content:</u>		
<ol style="list-style-type: none"> 1. Extrema of functions. 2. Unconstrained and constrained optimization. 3. Convex optimization. 4. Minimization of functions with one variable (golden section, parabola method). 5. Minimization of multivariable functions (Nelder-Mead, Newton, modified Newton, quasi-Newton, minimization with line search). 6. Methods of penalty functions. 7. Multi-aided and multicriteria decision problems (Pareto efficient solutions). 8. Linear programming. 9. About Soft Computing (SC) methods: fuzzy systems 10. About Soft Computing (SC) methods: genetic algorithms 11. About Soft Computing (SC) methods: neural network 12. Numerical solutions of ordinary differential equations and system of equations: Runge-Kutta, 13. Numerical solutions of ordinary differential equations and system of equations: predictor-corrector 14. Numerical solutions of ordinary differential equations and system of equations: finite differences. 		
<u>Teaching methodologies:</u>		
The 3-5 most important compulsory, or recommended literature (textbook, book) resources: Égertné, M. É., Kálovics, F., Mészáros, G.: Numerical Analysis I.-II. (Lecture notes), Miskolci Egyetemi Kiadó (1992), 1-175.		

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R. Fletcher: Practical Methods of Optimization, John Wiley & Sons, 2000.
P. E. Gill, W. Murray, M. H. Wright: Practical Optimization, Academic Press, 1981.
J. Nocedal, S. J. Wright: Numerical Optimization, Springer, 2000.
Galántai Aurél-Jeney András: Numerikus Módszerek; Miskolci Egyetemi Kiadó, 1997.
Galántai Aurél: Optimalizálási módszerek; Miskolci Egyetemi Kiadó, 2004.

Competencies to evolve (relevant Learning outcomes, Appendix 1):

Knowledge: T11

Skills: K4, K5, K6, K7, K8, K9, K10, K11

Attitudes:

Autonomy and responsibility: F1, F3, F4, F5

Demonstration of coherence of course content and unit's objectives:

The course gives the theory background for calculations applying numerical methods which are essential to solve different statistical and geophysical tasks.

Demonstration of coherence between teaching methodologies and the learning outcomes:

The course focuses on theory, which is supplemented by the course Computer sciences for engineers, providing the practical applications and exercises.

Responsible Academic staff member and lecturing load (name, position, scientific degree): **Dr. Körei Attila** matka@uni-miskolc.hu

Other Academic Staff Involved in Teaching, if any and lecturing load (name, position, scientific degree):

University of Miskolc, Earth Science Engineering MSc
Course descriptions

Engineering physics

Course Title: Engineering physics		ECTS: 4												
Type of course (C/E):	Course code: MFGFT7100011													
Type (lec./sem./lab./consult.) and Number of Contact Hours per Week: 2 lectures, 1 seminars														
The degree of <u>theoretical</u> or practical nature of the course: (in ECTS%)														
<p>Type of Assessment (exam. / pr. mark. / other): E Attendance at lectures is regulated by the university code of education and examination. Writing two tests at least satisfactory level, respectively during the semester is the requirement of signature</p> <p>Grading scale:</p> <table> <thead> <tr> <th>% value</th> <th>Grade</th> </tr> </thead> <tbody> <tr> <td>85 -100%</td> <td>5 (excellent)</td> </tr> <tr> <td>70 – 84%</td> <td>4 (good)</td> </tr> <tr> <td>60 - 69%</td> <td>3 (satisfactory)</td> </tr> <tr> <td>46 - 59%</td> <td>2 (pass)</td> </tr> <tr> <td>0 - 45%</td> <td>1 (failed)</td> </tr> </tbody> </table>			% value	Grade	85 -100%	5 (excellent)	70 – 84%	4 (good)	60 - 69%	3 (satisfactory)	46 - 59%	2 (pass)	0 - 45%	1 (failed)
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0 - 45%	1 (failed)													
Position in Curriculum (which semester): 1.	Pre-requisites (<i>if any</i>): -													
Course Description:														
<p><u>Objectives of the course:</u> Within the framework of the Earth Science Engineering MSc program, the students gain the deepening knowledge in those fields of the continuum physics, which are necessary to understand the geological processes and geophysical methods.</p> <p><u>Course content:</u> The principles of continuum physics. The relationship between the micro- and macroscopic descriptions, averaging in time and space. The kinematical principles of deformable continuum, deformation tensor. Volume and surface forces, stress tensor. Basic equations of continuum mechanics, continuity theories. The equation of motion of elastic continuum, integral and differential forms. Law of conservation of mass, continuity equation. Extensive and intensive quantities, the 0th law of thermodynamics. General forms of law of conservation of mass. Material equations, Curie’s law. Perfectly elastic body, linearly elastic body. Equation of motion of Hooke body. Fluid models, ideal fluids, viscous fluids. Newton body, Navier-Stokes body. Rheological models, Kelvin-Voight model, Maxwell model, Poynting-Thomson’s law for material and motion equation of standard body. Wave propagation in linearly elastic medium. Solutions of wave equation. Wave propagation in different rocks, dispersion, absorption. Disperse waves.</p> <p><u>Teaching methodologies:</u> Attendance at lectures is regulated by the university code of education and examination. Writing two tests at least satisfactory level, respectively during the semester is the requirement of signature</p>														
<p>The 3-5 most important compulsory, or recommended literature (textbook, book) resources: 1.Dobróka M., Somogyiné M. J. 2014: An introduction to continuum mechanics and elastic wave propagation Lecture notes. University of Miskolc. 2.K. Aki and P. Richards. Quantitative seismology. vol. 1: Theory and Methods. W H Freeman & Co (1980) 3.K. Aki and P. G. Richards. Quantitative seismology. vol. 2: Theory and Methods. W H Freeman & Co (1980) 4. Hudson J.A.1980. The excitation and propagation of seismic waves. Cambridge University Press</p>														

University of Miskolc, Earth Science Engineering MSc
Course descriptions

5. Schön J. 1998. Physical properties of Rocks. In. Seismic Exploration vol. 18.

Competencies to evolve (relevant Learning outcomes, Appendix 1):

Knowledge: T1, T2

Skills:

Attitudes: A3, A4, A5, A7

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

Demonstration of coherence of course content and unit's objectives:

This is primarily a theoretical course, giving strong background for later geophysical courses in order to understand and interpret the physical processes that are used in geophysical prospecting and exploration works.

Demonstration of coherence between teaching methodologies and the learning outcomes:

Following the theoretical part, the students complete different exercises in continuum mechanics.

Responsible Academic staff member and lecturing load (name, position, scientific degree): **Dr. Dobróka Mihály** dobroka@uni-miskolc.hu

Other Academic Staff Involved in Teaching, if any and lecturing load (name, position, scientific degree):

University of Miskolc, Earth Science Engineering MSc
Course descriptions

Physical geology

Course Title: Physical geology		ECTS: 4												
Type of course (C/E):	Course code: MFFTT710001													
Type (lec./sem./lab./consult.) and Number of Contact Hours per Week: 2 lectures, 1 seminars														
The degree of <u>theoretical</u> or practical nature of the course: (in ECTS%)														
<p>Type of Assessment (exam. / pr. mark. / other): E During the semester the following tasks should be completed: students have to complete two field programmes: 1) studying sedimentary rocks, reporting in ppt presentations (15%), 2) studying magmatic rocks,</p> <p>Grading scale:</p> <table> <thead> <tr> <th>% value</th> <th>Grade</th> </tr> </thead> <tbody> <tr> <td>80 -100%</td> <td>5 (excellent)</td> </tr> <tr> <td>70 – 79%</td> <td>4 (good)</td> </tr> <tr> <td>60 - 69%</td> <td>3 (satisfactory)</td> </tr> <tr> <td>50 - 59%</td> <td>2 (pass)</td> </tr> <tr> <td>0 - 49%</td> <td>1 (failed)</td> </tr> </tbody> </table>			% value	Grade	80 -100%	5 (excellent)	70 – 79%	4 (good)	60 - 69%	3 (satisfactory)	50 - 59%	2 (pass)	0 - 49%	1 (failed)
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50 - 59%	2 (pass)													
0 - 49%	1 (failed)													
Position in Curriculum (which semester): 1.	Pre-requisites (<i>if any</i>): -													
Course Description:														
<p><u>Objectives of the course:</u> The main objectives of the course are deepening the students' abilities for geological interpretation, making them familiar with the reconstruction of rock-forming processes, introducing them to facial analysis and the stratigraphic methods.</p> <p><u>Course content:</u> Fieldtrip, analysis of sedimentary formations The formation and the inner structure of the Earth Plate tectonic background of the geological processes The role of physical geology in the geological exploration. Magmatic processes, their interpretation on field Sedimentary processes, their interpretation on field Fieldtrip, studying magmatic rocks Metamorphic processes, their interpretation on field Principles of stratigraphy, stratigraphic nomenclature Stratotype, lito-, bio- and chronostratigraphy Magneto-, chemo-, seismic, sequence, and cycle stratigraphy Reconstruction of continental sedimentary environments Reconstruction of marine sedimentary environments Defining the succession of rock-forming processes and tectonic events</p> <p><u>Teaching methodologies:</u> During the semester the following tasks should be completed: students have to complete two field programmes: 1) studying sedimentary rocks, reporting in ppt presentations (15%), 2) studying magmatic rocks,</p>														
<p>The 3-5 most important compulsory, or recommended literature (textbook, book) resources: Sam J. Boggs: Principles of Sedimentology and Stratigraphy, Prentice Hall Publishing, 2011 Angela L. Coe: Field techniques. Wiley-Blackwell 2010 Gary Nichols: Sedimentology and Stratigraphy. Wiley-Blackwell, 2009</p>														

University of Miskolc, Earth Science Engineering MSc
Course descriptions

Competencies to evolve (relevant Learning outcomes, Appendix 1):

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

Skills: K1, K2, K3, K5, K6, K7, K9, K11, K12, K13

Attitudes:

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

Demonstration of coherence of course content and unit's objectives:

The course gives the fundamentals to later specific geological courses. It introduces the basic concepts and skills necessary for interpretation of different geological processes.

Demonstration of coherence between teaching methodologies and the learning outcomes:

Theoretical part is complemented by classworks as well as field works

Responsible Academic staff member and lecturing load (name, position, scientific degree): **Dr. Hartai Éva** foldshe@uni-miskolc.hu

Other Academic Staff Involved in Teaching, if any and lecturing load (name, position, scientific degree):

University of Miskolc, Earth Science Engineering MSc
Course descriptions

Mineralogy and geochemistry

Course Title: Mineralogy and geochemistry		ECTS: 4												
Type of course (C/E):	Course code: MFFAT710005													
Type (lec./sem./lab./consult.) and Number of Contact Hours per Week: 2 lectures, 1 seminars														
The degree of <u>theoretical</u> or practical nature of the course: (in ECTS%)														
<p>Type of Assessment (exam. / pr. mark. / other): E The final grade will consist of two part. During the semester two midterm tests are written. The average of them will be the 50% of the final grade. The rest 50% is for the final exam.</p> <p>Grading scale:</p> <table> <thead> <tr> <th>% value</th> <th>Grade</th> </tr> </thead> <tbody> <tr> <td>90 -100%</td> <td>5 (excellent)</td> </tr> <tr> <td>80 – 89%</td> <td>4 (good)</td> </tr> <tr> <td>70 - 79%</td> <td>3 (satisfactory)</td> </tr> <tr> <td>60 - 69%</td> <td>2 (pass)</td> </tr> <tr> <td>0 - 59%</td> <td>1 (failed)</td> </tr> </tbody> </table>			% value	Grade	90 -100%	5 (excellent)	80 – 89%	4 (good)	70 - 79%	3 (satisfactory)	60 - 69%	2 (pass)	0 - 59%	1 (failed)
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80 – 89%	4 (good)													
70 - 79%	3 (satisfactory)													
60 - 69%	2 (pass)													
0 - 59%	1 (failed)													
Position in Curriculum (which semester): 1.	Pre-requisites (<i>if any</i>): -													
Course Description:														
<p><u>Objectives of the course:</u> Students will get the knowledge of the principals of the distribution of chemical element in the Earth. They will also know the most important thermodynamic processes concerning solid materials, the geochemical classification of elements, the geochemical aspects of the genesis of the most important minerals and mineral assemblages. The geochemistry of isotopes, which explores the chemical evolution of the Earth will also be introduced, as well as the geochemical characteristics of water, organic matter, magmatic, sedimentary and metamorphic rocks by which we can describe the mineral-and rock-forming processes in the crust and mantle.</p> <p><u>Course content:</u> Introduction; Hydrogen and alkaline metals Alkaline earth metals Boron, aluminium, carbon and silicon Rare earth elements, titanium and zirconium Uranium, thorium, vanadium, niobium and tantalum Chromium, molybdenum and tungsten Midterm test (1st); Manganese, iron, cobalt and nickel Copper, gold, silver and platina group elements Zinc, cadmium, mercury, gallium, indium and thallium Tin, lead, arsenic, antimony and bismuth Nitrogen, phosphorus and oxygen Sulphur, selenium, tellurium, haloids and noble gases</p> <p><u>Teaching methodologies:</u> The final grade will consist of two part. During the semester two midterm tests are written. The average of them will be the 50% of the final grade. The rest 50% is for the final exam.</p>														
<p>The 3-5 most important compulsory, or recommended literature (textbook, book) resources: Dill H.G. (2010): The „chessboard” classification scheme of mineral deposits. Elsevier, 2010. White, W. M. (2013): Geochemistry. Wiley-Blackwell.</p>														

University of Miskolc, Earth Science Engineering MSc
Course descriptions

Nordstrom D.K., Blowes D.W., Ptacek C.J. (2015): Hydrogeochemistry and microbiology of mine drainage: An update. Applied Geochemistry, Elsevier.
Albared, F. (2005): Geochemistry. An introduction. Cambridge Univ. Press.
Sarkar D., Datta R., Hanningan R.(2007): Concepts, and applications in environmental geochemistry, Elsevier.
John W. Anthony, Richard A. Bideaux, Kenneth W. Bladh, and Monte C. Nichols, Eds. (2003): Handbook of Mineralogy. Mineralogical Society of America.

Competencies to evolve (relevant Learning outcomes, Appendix 1):

Knowledge: T7

Skills: K1, K2

Attitudes: A1, A2, A9

Autonomy and responsibility: F2, F5

Demonstration of coherence of course content and unit's objectives:

This is a fundamental course, discussing systematic mineralogy and geochemical background of mineral formation processes

Demonstration of coherence between teaching methodologies and the learning outcomes:

Theoretical part is complemented by mineralogy laboratory work and geochemical modeling exercises

Responsible Academic staff member and lecturing load (name, position, scientific degree): Dr. Zajzon Norbert askzn@uni-miskolc.hu

Other Academic Staff Involved in Teaching, if any and lecturing load (name, position, scientific degree): Móricz Ferenc

University of Miskolc, Earth Science Engineering MSc
Course descriptions

Geodesy, spatial informatics

Course Title: Geodesy, spatial informatics		ECTS: 4												
Type of course (C/E):	Course code: MFGGT710002													
Type (lec./sem./lab./consult.) and Number of Contact Hours per Week: 2 lectures, 1 seminars														
The degree of <u>theoretical</u> or practical nature of the course: (in ECTS%)														
<p>Type of Assessment (exam. / pr. mark. / other): E Students will be assessed with using the following elements. Attendance 15 % Short quizzes 10 % Midterm exam 40 % Final exam 35 %</p> <p>Grading scale:</p> <table> <thead> <tr> <th>% value</th> <th>Grade</th> </tr> </thead> <tbody> <tr> <td>85 -100%</td> <td>5 (excellent)</td> </tr> <tr> <td>70 – 84%</td> <td>4 (good)</td> </tr> <tr> <td>55 - 69%</td> <td>3 (satisfactory)</td> </tr> <tr> <td>40 - 54%</td> <td>2 (pass)</td> </tr> <tr> <td>0 - 39%</td> <td>1 (failed)</td> </tr> </tbody> </table>			% value	Grade	85 -100%	5 (excellent)	70 – 84%	4 (good)	55 - 69%	3 (satisfactory)	40 - 54%	2 (pass)	0 - 39%	1 (failed)
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55 - 69%	3 (satisfactory)													
40 - 54%	2 (pass)													
0 - 39%	1 (failed)													
Position in Curriculum (which semester): 1.	Pre-requisites (<i>if any</i>): -													
Course Description:														
<p><u>Objectives of the course:</u> The students will acquire the principles of modern geomatics, its measuring methods and the application of IT in the subject. They will be prepared to apply the modern measuring techniques, the remote data-acquiring methods and use them to solve practical problems. They will learn the application fields of geo-informatics and GIS programs. The students will be competent in the application of modern geodetic technology and geo-informatics in their field. The students enable to process their professional data and organize them into geo-information databases.</p> <p><u>Course content:</u> Coordinate Systems in geodesy. Geometric shape and gravitational field of Earth. Projections and mapping. Hungarian projections and mapping. Modern measuring techniques in Geodesy: Photogrammetry, Remote Sensing, GPS, Inertial Measurements, SAR technology for promoting surveying tasks in the related special fields. Geo-objects and geo-models. Raster and vector models. Data-storing techniques. Database-modelling in geo-informatics. Thematical data and their storage problems. GIS packages. Digitalization, analytical problems, knowledge based systems in GIS environment. Practical work: self-made solutions of simple case-study problems.</p> <p><u>Teaching methodologies:</u> Students will be assessed with using the following elements. Attendance 15 % Short quizzes 10 % Midterm exam 40 % Final exam 35 %</p>														
<p>The 3-5 most important compulsory, or recommended literature (textbook, book) resources: Quest: Geodesy Tutorial; Vanicek, P.: Geodesy; Burkard, R.K.: Geodesy for the Layman; Gábor Bartha: Geoinformation Master Course. University of Miskolc, 2014. István Havasi -Gábor Bartha: Introduction to GIS, Introduction to Geoinformatics (pp. 10.5) (Gábor Bartha), Satellite Global Positioning Systems (pp. 67) (István Havasi). angol nyelvű digitális</p>														

University of Miskolc, Earth Science Engineering MSc
Course descriptions

tankönyv: <http://digitalisegyetem.uni-miskolc.hu>, Miskolci Egyetem. TÁMOP 4.1.2.-08/1/A-2009-0033 projekt, 2011;
Short,N.: The RemoteSensingTutorial

Competencies to evolve (relevant Learning outcomes, Appendix 1):

Knowledge: T7

Skills: K2

Attitudes: A2

Autonomy and responsibility: F6

Demonstration of coherence of course content and unit's objectives:

The course contributes to skills of students which should be applied for different geological and geophysical prospecting and exploration tasks in field as well as presenting and handling spatial data.

Demonstration of coherence between teaching methodologies and the learning outcomes:

Theoretical part is complemented by exercises

Responsible Academic staff member and lecturing load (name, position, scientific degree): Dr. Bartha Gábor itgabor@uni-miskolc.hu

Other Academic Staff Involved in Teaching, if any and lecturing load (name, position, scientific degree):

University of Miskolc, Earth Science Engineering MSc
Course descriptions

Computer science for engineers

Course Title: Computer science for engineers		ECTS: 2
Type of course (C/E):	Course code: GEMAK713MA	
Type (lec./sem./lab./consult.) and Number of Contact Hours per Week: 0 lectures, 2 seminars		
The degree of <u>theoretical</u> or practical nature of the course: (in ECTS%)		
Type of Assessment (exam. / pr. mark. / other): P		
Grading scale:		
% value	Grade	
90 -100%	5 (excellent)	
80 – 89%	4 (good)	
70 - 79%	3 (satisfactory)	
60 - 69%	2 (pass)	
0 - 59%	1 (failed)	
Position in Curriculum (which semester): 1.	Pre-requisites (<i>if any</i>): -	
Course Description:		
<u>Objectives of the course:</u> Programming and using of MATLAB environment (desktop): operation with matrices, elements of linear algebra, plot of one, two or three dimensional functions, printing, control statements, handle graphics and user interface.		
<u>Course content:</u> Object-oriented programming. Design of programming. Computer aided solution plan for chosen problems. Numerical kernel: numerical methods, input-output. Using of files. User interface with karakters and graphics. Writing, testing an documentation for programs. Online and printed description of programs. Help and demo in programs. Printability for the results. Basic concepts, objects of Maple programming language: definition and using of assign, variable, set, array, function. The Maple as programming language: using of array, conditional and loop statement. Definition and application of procedure. Main algorithm in Maple. Graphics of Maple: plot and plot3d, animation statements. Using of files, applications.		
<u>Teaching methodologies:</u>		
The 3-5 most important compulsory, or recommended literature (textbook, book) resources: H. Moore: MATLAB for Engineers, Prentice Hall, 2011 P. E. Gill, W. Murray, M. H. Wright: Practical Optimization, Academic Press, 1981. J. Nocedal, S. J. Wright: Numerical Optimization, Springer, 2000. Stoyan G. (szerk.): MATLAB, Typotex, 2005. The MATH WORKS Inc., Release 13 Product Family Documentation Set, 2002.		
Competencies to evolve (relevant Learning outcomes, Appendix 1): Knowledge: T2, T7 Skills: Attitudes: Autonomy and responsibility:		
Demonstration of coherence of course content and unit's objectives: The course provides practical skills to solve technical tasks by applying numerical methods		

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Demonstration of coherence between teaching methodologies and the learning outcomes:

This is a learning by doing course where students shall complete calculations using numerical methods with application of MATLAB

Responsible Academic staff member and lecturing load (*name, position, scientific degree*): **Dr. Körei Attila** matka@uni-miskolc.hu

Other Academic Staff Involved in Teaching, if any and lecturing load (*name, position, scientific degree*):

University of Miskolc, Earth Science Engineering MSc
Course descriptions

Geophysical exploration methods I.

Course Title: Geophysical exploration methods I.		ECTS: 4												
Type of course (C/E):	Course code: MFGFT7100021													
Type (lec./sem./lab./consult.) and Number of Contact Hours per Week: 2 lectures, 1 seminars														
The degree of <u>theoretical</u> or practical nature of the course: (in ECTS%)														
<p>Type of Assessment (exam. / pr. mark. / other): E Attendance at lectures is regulated by the university code of education and examination. Three writing tests with satisfactory results, and two assignments during the semester is the requirement of signature.</p> <p>Grading scale:</p> <table> <thead> <tr> <th>% value</th> <th>Grade</th> </tr> </thead> <tbody> <tr> <td>86 -100%</td> <td>5 (excellent)</td> </tr> <tr> <td>70 – 85%</td> <td>4 (good)</td> </tr> <tr> <td>60 - 69%</td> <td>3 (satisfactory)</td> </tr> <tr> <td>46 - 59%</td> <td>2 (pass)</td> </tr> <tr> <td>0 - 45%</td> <td>1 (failed)</td> </tr> </tbody> </table>			% value	Grade	86 -100%	5 (excellent)	70 – 85%	4 (good)	60 - 69%	3 (satisfactory)	46 - 59%	2 (pass)	0 - 45%	1 (failed)
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0 - 45%	1 (failed)													
Position in Curriculum (which semester): 1.	Pre-requisites (<i>if any</i>): -													
Course Description:														
<p><u>Objectives of the course:</u> Understanding the surface geophysical methods and the geophysical methods used in boreholes for the purpose that students can design and execute geophysical research and evaluate data.</p> <p><u>Course content:</u> Classification of applied geophysics methods. Gravity methods: measured quantities, basic corrections and data processing methods. Filtering gravity maps. Evaluation of measurement data for causative bodies with simple geometries. Geological and environmental geological applications. Magnetic methods: measured quantities, basic corrections and data processing methods. Reducing magnetic data to the pole. Evaluation of measurement data for magnetizable bodies with simple geometries. Geological and environmental geological applications. The specific resistivity of rocks, the concept of apparent resistivity. Direct current geoelectric methods. VES and multi-electrode measurement methods. Introduction of electromagnetic methods. Induced Polarization (IP) in the time domain (TDIP) and the frequency domain (FDIP). Types of electric polarizations creating the IP signal and their geological background. Frequency domain electromagnetic methods (FDEM): MT and VLF methods, artificial source frequency sounding methods: measurement systems, zones around the transmitter, characteristics of the apparent resistivity and phase curves. Time-domain electromagnetic methods (TDEM): transient, IP and ground radar methods. The transient EM measurement system and the zones around the transmitter. In the case of electrical and electromagnetic methods, the possibilities of controlling the depth of penetration. The development of seismic reflected waves. The travel-time curve and its characteristic parameters. Dynamic and static corrections. The common mid-point (CMP) gather. Features of seismic (TWT) sections. Interpretation of seismic (2D and 3D) sections. Isochronal maps. Seismic stratigraphy. Vertical and horizontal resolution. Acoustic impedance, reflection and transmission coefficients. Possibilities of detecting gas reservoirs by seismic method. The bright spot. The development of seismic refracted waves. The travel-time curve and its characteristic parameters. Processing and evaluation of refraction data. Near-surface applications. The relationship between the petrophysical properties of rocks and parameters measured by well logging methods.</p>														

University of Miskolc, Earth Science Engineering MSc
Course descriptions

Introduction to petrophysics. Reservoir modeling. The basics of nuclear well logging methods. Determination of lithology and porosity. Presentation of main application areas.
The basics of acoustic well logging methods. Determination of sonic porosity and permeability. Presentation of main application areas.
The basics of electric well logging methods. The relation between resistivity and water saturation. Presentation of main application areas.
Possibilities for joint processing of open-hole well logging data. Crossplot techniques. Statistical and depth-by-depth inversion methods.
Principle of engineering geophysical sounding measurements. Determination of petrophysical and geotechnical properties of soils/rocks.

Teaching methodologies:

Attendance at lectures is regulated by the university code of education and examination. Three writing tests with satisfactory results, and two assignments during the semester is the requirement of signature.

The 3-5 most important compulsory, or recommended **literature** (textbook, book) **resources**:
Telford W. M., Geldart L. P., Sheriff R. E., 1990. Applied geophysics. Second edition. Cambridge University Press.
Kearey P., Brooks M., Hill I., 2002. An Introduction to Geophysical Exploration. Third edition. Blackwell Science Ltd.
Serra O. & L., 2004. Well logging data acquisition and application, Editions Technip.
Szabó N. P., 2015. Geophysical exploration methods I. Electronic textbook. <http://www.uni-miskolc.hu/~geofiz/education.html>
Szabó N. P., 2016. Well-logging methods. Electronic textbook. <http://www.uni-miskolc.hu/~geofiz/education.html> Scientific papers selected from geophysical journals, e.g., First Break, Near Surface Geophysics, Geophysics, Journal of Applied Geophysics etc.

Competencies to evolve (relevant Learning outcomes, Appendix 1):

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

Skills: K1, K2, K3, K5, K9, K11, K12, K13

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

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

Demonstration of coherence of course content and unit's objectives:

The course introduces the principal theoretical background and practical skills to plan and perform geophysical explorations for different geological environments and deposit types

Demonstration of coherence between teaching methodologies and the learning outcomes:

Following the theoretical part, the students are introduced to different geophysical prospecting and exploration methods in practice.

Responsible Academic staff member and lecturing load (name, position, scientific degree): Dr. Szabó Norbert Péter gfnmail@uni-miskolc.hu

Other Academic Staff Involved in Teaching, if any and lecturing load (name, position, scientific degree):

University of Miskolc, Earth Science Engineering MSc
Course descriptions

Data and information processing

Course Title: Data and information processing		ECTS: 4												
Type of course (C/E):	Course code: MFGFT7100031													
Type (lec./sem./lab./consult.) and Number of Contact Hours per Week: 2 lectures, 1 seminars														
The degree of <u>theoretical</u> or practical nature of the course: (in ECTS%)														
<p>Type of Assessment (exam. / pr. mark. / other): P Attendance at lectures is regulated by the university code of education and examination. Writing two tests at least satisfactory level, respectively during the semester is the requirement of signature.</p> <p>Grading scale:</p> <table> <thead> <tr> <th>% value</th> <th>Grade</th> </tr> </thead> <tbody> <tr> <td>86 -100%</td> <td>5 (excellent)</td> </tr> <tr> <td>70 – 85%</td> <td>4 (good)</td> </tr> <tr> <td>60 - 69%</td> <td>3 (satisfactory)</td> </tr> <tr> <td>46 - 59%</td> <td>2 (pass)</td> </tr> <tr> <td>0 - 45%</td> <td>1 (failed)</td> </tr> </tbody> </table>			% value	Grade	86 -100%	5 (excellent)	70 – 85%	4 (good)	60 - 69%	3 (satisfactory)	46 - 59%	2 (pass)	0 - 45%	1 (failed)
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60 - 69%	3 (satisfactory)													
46 - 59%	2 (pass)													
0 - 45%	1 (failed)													
Position in Curriculum (which semester): 1.	Pre-requisites (<i>if any</i>): -													
Course Description:														
<p><u>Objectives of the course:</u> Understanding the basics of inversion method-based geoinformation processing</p> <p><u>Course content:</u> Introduction to the vector analysis. Multidimensional Euclidean spaces: N-dimensional dataspace, M-dimensional model parameter space. The parameters of inversion-based data and information processing. Classification of geophysical problems: direct problem, inverse problem. Explicit and implicit forms of direct problems. The linearization of the nonlinear direct problems, introduction of the Jacobi-matrix. The linear inverse problems. Solution of the overdetermined linear inverse problems: Gaussian Least Squares method (LSQ). Normal equation, stability, condition number. Definition of the generalized linear inverse problem. Solution of the underdetermined linear inverse problem by Lagrange multipliers, generalized inverse problem. The principle of the simple solution. The principles of information theory. The theory of signals. The principles of data and information processing by means of inversion methods. Modeling, model types. Theoretical and measured characteristics. Error characteristic parameters in the data and the model space. The purport of local and global inversion methods. Spectral transformations (Fourier integral transformation, DFT, FFT, Z-transformation). Convolution, discrete convolution. Correlation functions, discrete correlation functions. Deterministic filtering. Image processing filters.</p> <p><u>Teaching methodologies:</u> Attendance at lectures is regulated by the university code of education and examination. Writing two tests at least satisfactory level, respectively during the semester is the requirement of signature.</p>														
<p>The 3-5 most important compulsory, or recommended literature (textbook, book) resources: Dobróka M., 2001: The Methods of Geophysical Inversion. University textbook, University of Miskolc. W. Menke, 1984: Geophysical Data Analysis: Discrete Inverse Theory. Academic Press Inc. Mrinal Sen and Paul L. Stoffa: Seismic Exploration - Global Optimization: Methods In Geophysical Inversion. Software, Elsevier Science Ltd. 1997.</p>														

University of Miskolc, Earth Science Engineering MSc
Course descriptions

Szabó N.P., Dobróka M.: Float-encoded genetic algorithm used for the inversion processing of well-logging data *Global Optimization: Theory, Developments and Applications: Mathematics Research Developments, Computational Mathematics and Analysis Series*. New York: Nova Science Publishers Inc., 2013. pp. 79-104.

P.J.M. van Laarhoven, E.H.L. Aarts, 1987: *Simulated Annealing: Theory and Applications*. D. Reidel Publishing Company, ISBN 90-277-2513-6

Competencies to evolve (relevant Learning outcomes, Appendix 1):

Knowledge: T1, T2, T3, T6, T9

Skills: K2, K6, K7

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

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

Demonstration of coherence of course content and unit's objectives:

Theoretical background and application of data processing tasks are principal for completion of geophysical measurements and interpretation works. The course provides both theory and practice in this topic.

Demonstration of coherence between teaching methodologies and the learning outcomes:

Following the theoretical part, the students complete data management and processing exercises.

Responsible Academic staff member and lecturing load (name, position, scientific degree): **Dr. Dobróka Mihály** dobroka@uni-miskolc.hu

Other Academic Staff Involved in Teaching, if any and lecturing load (name, position, scientific degree):

University of Miskolc, Earth Science Engineering MSc
Course descriptions

Graduate research seminar

Course Title: Graduate research seminar		ECTS: 2												
Type of course (C/E):	Course code: MFFAT710006													
Type (lec./sem./lab./consult.) and Number of Contact Hours per Week: 0 lectures, 2 seminars														
The degree of <u>theoretical</u> or practical nature of the course: (in ECTS%)														
<p>Type of Assessment (exam. / pr. mark. / other): P During the semester the following tasks should be completed: short presentation of the selected topic, outline and references (20%), elaboration of the concept map of the article (20%), submission of first draft (15%), submission of the final text (20%),</p> <p>Grading scale:</p> <table> <thead> <tr> <th>% value</th> <th>Grade</th> </tr> </thead> <tbody> <tr> <td>80 -100%</td> <td>5 (excellent)</td> </tr> <tr> <td>70 – 79%</td> <td>4 (good)</td> </tr> <tr> <td>60 - 69%</td> <td>3 (satisfactory)</td> </tr> <tr> <td>50 - 59%</td> <td>2 (pass)</td> </tr> <tr> <td>0 - 49%</td> <td>1 (failed)</td> </tr> </tbody> </table>			% value	Grade	80 -100%	5 (excellent)	70 – 79%	4 (good)	60 - 69%	3 (satisfactory)	50 - 59%	2 (pass)	0 - 49%	1 (failed)
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70 – 79%	4 (good)													
60 - 69%	3 (satisfactory)													
50 - 59%	2 (pass)													
0 - 49%	1 (failed)													
Position in Curriculum (which semester): 1.	Pre-requisites (<i>if any</i>): -													
Course Description:														
<p><u>Objectives of the course:</u> To introduce the methods of information gathering and evaluation, formal and ethic requirements of scientific communication, rules for preparation of oral and poster presentations. During the course these general requirements are actualized to the field of earth science and engineering. Examples and excercises will use English publications and text materials.</p> <p><u>Course content:</u> Editorial and formal requirements of scientific publications. Planning of the concept and structure of a scientific publication, making an outline, development of a concept map. Usage of references, reference styles. Etics of scientific writing: how to avoid plagiarism, usage of citations. Information sources provided by the Central Library: hard copy, catalogue search, electronic resources. Usage of electronic information resources: search options, simple and combined search, electronic libraries. Data visualization: graphs, figures, tables. The art of presentation: preparation for an oral contribution. The art of presentation: preparation of a poster.</p> <p><u>Teaching methodologies:</u> During the semester the following tasks should be completed: short presentation of the selected topic, outline and references (20%), elaboration of the concept map of the article (20%), submission of first draft (15%), submission of the final text (20%),</p>														
<p>The 3-5 most important compulsory, or recommended literature (textbook, book) resources: L. C. Perelman, J. Paradis, and E. Barrett: The Mayfield Handbook of Technical and Scientific Writing (McGraw-Hill, 2001). G. J. Alred, C. T. Brusaw, and W. E. Oliu: Handbook of Technical Writing, (St. Martin's, New York, 2003). Hagan P; Mort P: Report writing guideline for mining entóGINEERS. Mining Education Australia, 2014. Chun-houh Chen, Wolfgang Härdle, Antony Unwin (eds.) Handbook of Data Visualization (Springer, 2008).</p>														

University of Miskolc, Earth Science Engineering MSc
Course descriptions

MEA Report writing guide. https://www.engineering.unsw.edu.au/mining-engineering/sites/mine/files/publications/MEA_ReportWritingGuide_eBook_2018ed.pdf
ISO 690-2: Information and documentation - Bibliographic references.

Competencies to evolve (relevant Learning outcomes, Appendix 1):

Knowledge: T1, T5, T8, T12

Skills: K1, K2, K3, K5, K6, K7, K8, K9, K10, K11

Attitudes: A2, A3, A4, A5, A6, A7, A8, A9

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

Demonstration of coherence of course content and unit's objectives:

Students are introduced to the information sources available paper-based and electronically. They are also introduced to best practices on scientific writing, referencing and presentation techniques.

Demonstration of coherence between teaching methodologies and the learning outcomes:

Completing a small research article and a presentation the students improve their knowledge in scientific communication. This is a learning by doing course, where one of the most important goals is to learn the proper way of scientific writing and referen

Responsible Academic staff member and lecturing load (name, position, scientific degree): **Dr. Mádai Ferenc** askmf@uni-miskolc.hu

Other Academic Staff Involved in Teaching, if any and lecturing load (name, position, scientific degree):

University of Miskolc, Earth Science Engineering MSc
Course descriptions

Structural geology

Course Title: Structural geology		ECTS: 4												
Type of course (C/E):	Course code: MFFAT720020													
Type (lec./sem./lab./consult.) and Number of Contact Hours per Week: 1 lectures, 2 seminars														
The degree of <u>theoretical</u> or practical nature of the course: (in ECTS%)														
<p>Type of Assessment (exam. / pr. mark. / other): E Attendance at lectures is regulated by the university code of education and examination. Writing a test and constructing a geological profile at least on satisfactory level, respectively during the semester is the requirement of signature. The exam is ora</p> <p>Grading scale:</p> <table> <thead> <tr> <th>% value</th> <th>Grade</th> </tr> </thead> <tbody> <tr> <td>86 -100%</td> <td>5 (excellent)</td> </tr> <tr> <td>70 – 85%</td> <td>4 (good)</td> </tr> <tr> <td>60 - 69%</td> <td>3 (satisfactory)</td> </tr> <tr> <td>46 - 59%</td> <td>2 (pass)</td> </tr> <tr> <td>0 - 45%</td> <td>1 (failed)</td> </tr> </tbody> </table>			% value	Grade	86 -100%	5 (excellent)	70 – 85%	4 (good)	60 - 69%	3 (satisfactory)	46 - 59%	2 (pass)	0 - 45%	1 (failed)
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46 - 59%	2 (pass)													
0 - 45%	1 (failed)													
Position in Curriculum (which semester): 2.	Pre-requisites (<i>if any</i>): -													
Course Description:														
<p><u>Objectives of the course:</u> The course provides a background in the fundamentals of structural geology. It introduces the methods of interpreting structural observations and determining the 3-D distribution of the lithological units, the physical properties controlling the development of fractures, folds and other structural features. The course also introduces the students to building up, constructing and analysing spatial models.</p> <p><u>Course content:</u> Theoretical backgrounds: basic terms of structural geology and tectonics. Techniques of data acquisition, recording and visualization. Stress and strain, deformation mechanisms, rheological models. Brittle and ductile features, their style and origin. Syngenetic structures and their role in further structural evolution. Plate tectonics and large scale structures. Characteristics of tectonic regimes. Practical exercises: use of tools to measure, demonstrate and analyze the structural data. Basics for constructing maps and cross sections. Lecture: Basic terms; information on the interior of the Earth. Practice: Use of geological maps; rules and geometrical basis of construction of cross sections. Lecture: Structural features of the rocks, deformation, description of movements. Practice: construction of cross sections. Lecture: Stresses, mechanics. Practice: construction of cross sections. Lecture: Rheology and failure envelopes. Practice: construction of cross sections. Lecture: Mechanisms and features of brittle deformation. Practice: construction of cross sections with drill logs Lecture: Mechanisms and features of ductile deformation Practice: construction of cross sections with drill logs. Field exercise: structural orientation measurements on folded and faulted rocks. (The exercise is organised by exchange with the contact hours of another course, in 6 hours) Practice: working with orientation data, stereograms. Practice: working with orientation data, stereograms. Practice: construction exercises.</p>														

University of Miskolc, Earth Science Engineering MSc
Course descriptions

Practice: construction exercises.

Teaching methodologies:

Attendance at lectures is regulated by the university code of education and examination. Writing a test and constructing a geological profile at least on satisfactory level, respectively during the semester is the requirement of signature. The exam is ora

The 3-5 most important compulsory, or recommended **literature** (textbook, book) **resources**:
Twiss, R. J. & Moores, E. M: Structural Geology. Freeman & Co., New York, 1992, 532 p.
Ramsay, J. G. & Huber, M. I: The techniques of modern structural geology. Vol. 1: Strain Analysis. Academic Press, London, 1983, 1-308 p.
Ramsay, J. G. & Huber, M. I: The techniques of modern structural geology. Vol. 2: Folds and Fractures. Academic Press, London, 1987, 309-700 p.
Ramsay, J. G. & Lisle, R. J: The techniques of modern structural geology. Vol. 3: Applications of continuum mechanics in structural geology. Academic Press, London, 2000, 701-1062 p.
Twiss, R. J. & Moores, E. M: Tectonics. Freeman & Co., New York, 1995, 415 p.

Competencies to evolve (relevant Learning outcomes, Appendix 1):

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

Skills: K1, K2, K3, K5, K9, K11, K12, K13

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

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

Demonstration of coherence of course content and unit's objectives:

In the limited timeframes of the semester, the thematics includes all topics which belong to the structural geology on introductory level. It also provides a possibility to go deeper in some topics for those who have the appropriate basic knowledge ahead

Demonstration of coherence between teaching methodologies and the learning outcomes:

The program is arranged with giving the theoretical and practical basics first and then going to the application of these basics by making field observations, measurements and then working with these data. The students have to be able to interpret the obs

Responsible Academic staff member and lecturing load (name, position, scientific degree): Dr. Németh Norbert foldnn@uni-miskolc.hu

Other Academic Staff Involved in Teaching, if any and lecturing load (name, position, scientific degree):

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Course descriptions

Mineral deposits

Course Title: Mineral deposits		ECTS: 4												
Type of course (C/E):	Course code: MFFTT720021													
Type (lec./sem./lab./consult.) and Number of Contact Hours per Week: 2 lectures, 1 seminars														
The degree of <u>theoretical</u> or practical nature of the course: (in ECTS%)														
<p>Type of Assessment (exam. / pr. mark. / other): E Test about recognizing the different hand specimens of ores, raw materials (35%); Written test about the classification of ores with examples (65%).</p> <p>Grading scale:</p> <table> <thead> <tr> <th>% value</th> <th>Grade</th> </tr> </thead> <tbody> <tr> <td>80 -100%</td> <td>5 (excellent)</td> </tr> <tr> <td>70 – 79%</td> <td>4 (good)</td> </tr> <tr> <td>60 - 69%</td> <td>3 (satisfactory)</td> </tr> <tr> <td>50 - 59%</td> <td>2 (pass)</td> </tr> <tr> <td>0 - 49%</td> <td>1 (failed)</td> </tr> </tbody> </table>			% value	Grade	80 -100%	5 (excellent)	70 – 79%	4 (good)	60 - 69%	3 (satisfactory)	50 - 59%	2 (pass)	0 - 49%	1 (failed)
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Position in Curriculum (which semester): 2.	Pre-requisites (<i>if any</i>): -													
Course Description:														
<p><u>Objectives of the course:</u> The key target of the course is to introduce the geology of raw material deposits, their spatial distribution, their quantity and quality for the different commodities.</p> <p><u>Course content:</u> During the introduction the students get familiar with the different groups of commodities – ores, industrial minerals, solid fossil energy minerals, construction materials and their use and history. In the next period, the students will learn the ore forming geological processes and their appearances, which creates the different deposits. Also they will learn the genetic classification of the deposits with national and international examples. It prepares the students to be able to recognize the geological features of mineralizations, alterations and tectonic preformation. It covers all the important mines and ore districts in Europe and worldwide. During the laboratory classes the students can learn the natural occurrences of the ores, non-ores and industrial minerals. They will learn the physical and chemical properties, and texture of the different raw material types, and how to identify and distinguish them. To the proper use of geological maps and sections in 3D, the students will do exercises to develop their capabilities. During the related field trips the students will examine real deposits in the field.</p> <p><u>Teaching methodologies:</u> Test about recognizing the different hand specimens of ores, raw materials (35%); Written test about the classification of ores with examples (65%).</p>														
<p>The 3-5 most important compulsory, or recommended literature (textbook, book) resources: Robb, L., (2005): Introduction to Ore-Forming Processes: Blackwell Publishing Co., 373 p. (ISBN 0-632-06378-5). EVANS, A. M. 1993: Ore Geology and Industrial Minerals – An Introduction. Blackwell Publishing, ISBN 978-0632-02953-2 CRAIG, J. R. & Vaughan, D. J. 1994: Ore Microscopy & Ore Petrography. John Wiley and Sons Inc. ISBN 10158-0012 Dill H.G. (2010): The „chessboard” classification scheme of mineral deposits. Elsevier, 2010.</p>														

University of Miskolc, Earth Science Engineering MSc
Course descriptions

Cox, D.P. Singer D.E. (1992): Mineral Deposit Models, U.S.G.S. Bulletin 1993.

Competencies to evolve (relevant Learning outcomes, Appendix 1):

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

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

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

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

Demonstration of coherence of course content and unit's objectives:

Students get familiar with the different groups of commodities – ores, industrial minerals, solid fossil energy minerals, construction materials and their use and history, as well as the ore forming geological processes and their appearances, genetic clas

Demonstration of coherence between teaching methodologies and the learning outcomes:

Theoretical part is complemented by laboratory classes where students analyze specimens from different deposit types. learn the natural occurrences of the ores, non-ores and industrial minerals. They will learn the physical and chemical properties, and te

Responsible Academic staff member and lecturing load (name, position, scientific degree): Dr. Zajzon Norbert askzn@uni-miskolc.hu

Other Academic Staff Involved in Teaching, if any and lecturing load (name, position, scientific degree): Leskó Máté

University of Miskolc, Earth Science Engineering MSc
Course descriptions

Engineering geology and hydrogeology

Course Title: Engineering geology and hydrogeology		ECTS: 4												
Type of course (C/E):	Course code: MFKHT720020													
Type (lec./sem./lab./consult.) and Number of Contact Hours per Week: 2 lectures, 1 seminars														
The degree of <u>theoretical</u> or practical nature of the course: (in ECTS%)														
<p>Type of Assessment (exam. / pr. mark. / other): E Participation in presentation lectures and practical classes is mandatory. Field trips and classroom calculations. The successful completion of the course is based on the successful completion of the semester test and the successful completion of the exam</p> <p>Grading scale:</p> <table> <thead> <tr> <th>% value</th> <th>Grade</th> </tr> </thead> <tbody> <tr> <td>85 -100%</td> <td>5 (excellent)</td> </tr> <tr> <td>75 – 84%</td> <td>4 (good)</td> </tr> <tr> <td>63 - 74%</td> <td>3 (satisfactory)</td> </tr> <tr> <td>50 - 62%</td> <td>2 (pass)</td> </tr> <tr> <td>0 - 49%</td> <td>1 (failed)</td> </tr> </tbody> </table>			% value	Grade	85 -100%	5 (excellent)	75 – 84%	4 (good)	63 - 74%	3 (satisfactory)	50 - 62%	2 (pass)	0 - 49%	1 (failed)
% value	Grade													
85 -100%	5 (excellent)													
75 – 84%	4 (good)													
63 - 74%	3 (satisfactory)													
50 - 62%	2 (pass)													
0 - 49%	1 (failed)													
Position in Curriculum (which semester): 2.	Pre-requisites (<i>if any</i>): -													
Course Description:														
<p><u>Objectives of the course:</u> It introduces students to the key concepts of engineering geology, modern hydrogeology, and field hydrogeology, soil formation, soil classification methods, laboratory and field soil tests, water-to-rock underwater stress, and groundwater flow patterns.</p> <p><u>Course content:</u> Introduction to the examination of soil characteristics Determination of shear strength parameters of soils Soil consolidation Shallow and deep foundation, the basics of EC7 design The most important basics, problems and relationships of hydrogeology Hydrogeological pools, flow systems, sustainability, artificial replenishment Hydrogeochemistry, transport processes Water management issues, particularly in cross-border areas Hydrogeology of the Carpathian Basin Isotope hydrogeology, use of stable isotopes to understand groundwater Groundwater recharge and their interpretation Well hydraulics calculations Isotope hydrogeology, use of radioactive isotopes to understand groundwater</p> <p><u>Teaching methodologies:</u> Participation in presentation lectures and practical classes is mandatory. Field trips and classroom calculations. The successful completion of the course is based on the successful completion of the semester test and the successful completion of the exam</p>														
<p>The 3-5 most important compulsory, or recommended literature (textbook, book) resources: David Daming: Introduction to Hydrogeology, McGraw-Hill Higher Education, 2002. F. G. Bell: Engineering Geology, Oxford, Blackwell Scientific Publications, 1992</p>														

University of Miskolc, Earth Science Engineering MSc
Course descriptions

Dr. Juhász József: Hidrogeológia. Akadémiai kiadó, Budapest, 2002. Dr. Juhász József: Mérnökgeológia I-III. Miskolci Egyetemi Kiadó, 1999; 2002; 2003 Dr. Kleb Béla: Mérnökgeológia Budapest, 1980 David Daming: Introduction to Hydrogeology, McGraw-Hill Higher Education, 2002. F. G. Bell: Engineering Geology, Oxford, Blackwell Scientific Publications, 1992 S. E. Ingebritsen, W. E. Sanford: Groundwater in Geologic Processes. Cambridge University Press, 1998. Kruseman G.P. and Ridder N.A: Analysis and Evaluation of Pumping Test Data, ILRI publication, Wageningen, Netherlands, 1990, pp. 1-377. Neven Kresic: Quantitative Solutions in Hydrogeology and Groundwater Modeling. Lewis Publishers, 1997. Barnes, C. W. (1988): Earth, Time and Life. John Wiley and Sons, New York Brookfield, M. (2006): Principles of Stratigraphy. Blackwell Publishing, New York

Competencies to evolve (relevant Learning outcomes, Appendix 1):

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

Skills: K1, K2, K3, K5, K6, K7, K8, K9, K10, K11, K12, K13

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

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

Demonstration of coherence of course content and unit's objectives:

The course provides the theory and practical skills to understand the hydrogeological and engineering geological background for interpretation of different geological and geotechnical processes.

Demonstration of coherence between teaching methodologies and the learning outcomes:

Theoretical part is complemented by laboratory classes where students perform calculations and modeling exercises of hydrogeological systems and geotechnical characterization of soils.

Responsible Academic staff member and lecturing load (name, position, scientific degree): Dr. Szűcs Péter hgszucs@ui-miskolc.hu

Other Academic Staff Involved in Teaching, if any and lecturing load (name, position, scientific degree):

University of Miskolc, Earth Science Engineering MSc
Course descriptions

Analytical technics in mineralogy and petrology

Course Title: Analytical technics in mineralogy and petrology		ECTS: 2												
Type of course (C/E):	Course code: MFFAT720025													
Type (lec./sem./lab./consult.) and Number of Contact Hours per Week: 1 lectures, 1 seminars														
The degree of <u>theoretical</u> or practical nature of the course: (in ECTS%)														
<p>Type of Assessment (exam. / pr. mark. / other): P 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 a</p> <p>Grading scale:</p> <table> <thead> <tr> <th>% value</th> <th>Grade</th> </tr> </thead> <tbody> <tr> <td>80 -100%</td> <td>5 (excellent)</td> </tr> <tr> <td>70 – 79%</td> <td>4 (good)</td> </tr> <tr> <td>60 - 69%</td> <td>3 (satisfactory)</td> </tr> <tr> <td>50 - 59%</td> <td>2 (pass)</td> </tr> <tr> <td>0 - 49%</td> <td>1 (failed)</td> </tr> </tbody> </table>			% value	Grade	80 -100%	5 (excellent)	70 – 79%	4 (good)	60 - 69%	3 (satisfactory)	50 - 59%	2 (pass)	0 - 49%	1 (failed)
% value	Grade													
80 -100%	5 (excellent)													
70 – 79%	4 (good)													
60 - 69%	3 (satisfactory)													
50 - 59%	2 (pass)													
0 - 49%	1 (failed)													
Position in Curriculum (which semester): 2.	Pre-requisites (<i>if any</i>): -													
Course Description:														
<p><u>Objectives of the course:</u> 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.</p> <p><u>Course content:</u> Description of the work, formulating analytical pairs, work and lab safety teaching Physical properties (hardness, magnetic, solubility, density), density measurements X-ray diffraction lecture I. X-ray diffraction lecture II. X-ray diffraction practice DTA lecture DTA quantitative calculations Scanning electron microscopy lecture I. Scanning electron microscopy lecture II. Scanning electron microscopy practice Formula calculations</p> <p><u>Teaching methodologies:</u> 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 a</p>														
<p>The 3-5 most important compulsory, or recommended literature (textbook, book) resources: 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.</p>														

University of Miskolc, Earth Science Engineering MSc
Course descriptions

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.

Competencies to evolve (relevant Learning outcomes, Appendix 1):

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

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

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

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

Demonstration of coherence of course content and unit's objectives:

Lectures cover the theoretical fundamentals for different methods of analysis of minerals, which is essential basics for geological exploration tasks.

Demonstration of coherence between teaching methodologies and the learning outcomes:

Following the introduction of different analytical methods, this is a learning by doing course where students go through the preparation, analysis and interpretation steps for various analytical techniques (XRPD, EPMA, SEM)

Responsible Academic staff member and lecturing load (name, position, scientific degree): Dr. Zajzon Norbert askzn@uni-miskolc.hu

Other Academic Staff Involved in Teaching, if any and lecturing load (name, position, scientific degree):

Geophysical engineering specialisation

Geophysical measurements

Course Title: Geophysical measurements		ECTS: 4
Type of course (C/E):	Course code: MFGFT720012	
Type (lec./sem./lab./consult.) and Number of Contact Hours per Week: 2 lectures, 1 seminars		
The degree of <u>theoretical</u> or practical nature of the course: (in ECTS%)		
Type of Assessment (exam. / pr. mark. / other): exam		
Grading scale:		
% value	Grade	
90 -100%	5 (excellent)	
80 – 89%	4 (good)	
65 - 79%	3 (satisfactory)	
60 - 64%	2 (pass)	
0 - 49%	1 (failed)	
Position in Curriculum (which semester): 2.	Pre-requisites (<i>if any</i>): -	
Course Description:		
<u>Objectives of the course:</u>		
<p>Within the frame of this subject the students specialized in geophysical engineering study the application of geophysical methods in the different exploration phases, as well as the principles and aspects of planning geophysical surveys. An additional aim of the subject is to familiarize the students with the working principles and use of geophysical measurement devices.</p>		
<u>Course content:</u>		
<p>Lectures: General principles and main tasks of the raw-material exploration. Exploration phases. The principles of geophysical surveys. The role of geophysical methods in the exploration phases. Gravity data acquisition. Measuring devices and measured quantities of the gravity method. Gravity data processing and corrections. Magnetic data acquisition. Measuring devices and measured quantities of the magnetic method. Magnetic gradiometry. Magnetic data processing and corrections. The components and properties of geoelectrical data acquisition systems. Electrode configurations and setting up of electrode spreads. Main aspects of planning geoelectrical surveys. The components and properties of electromagnetic data acquisition systems. Survey configurations of different electromagnetic methods. Main aspects of planning electromagnetic surveys. Quality control of recorded data. The types and properties of seismic sources. The components and properties of seismic data acquisition systems. Main aspects of planning seismic surveys. Quality control of recorded seismic data. The field techniques of improving the signal-to-noise ratio. Basic steps of seismic data processing. Components and properties of data acquisition systems used for vertical seismic profiling (VSP). Basic steps of VSP data processing. Main properties and components of the techniques of borehole geophysical logging (wireline logging and measured while logging). Quality control a well logs. The constructions and properties of resistivity and induction logging tools. The constructions and properties of nuclear logging tools. The constructions and properties of sonic logging tools.</p> <p>Seminar</p> <p>Spreading systems of geophysical surveys. The steps and products of the workflow of geophysical surveys. The introduction of Scintrex CG-5 Autograv gravimeter. The introduction of GEM GSM-19 Ovehauser magnetometer. The introduction of geoelectrical data acquisition systems. The introduction of VLF measuring</p>		

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Course descriptions

devices and ground penetrating radar. The introduction of a gamma spectrometer. The main functions and properties of the components of a wireline logging system. The main aspects of planning a well logging program.

Teaching methodologies:

The 3-5 most important compulsory, or recommended **literature** (textbook, book) **resources:**
P. Kearey, M. Brooks, I. Hill, 2002: An introduction to geophysical exploration, Blackwell Science Ltd., ISBN 0-632-04929-4
D. V. Ellis, J. M. Singer, 2007: Well logging for earth scientists. Springer, Dordrecht, The Netherlands, ISBN 978-1-4020-3738-2 (HB).
W. M. Telford, L. P. Geldart, R. E. Sheriff., 1990: Applied Geophysics. 2nd Edition. Cambridge University Press, ISBN: 0 521 32693 1
O. Serra, L. Serra, 2004: Data Acquisition and Applications, Editions Serralog, France, ISBN: 978295156125
Other educational materials and study aids on the web page of Geophysical Department: <http://www.uni-miskolc.hu/~geofiz/segedlet.html>
Operating manuals: https://scintrextld.com/wp-content/uploads/2017/02/CG-5-Manual-Ver_8.pdf;
https://userpage.fu-berlin.de/geodyn/instruments/Manual_GEM_GSM-19.pdf

Competencies to evolve (relevant Learning outcomes, Appendix 1):

Knowledge: T1, T2, T3, T4, T5, T7, T8, T9

Skills: K1, K2, K3, K9, K12, K13

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

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

Demonstration of coherence of course content and unit's objectives:

The syllabus elaborated for and applied to the education of the course strives to cover all the important parts of the specialities connected to the objectives. This well-considered construction of topics enables the lecturer to emphasize the essential re

Demonstration of coherence between teaching methodologies and the learning outcomes:

The applied teaching methodologies are aimed at communicating up-to-date knowledge, developing the students' capability to apply the introduced ideas and information, improving their ability to test these ideas and evidence, to generate own ideas and evid

Responsible Academic staff member and lecturing load (name, position, scientific degree): Dr. Vass Péter, private professor gfvassp@uni-miskolc.hu

Other Academic Staff Involved in Teaching, if any and lecturing load (name, position, scientific degree): Dr. Gombár László, Dr. Turai Endre, Dr. Szabó Norbert Péter

University of Miskolc, Earth Science Engineering MSc
Course descriptions

Geophysical Exploration Methods II

Course Title: Geophysical Exploration Methods II		ECTS: 4
Type of course (C/E):	Course code: MFGFT720015	
Type (lec./sem./lab./consult.) and Number of Contact Hours per Week: 2 lectures, 1 seminars		
The degree of <u>theoretical</u> or practical nature of the course: (in ECTS%)		
Type of Assessment (exam. / pr. mark. / other): exam		
Grading scale:		
% value	Grade	
86 -100%	5 (excellent)	
71 – 85%	4 (good)	
61 - 70%	3 (satisfactory)	
46 - 60%	2 (pass)	
0 - 45%	1 (failed)	
Position in Curriculum (which semester): 2.	Pre-requisites (<i>if any</i>): -	
Course Description:		
Objectives of the course: The main objective of the subject is to familiarize the students specialized in geophysical engineering with the details of different geophysical methods used in the fields of raw-material exploration and environmental investigations.		
Course content: Physical basics of seismic methods. Reflexion seismic method. Refraction seismic method. Vertical seismic profile (VSP). Geophysical inversion of magnetic data. Magnetic forward problem of arbitrary shaped source. The problem of ambiguity. 3D underdetermined problems of magnetic data. Geological applications. Physical basics of geoelectrical methods. Self-potential method. Charged-body method. Direct current resistivity methods. Induced polarization method. Physical basics of electromagnetic (EM) methods. Magnetotelluric method. Frequency-domain (FD) electromagnetic methods. Transient electromagnetic method (TEM). Very-low-frequency electromagnetic method (VLF-EM). Main features and essentials of borehole geophysics. Classification of well logging methods. Formation density logging. Photoelectric factor logging. Neutron logging methods. Well log interpretation techniques. Quick-Look Interpretation. Crossplots and overlays. Formation evaluation in shaly sands.		
Teaching methodologies:		
The 3-5 most important compulsory, or recommended literature (textbook, book) resources : W. M. Telford, L. P. Geldart, R. E. Sheriff., 1990: Applied Geophysics. 2nd Edition. Cambridge University Press, ISBN: 0 521 32693 1 UBC Geophysical Inversion Facility – Inversion manuals (GRAV3D and MAG3D). http://gif.eos.ubc.ca/documentation P. Kearey, M. Brooks, I. Hill, 2002: An introduction to geophysical exploration, Blackwell Science Ltd., ISBN 0-632-04929-4 D. V. Ellis, J. M. Singer, 2007: Well logging for earth scientists. Springer, Dordrecht, The Netherlands, ISBN 978-1-4020-3738-2 (HB). O. Serra, L. Serra, 2004: Data Acquisition and Applications, Editions Serralog, France, ISBN: 978295156125		

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Course descriptions

Other educational materials and study aids on the web page of Geophysical Department:
<http://www.uni-miskolc.hu/~geofiz/segedlet.html>

Competencies to evolve (relevant Learning outcomes, Appendix 1):

Knowledge: T1, T2, T3, T4, T5, T6, T7, T8, T9

Skills: K1, K2, K3, K12, K13

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

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

Demonstration of coherence of course content and unit's objectives:

The syllabus elaborated for and applied to the education of the course strives to cover all the important parts of the specialities connected to the objectives. This well-considered construction of topics enables the lecturer to emphasize the essential re

Demonstration of coherence between teaching methodologies and the learning outcomes:

The applied teaching methodologies are aimed at communicating up-to-date knowledge, developing the students' capability to apply the introduced ideas and information, improving their ability to test these ideas and evidence, to generate own ideas and evid

Responsible Academic staff member and lecturing load (name, position, scientific degree): Dr. Vass Péter, gfvassp@uni-miskolc.hu

Other Academic Staff Involved in Teaching, if any and lecturing load (name, position, scientific degree): Dr. Gombár László, Dr. Turai Endre, Dr. Szabó Norbert Péter

Geological engineering specialisation

Historical geology

Course Title: Historical geology		ECTS: 4												
Type of course (C/E):	Course code: MFFTT720028													
Type (lec./sem./lab./consult.) and Number of Contact Hours per Week: 2 lectures, 1 seminars														
The degree of <u>theoretical</u> or practical nature of the course: (in ECTS%)														
<p>Type of Assessment (exam. / pr. mark. / other): exam Completion of inter-semester test with at least satisfactory result (see below). It can be repeated once. Practical requirements: obligatory participation in the field-trips, ppt-presentation for one of them</p> <p>Grading scale:</p> <table> <thead> <tr> <th>% value</th> <th>Grade</th> </tr> </thead> <tbody> <tr> <td>80 -100%</td> <td>5 (excellent)</td> </tr> <tr> <td>70 – 79%</td> <td>4 (good)</td> </tr> <tr> <td>60 - 69%</td> <td>3 (satisfactory)</td> </tr> <tr> <td>50 - 59%</td> <td>2 (pass)</td> </tr> <tr> <td>0 - 49%</td> <td>1 (failed)</td> </tr> </tbody> </table>			% value	Grade	80 -100%	5 (excellent)	70 – 79%	4 (good)	60 - 69%	3 (satisfactory)	50 - 59%	2 (pass)	0 - 49%	1 (failed)
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80 -100%	5 (excellent)													
70 – 79%	4 (good)													
60 - 69%	3 (satisfactory)													
50 - 59%	2 (pass)													
0 - 49%	1 (failed)													
Position in Curriculum (which semester): 2.	Pre-requisites (<i>if any</i>): -													
Course Description:														
<p><u>Objectives of the course:</u> The aim of the subject is to give knowledge (1) on the role of time in the geological processes, (2) on the different methods of age-determination, (3) on the structural evolution of the Earth and (4) on the history of life in the Earth with special emphasis on the utility of all these in prospecting raw materials) and how to reconstruct paleoenvironments in geology as basic information for raw material exploration</p> <p><u>Course content:</u> Principles of stratigraphy. Basic principles of stratigraphy, litho-, bio- and chronostratigraphy. Different methods of stratigraphical correlation and their significance in raw material prospecting. Age-determining methods: biostratigraphy, radiometry, magnetostratigraphy, chemostratigraphy, event stratigraphy, sequence stratigraphy. Reconstruction of different palaeoenvironments and their application in raw materail prospecting. Different magmatic, metamorphic and sedimentary facies types. The geological time scale, the structural, climatological and biological evolution of the Earth during the Precambrian, the Paleozoic, the Mesozoic and the Cenozoic. The evolution of Homoidea.</p> <p><u>Teaching methodologies:</u> Completion of inter-semester test with at least satisfactory result (see below). It can be repeated once. Practical requirements: obligatory participation in the field-trips, ppt-presentation for one of them</p>														
<p>The 3-5 most important compulsory, or recommended literature (textbook, book) resources: Levin, H.L. (2006) – The Earth Through Time, 8th Ed., 616 p., Wiley Barnes, C.W. (1988): Earth, Time and Life. John Wiley and Sons, New York Brookfield, M. (2006): Principles of Stratigraphy. Blackwell Publishing, New York</p>														

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Competencies to evolve (relevant Learning outcomes, Appendix 1):

Knowledge: T1, T2, T3, T4, T5, T7, T8, T9

Skills: K1, K2, K3, K5, K6, K7, K9, K11, K12, K13

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

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

Demonstration of coherence of course content and unit's objectives:

This is a fundamental course to understand the principles of stratigraphy, its applicability to solve complex geological problems and tasks.

Demonstration of coherence between teaching methodologies and the learning outcomes:

The lectures of the course introduce in detail the methods included in the curriculum, while practical skills are developed by field trips and case studies.

Responsible Academic staff member and lecturing load (name, position, scientific degree): Dr. Less György, full professor foldlgy@uni-miskolc.hu

Other Academic Staff Involved in Teaching, if any and lecturing load (name, position, scientific degree):

University of Miskolc, Earth Science Engineering MSc
Course descriptions

Geological mapping

Course Title: Geological mapping		ECTS: 4												
Type of course (C/E):	Course code: MFFTT720029													
Type (lec./sem./lab./consult.) and Number of Contact Hours per Week: 1 lectures, 2 seminars														
The degree of <u>theoretical</u> or practical nature of the course: (in ECTS%)														
<p>Type of Assessment (exam. / pr. mark. / other): practical mark Criterion for signature: Preparation of two geological cross-sections based on real Carpathian geological maps (from Slovakia and Romania); Preparation of covered and uncovered (without Quaternary deposits) geological map of an about 2 sq. km territory (i</p> <p>Grading scale:</p> <table> <thead> <tr> <th>% value</th> <th>Grade</th> </tr> </thead> <tbody> <tr> <td>90 -100%</td> <td>5 (excellent)</td> </tr> <tr> <td>75 – 89%</td> <td>4 (good)</td> </tr> <tr> <td>60 - 74%</td> <td>3 (satisfactory)</td> </tr> <tr> <td>45 - 59%</td> <td>2 (pass)</td> </tr> <tr> <td>0 - 44%</td> <td>1 (failed)</td> </tr> </tbody> </table>			% value	Grade	90 -100%	5 (excellent)	75 – 89%	4 (good)	60 - 74%	3 (satisfactory)	45 - 59%	2 (pass)	0 - 44%	1 (failed)
% value	Grade													
90 -100%	5 (excellent)													
75 – 89%	4 (good)													
60 - 74%	3 (satisfactory)													
45 - 59%	2 (pass)													
0 - 44%	1 (failed)													
Position in Curriculum (which semester): 2.	Pre-requisites (<i>if any</i>): -													
Course Description:														
<p><u>Objectives of the course:</u> The subject gives knowledge on the figuration of geological phenomena on topographic maps, on preparing geological maps, cross-sections, their legend and on assembling explanatory report</p> <p><u>Course content:</u> The aim of preparing geological maps. The geological map and its additional parts (geological cross-sections, stratigraphical columns and legend). Geological phenomena figured in the geological maps: lithostratigraphical units, structural characteristics. Different types of geological boundaries and their recognition on the field. Orientation on the field with topographical map and with GPS. Documentation of field observations in the field booklet and on the topographical map. Preparation of geological cross-sections. Preparation of covered and uncovered (without Quaternary deposits) geological maps with stratigraphical column and legend. Assembly of explanatory reports</p> <p><u>Teaching methodologies:</u> Criterion for signature: Preparation of two geological cross-sections based on real Carpathian geological maps (from Slovakia and Romania); Preparation of covered and uncovered (without Quaternary deposits) geological map of an about 2 sq. km territory (i</p>														
<p>The 3-5 most important compulsory, or recommended literature (textbook, book) resources: Tearprock, D.J. & Bischke, R.E. (2002): Applied Subsurface Geological Mapping with Structural Methods 2nd Edition, 846 p., Prentice Hall Hamilton, D.E. & Jones, T.A.: Computer modeling of geological surfaces and volumes. – AAPG Computer applications in geology. No.1., 589 p. Tulsa, Oklahoma McClay, K. (1995): The mapping of Geological Structures. Geolog. Soc. of London Handbook. John Wiley Sons, Chichester, New York, Brisbane, Toronto, Singapore. SURFER 8.0 Tutorial and User’s Guide. - Golden Software. P512 . Denver</p>														
Competencies to evolve (relevant Learning outcomes, Appendix 1):														

University of Miskolc, Earth Science Engineering MSc
Course descriptions

Knowledge: T1, T2, T3, T4, T5, T7, T8, T9
Skills: K1, K2, K3, K5, K6, K7, K9, K11, K12, K13
Attitudes: A1, A2, A3, A4, A5, A7
Autonomy and responsibility: F1, F2, F3, F4, F5

Demonstration of coherence of course content and unit's objectives:

Theoretical part and laboratory exercises give an overview to the students about methodology and tools of geological mapping works.

Demonstration of coherence between teaching methodologies and the learning outcomes:

After giving the theoretical basis of mapping methodology, this is a learning by doing course, where the students should complete geological mapping work in the Bükk mountains

Responsible Academic staff member and lecturing load (*name, position, scientific degree*): Dr. Less György, full professor foldlgy@uni-miskolc.hu

Other Academic Staff Involved in Teaching, if any and lecturing load (*name, position, scientific degree*):

List of competences

a) Knowledge

- T1 - Understands the processes described by the general and specific theories required for the practising of the fields of earth science engineering (geologist-engineering, geophysical-engineering, geoinformatics-engineering), understands the internal connections between geological processes, and knows the planning and interpretation procedures based on the processes.
- T2 - Has a solid technical and scientific knowledge required for the high-level progress in earth sciences engineering disciplines, among others in numerical methods, technical physics and their contexts.
- T3 - Based on his/her knowledge, understands the structure of the raw material extraction sector, the technologies used for the extraction and preparation of mineral raw materials, as well as the scope of geo-environmental tasks, their external socio-economic environment and regulatory system.
- T4 - Has a thorough knowledge and understanding of the best practices applied to earth science engineering tasks and the long-term development directions that can be expected in this field in the medium term.
- T5 - Knows the problem-solving (research-planning and management) techniques of best available practices in earth sciences.
- T6 - At the application level, knows the GIS methods of computer design and analysis and the geoinformatics systems.
- T7 - Knows in detail the geological and geophysical methods suitable for exploring natural resources.
- T8 - Has a well-established knowledge of the methods of exploring mineral deposits.
- T9 - Has detailed knowledge and sound application practice on the methods of knowledge acquisition and data collection in the technical earth sciences, and on their instrumental measurement and IT data processing procedures.
- T10 - Has a well-established knowledge of the legal, economic, administrative, safety, work and fire protection, information technology and environmental protection fields related to the fields of earth science engineering.

b) Skills

- K1 - Able to apply general and specific basic and applied scientific theories within the technical earth sciences, able to systematize them, to solve independent engineering tasks (mainly complex geological prospecting, final report summarizing exploration results, geological-geophysical parts of environmental impact assessments).
- K2 - Able to convey knowledge authentically by preparing presentations and written documents in Hungarian or in a foreign language.
- K3 - Able to perform complex planning, construction, inspection and official licensing tasks (geological-geophysical exploration plans of natural resources, acquisition of environmental geology) with the innovative application of theories and terminology describing technical earth science knowledge.
- K4 - Able to review legal and economic knowledge and activities related to technical earth science tasks, to optimize connections.
- K5 - Able to actively cooperate with, organize, manage, and supervise larger and more complex activities based on or incorporating technical earth science tasks (especially mining, environmental technology investments, operations).
- K6 - Uses modern information acquisition and data collection methods.
- K7 - Able to solve technical problems requiring innovative skills in theory and practice (especially field, surface, underground data collection, measurements, and their processing and interpretation requiring innovative skills).
- K8 - Able to process raw material exploration and production data and organize it into geoinformatics databases (systems).
- K9 - Able to prospect and explore geological structures, to plan these research phases.
- K10 - Able to take quantitative and qualitative assessment of mineral resources, to evaluate their economics, to compile concession tenders and to give opinions on this type of report.
- K11 - Able to contribute to the solution of geological-geophysical tasks arising during the extraction of mineral raw materials (planning, investment, operation, closure) and to analyze the solution possibilities.

University of Miskolc, Earth Science Engineering MSc

Course descriptions

K12 - Able to review the structure of the raw materials extraction sector, the technologies used for the extraction and processing of mineral raw materials, as well as the scope of geo-environmental tasks, their external socio-economic environment and regulatory system.

K13 - Able to organize cooperation with related disciplines and manage the (working) group within the framework of larger and more complex activities based on or incorporating technical earth science tasks.

c) Competence in terms of attitude

A1 - Open and receptive to the knowledge and acceptance of professional and technological methodological developments in the fields of technical earth sciences, to the acquisition of their management, and to the participation in their development.

A2 - Actively applies innovative skills and knowledge in solving professional problems in the fields of earth science engineering.

A3 - Commits and convincingly demonstrates to knowing and adhering to the professional and ethical values.

A4 - Professionalism and professional solidarity have deepened.

A5 - Respects and follows the ethical principles and written rules of work and professional culture in activities, and is able to follow them even when managing small workgroups.

A6 - In the course of professional work, observes and adheres to the requirements of safety, health, environmental protection and quality assurance and control (SHE and QA / QC).

A7 - Has a sufficient motivation to carry out activities in often changing working, geographical and cultural circumstances.

(d) Competence in terms of autonomy and responsibility

F1 - With the in-depth knowledge of the received strategic guidelines and external environmental requirements, is able to plan the work independently, and is also suitable to lead workgroups.

F2 - Takes responsibility and is accountable for the work processes carried out under his / her control, for the employees working in them.

F3 - Makes decisions carefully, in consultation with representatives of other disciplines (primarily legal, economic, and environmental), independently, takes responsibility for decisions.

F4 - In addition to constructive teamwork, is an autonomous specialist capable of making professional decisions in the field of operation entrusted to him/her.

F5 - Committed to the practice of sustainable natural resource management, occupational health and safety

Semester 3
WUST

FACULTY OF GEOENGINEERING, MINING AND GEOLOGY

SUBJECT CARD**Name of subject in Polish ...** Geofizyka inżynierska**Name of subject in English** Engineering Geophysics**Main field of study:** Mining and geology**Specialization:** Mining Engineering,
Geotechnical and Environmental Engineering,
Geomatics for Mineral Resource Management
..... Mineral Resource Exploration**Level and form of studies:** 2nd level, full-time**Kind of subject:** obligatory**Subject code** W06GIG-SM3004....**Group of courses** NO

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15			15	
Number of hours of total student workload (CNPS)	25			50	
Form of crediting	crediting with grade			crediting with grade	
For group of courses mark (X) final course					
Number of ECTS points	1			2	
including number of ECTS points for practical classes (P)				2	
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	0,8			0,9	

*delete as not necessary

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. has knowledge of fundamentals of applied geophysics, physics and geology.
2. knows fundamentals of soil and rock mechanics.
3. is able to use MS Office software.
4. is able to work in a team.

SUBJECT OBJECTIVES

- C1 familiarize with physical phenomena in geosphere of the Earth
 C2 familiarize with engineering problems solved by means of geophysical surveying
 C3 familiarize with various geophysical surveys.
 C4 acquisition of skills to plan geophysical field surveying and to interpret its results.
 C5 development of skills to work in a group.

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge:

- PEU_W01 recognizes, names and explains engineering problems in different fields.
 PEU_W02 identifies, describes and chooses geophysical surveying methods.
 PEU_W03 analyses and assesses case studies from solving the engineering problems.

relating to skills:

PEU_U01 is able to coordinate team work, create field research plans and manage the work progress.

PEU_U02 is able to independently create solutions for complex practical problems in engineering and geoenvironmental applying knowledge about geophysical surveying, mining geophysics, utilizing modern methods in geophysical data acquisition and interpretation.

PEU_U03 is able to critically assess, process and interpreted results of the geophysical surveying and provide recommendations related to engineering problems in mining, civil engineering, engineering geology, municipal waste site, archeology, engineering properties of soil and rocks, hydrogeology, monitoring seepage in river dykes or dams.

PEU_U04 is able to solve geophysical problems.

PEU_U05 is able to conduct auto-didactical education related to detailed handling of typical software.

relating to social competences:

PEU_K01 understands the need to create and transfer to the society – among others by mass media- information and opinions related to mining engineering achievements and other activities of mining engineer; tries to transfer the information in commonly understood way, presenting different points of view; is aware of the quality and need to shape the work safety culture in mining and the responsibility for the health and life of other employees.

PROGRAMME CONTENT

Lecture		Number of hours
Lec 1	Physical properties of rocks. Inter-relationships between the various subdisciplines of applied geophysics. Overview of geophysical methods, their physical principles and applications. Methodology of geophysical surveying.	1
Lec 2	Engineering problems solved with geophysical surveying. Case studies.	2
Lec 3	Electrical resistivity methods. Tomography and VSE. IP method. Physical principles. Equipment. Methods of field surveying. Interpretation and application. Case studies.	2
Lec 4	Electromagnetic methods. FDEM and TDEM methods. Magnetotelluric methods. Physical principles. Methods of field surveying. Equipment. Interpretation and application. Case studies.	2
Lec 5	GPR surveying. Physical principles. Methods of field surveying. Equipment. Interpretation and application. Case studies.	2
Lec 6	Seismic tomography. Seismic interferometry. Physical principles. Applications. Case studies.	2
Lec 7	Mine geophysics. Seismology. Seismic methods. Active and passive seismic tomography. Microgravimetry. Case studies.	2
Lec 8	Gravity and magnetic surveying. Equipment. Methods of field surveying. Interpretation and application. Case studies.	2
	Total hours	15
Project		Number of hours

Proj 1	One selected geophysical technique. Fundamentals and equipment. Field surveying	4
Proj 2	Processing and interpretation of field data.	3
Proj 3	Solving the geophysical problems.	8
	Total hours	15

TEACHING TOOLS USED

N1. N1.Lecture aided by presentation.
N2.Demonstration.
N3.Discussion and consultations
N3Calculations
N5Practical field surveying

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT

Evaluation (F – forming during semester), P – concluding (at semester end)	Learning outcomes code	Way of evaluating learning outcomes achievement
P1	W01-W03	Test related to lecture content. Final grade.
F1	U01-U02, U05	Test. Project 1. Report on Project 1
F2	U03, U05	Test. Project 2. Report on Project 2
F3	U04, U05	Test. Solving geophysical problems
F1-F3, P2	U01-U05 K02	Grades are given for each of three project tasks including tests and reports. The final grade P2 for the project course is the weighted average grade of F1-F3.

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

- [1] Aki, K., Richards P.G., 1980. Quantitative Seismology: Theory and Methods. W.H. Freeman Co.. San Francisco.
- [2] Burger, H.R., Sheehan, A.F., Jones, C.H., 2006. Introduction to Applied Geophysics: Exploring the Shallow Subsurface. W.W. Norton & Company, Inc.
- [3] Mendecki, A.J. (ed.), 1997. Seismic Monitoring in Mines. Chapman & Hall.
- [4] Reynolds, J.M., 2011. An Introduction to Applied and Environmental Geophysics. Wiley – Blackwell. John Wiley & Sons.
- [5] Sharma, Prem V., 2002. Environmental and engineering geophysics. Cambridge University Press.
- [6] Torge, W., 1989. Gravimetry. Water de Gruyter. Berlin. New York.
- [7] Selected Journal Publications (for example journals: Progress in Geophysics, Engineering Geophysics Journal, Environmental and Engineering Geophysics, Journal of Geophysics and Engineering, Pure and Applied Geophysics).

SECONDARY LITERATURE:

- [1] Lowrie, W., 2007. Fundamentals of Geophysics. Cambridge University Press.
- [2] Milsom, J., 2003. Field Geophysics. John Wiley & Sons Ltd.
- [3] Telford, W.M., Geldart, L.P., Sheriff, R.E., 1990. Applied Geophysics. Cambridge University Press.

SUBJECT SUPERVISOR (NAME AND SURNAME, E-MAIL ADDRESS)

ANNA BARBARA GOGOLEWSKA, anna.gogolewska@pwr.edu.pl

FACULTY OF GEOENGINEERING, MINING AND GEOLOGY	
SUBJECT CARD	
Name of subject in Polish Wspomagane komputerowo modelowanie geologiczne i geostatystyka.)	
Name of subject in English: Computer Aided Geological Modelling and Geostatistics	
Main field of study (if applicable): Górnictwo i geologia.	
Specialization (if applicable): Mining Engineering, Geotechnical and Environmental Engineering, Geomatics for Mineral Resource Management Mineral Resource Exploration	
Profile: academic	
Level and form of studies: 2nd level, full-time	
Kind of subject: obligatory	
Subject code	W06GIG-SM3002
Group of courses	No

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15		45		
Number of hours of total student workload (CNPS)	50		75		
Form of crediting	crediting with grade	Examination / crediting with grade*	crediting with grade	Examination / crediting with grade*	Examination / crediting with grade*
For group of courses mark (X) final course					
Number of ECTS points	2		3		
including number of ECTS points for practical classes (P)			3		
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	0,8		1,9		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Mathematical Statistics,
2. Fundamentals of Geology and Mineral Deposits

SUBJECT OBJECTIVES

- C1 Developing basic skills in computer modelling of 3-D objects.
C2 Introduction of the principles of digital modelling of typical geological structures.
C3 Introduction to the methods of deposit parameters estimation and resources evaluation.

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge:

PEU_W01 Estimation methods, principles of geostatistics, kriging estimators

PEU_W02 Geostatistical modelling of the selected deposit parameters (domain analysis, variogram modelling,

PEU_W03 Creating and validating 3-D models of various geological structures in the comprehensive dedicated software environment.

relating to skills:

PEU_U01 Application of relevant estimation methods for quality modelling of a deposit

PEU_U02 Evaluating 3-D objects against structural and quality block models (volumes, tonnages, grades)

PEU_U03 Describing the interpretation and applied approach, creating models, evaluation results, recommendations for possible enhancements

relating to social competences:

PEK_K01 The student can think and act in a creative and enterprising way

PROGRAMME CONTENT

Lecture		Number of hours
Lec 1	Introduction to the course. Geological database and validation of the geological data.	2
Lec 2	Geology of the seam.	2
Lec 3	Structural model of the stratified deposit. Methods of the prediction of the surface layer parameters.	2
Lec 4	Spatial distribution of samples values. Regionalized variable.	2
Lec 5	BLUE Estimator of the mean value: Kriging.	2
Lec 6	Quality model of the deposit – block model of the parameter layers. Estimation and evaluation of the block model.	2
Lec 7	Reserves modelling and evaluation.	2
Lec 8	Mineral resources. International reporting. The JORC Code	1
	Total hours	15

Laboratory		Number of hours
La1	Determining the rules of work at the laboratory.	3
La2	Assignment of the individual dataset for the exercises and creating initial data files.	3
La3	Data validation and creating initial geological database.	3
La4	Construction of the structural wireframe model of stratigraphy layers.	3
La5	Construction of the block model of the deposit and overburden layers. Thickness and stripping ratio analysis.	3
La6	Data preparation to geostatistical analysis. Compositing of the samples.	3
La7	Domain analysis with the use of the statistical methods.	3
La8	Determination of the empirical variogram. Anisotropy analysis.	3
La9	Variogram modelling.	3
La10	Kriging Neighborhood Analysis - defining optimal parameters of the	3

	estimation procedure.	
La11	Estimation of quality parameters in block model of the deposit layers. Validation of the estimation quality.	3
La12	Validation of the quality model and classification of the resources. Balance resources evaluation.	3
La13	Preparation of data for continuous surface mining ultimate pit design. Ultimate pit outlines generation	3
La14	Wireframe and block modelling of the ultimate pit	3
La15	Reserves evaluation, visualization and interrogation of created models	3
	Total hours	45

TEACHING TOOLS USED

N1. Form of lectures - traditional, multimedia presentations using specialized software and demonstrations of its application "live", individual development of specialist topics covered during the lecture,
N2. individual development of project tasks within the laboratories frames, individual development of electronic reports concerning project tasks within the laboratories frames,
N3. evaluation of laboratory tasks reports with multipoint grade of student's work, group analysis of the results obtained during laboratory tasks; preparation of conclusions concerning data dependencies and constraints of mining projects, skill control tests, duty hours in laboratory.

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT

Evaluation (F – forming during semester), P – concluding (at semester end)	Learning outcomes code	Way of evaluating learning outcomes achievement
F1	PEU_W01, PEU_W02	Lecture grade on the basis of the written examination
F2	PEU_W03,	Laboratory task assessment: “structural modelling assessment
F3	PEU_U01	Laboratory task assessment: “geostatistical modelling”
F4	PEU_U02, PEU_U03	Laboratory task assessment: “reserves evaluation”.
P average of F1, F2, F3, F4		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

- [1] M. Armstrong, Basic Linear Geostatistics, Springer Verlag, 1998.
- [2] P. Goovaerts: "Geostatistics for Natural Resource Evaluation", Oxford University Press, 1997.
- [3] R. H. Grishong, Jr., 3-D Structural Geology, Springer Verlag, 2008
- [4] K. Hefferan, J. O'Brien, Earth materials, Willey-Blacwell, Chichester U.K., 2010
- [5] W. Hustrulid, M. Kuchta, Open pit mine planning and design. Chapter 3. Orebody description, Taylor&Francis, 2013.
- [6] A. G. Journel, and C.J. Huijbregts, Mining Geostatistics, Academic Press, 1978.
- [7] Ch.C. Plummer, D.H. Carlson, L. Hammersley, Physical geology, McGraw-Hill I.E. N.Y. 2010
- [8] D.R. Prothero, R.H. Dott Jr., Evolution of the Earth, McGraw-Hill I.E. N.Y., 2010
- [9] M.W. Rossi, C.V. Deutsch, Mineral Resources Estimation, Springer Verlag 2014.

SECONDARY LITERATURE:

- [10] Handouts, tutorials.

SUBJECT SUPERVISOR (NAME AND SURNAME, E-MAIL ADDRESS)

Dr inż. Krzysztof Hołodnik

Dr inż. Witold Kawalec

FACULTY OF GEOENGINEERING, MINING AND GEOLOGY	
SUBJECT CARD	
Name in Polish:	Cyfrowa kopalnia
Name in English:	Digital Mine.....
Main field of study:	Mining and geology
Specialization:	Mining Engineering, Geotechnical and Environmental Engineering, Mineral Resource Exploration
Level and form of studies:	2nd level, full-time
Kind of subject:	obligatory
Subject code:	W06GIG-SM3006
Group of courses:	No

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15		15		
Number of hours of total student workload (CNPS)	25		25		
Form of crediting	crediting with grade		crediting with grade		
For group of courses mark (X) final course					
Number of ECTS points	1		1		
including number of ECTS points for practical (P) classes			1		
Including number of ECTS points for direct teacher-student contact (BK) classes	0,8		0,8		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Computer literacy skills
2. Basic knowledge related to Mining Engineering and Mineral Processing
3. Programming

SUBJECT OBJECTIVES

- C1. Acquisition of the ability to create utility applications in the C / C ++ and LabVIEW environment
- C2. Providing students with knowledge about embedded systems, their construction, selection of components, designing, programming and their exploitation.
- C3. Familiarizing with the advances of technology & methods of future mining operations.
- C4. Acquisition and consolidation of social competencies including emotional intelligence skills involving the cooperation in the group of students aiming to effectively solve problems.
- Responsibility, honesty and fairness in the proceedings; observance force in academia and society

SUBJECT EDUCATIONAL EFFECTS**relating to knowledge:**

PEU_W01 A student has knowledge related to automation systems, control systems and measurement systems in various aspects of the mining industry.

PEU_W02 The student has knowledge of the importance of automation and robotics systems in modern mining.

relating to skills:

PEU_U01 A student is able to select and integrate elements of a specialized measuring and control system including: control unit, executive system, measuring system as well as peripheral and communication modules

PEU_U02 A student can design improvements in the existing design solutions for automation and robotics components and systems

relating to social competences:

PEU_K01 A student is aware of the need for a professional approach to technical issues, meticulous reading of documentation and knows environmental conditions in which devices and their components can function

PEU_K02 The student has knowledge concerning the benefits of creation and implementation new solutions&technologies into mining industry

PROGRAMME CONTENT		
Form of classes - lecture		Number of hours
Lec 1	Terminology (process, automation, robots, measurement devices, control systems). Definition of digital mine	2
Lec 2	Aims, benefits, drawbacks of automation. Industrial revolutions. Definition of industry 4.0. Overview of components of the 4th industrial revolution. Industry 4.0 and mining	2
Lec 3	Elements of technological process in mining. Automation of cyclic processes Measuring technologies in industry 4.0. Sensors systems. Data transmission and data storage technologies. Analytics in industry 4.0. Industrial BigData, Cloud Computing	2
Lec 4	Industrial Internet of Things. M2M communication, anti-collision systems, location of people underground	2
Lec 5	Virtual and augmented realities for industry. Simulators. Digital Twin. Digital models of processes and objects. Management information creation systems, reporting	2
Lec 6	Case study: Automation in open pit lignite mining (KTZ, Autonomous haulage (use case from Australia))	1
Lec 7	Case study: underground mine (Rock Vader – Sandvik project, other use cases from Sandvik, Epiroc, MineMaster, Zanam, AOT from ZGPS KGHM, KIC project on shaft inspection, ... etc)	2
Lec 8	Case study: mineral processing (ConVis, FlowVis) in KGHM, OPMO project	2
Total hours		15

Form of classes - laboratory		Number of hours
Lab1	Scope of the course, teaching purpose, crediting conditions, literature, data. Introduction to ARDUINO	3
Lab2	Basic sensors for physical parameters measurements	3
Lab3	Measurements in Labview	3
Lab4	Analysis and Visualization in Labview	3
Lab5	Control in labview	3
	Total hours	15

TEACHING TOOLS USED
<p>N1. Type of lectures - traditional, illustrated with multimedia presentations with the usage of audio- visual equipment.</p> <p>N2. Discussion concerning lectures and laboratory.</p> <p>N3 Configuration on laboratory classes measuring systems (hardware and software), performing of measurements, teamwork</p> <p>N4. Projects defence - oral and written form.</p> <p>N5. Duty hours.</p>

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT

Evaluation (F – forming (during semester), P – concluding (at the end of semester))	Educational effect number	Way of evaluating educational effect achievement
F1, P1	PEK_U02- PEK_U04	<p>F1.1 Grade from laboratory work's performance and its merits</p> <p>F.1.2 Grade from laboratory work's oral or written defence</p> <p>P1.Final grade (weighted average of F1.1 - 60% and F1.2 - 40%).</p>
F2, P2	PEK_U02- PEK_U04	<p>F2.1 Grade from activity during the lecture (questions, discussions etc)</p> <p>F.2.2 Grade from written exam</p> <p>P2.Final grade (weighted average of F2.1 - 20% and F2.2 - 80%).</p>

LITERATURE

PRIMARY LITERATURE:

- [1] LabVIEW™ Getting Started with LabVIEW
<http://www.ni.com/pdf/manuals/373427j.pdf>
- [2] Monk Simon: Arduino dla początkujących. Podstawy i szkice, Anderson R., Cervo D., Helion, 2018
- [3] Monk Simon: Arduino dla początkujących. Kolejny krok, Anderson R., Cervo D., Helion, 2015

ONLINE LITERATURE:

- [1] LabVIEW Tutorial
- [2] ARDUINO Tutorial
- [3] Materials prepared by Tutor
- [4] Internet websites

SUBJECT SUPERVISOR (NAME AND SURNAME, E-MAIL ADDRESS)

**Prof. dr hab. inż. Radosław Zimroz, radoslaw.zimroz@pwr.edu.pl
dr inż. Anna.Nowak-Szpak**

<p>FACULTY OF GEOENGINEERING, MINING AND GEOLOGY SUBJECT CARD</p> <p>Name of subject in Polish Bezpieczeństwo i higiena pracy Name of subject in English: Occupational Health and Safety Main field of study (if applicable): Górnictwo i geologia. Specialization (if applicable): Mining Engineering, Geotechnical and Environmental Engineering, Mineral Resource Exploration</p> <p>Profile: academic Level and form of studies: 2nd level, full-time Kind of subject: obligatory Subject code W06GIG-SM3005 Group of courses No</p>

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15			15	
Number of hours of total student workload (CNPS)	25			25	
Form of crediting	crediting with grade			crediting with grade	
For group of courses mark (X) final course					
Number of ECTS points	1			1	
including number of ECTS points for practical classes (P)				1	
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	0,7			0,8	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Possesses basic knowledge of technologies used in open-pit mines and underground mines.
2. Is able to use Microsoft Office environment to prepare documents in Word, multimedia presentations in Power Point and work with Excel spreadsheets.
3. Is able to identify harmful, dangerous and nuisance factors in the workplace environment.

SUBJECT OBJECTIVES

- C1. To introduce the principles of occupational risk assessment in accordance with relevant standards
- C2 To present the principles of occupational risk assessment and the determination of admissibility with the use of STER software and the RISC SCORE method.

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge:

PEU_W01 Possesses general knowledge of rules of occupational risk assessment formulation

PEU_W02 – Possesses knowledge of evaluating and determining the admissibility of occupational risk.

PEU_W03 – Possesses general knowledge of corrective and preventive actions regarding hazards of typical work posts in the mining industry....

relating to skills:

PEU_U01 Is able to identify hazards of harmful, dangerous and nuisance factors of typical work posts in the mining industry

PEU_U02 Is able to estimate and determine risk acceptability with methods according to STER software and the RISC SCORE method.

PEU_U03 - Is able to plan corrective and preventive actions for hazards of typical work posts in the mining industry....

relating to social competences:

PEU_K01 - Is able to work in a team and together complete occupational risk assessment and develop its results and the required documentation in the form of a team report

PROGRAMME CONTENT

Lecture		Number of hours
Lec 1	Definition of occupational risk. Legal basics of occupational risk assessment. Risk assessment methods. Course of occupational risk assessment. Information necessary for occupational risk assessment. Identification of harmful, dangerous and nuisance factors in the work environment.	3
Lec 2	Estimation of occupational risk assessment and determination of admissibility. Corrective and preventive actions. Familiarising employees with the results of occupational risk assessment. Implementation of agreed corrective and preventive actions. Monitoring the effectiveness of implemented actions. Periodic occupational risk assessment. Harmful factors – identification and assessment of risks.	3
Lec 3	Dangerous factors - identification and assessment of risks.	3
Lec 4	Nuisance factors in occupational risk assessment: psychological burden, static burden, monotony.	3
Lec 5	Methods of occupational risk assessment: STER software, the RISC SCORE method, written test	3
	Total hours	15

Project		Number of hours
Pr1	Occupational risk assessment with the use of STER software for two work posts – description of work post, identification of hazards. Occupational risk assessment with the use of STER software for two work posts – estimation of occupational risk and determination of admissibility of harmful factors (dust, noise)	3
Pr2	Occupational risk assessment with the use of STER software for two work posts – estimation of occupational risk and determination of admissibility of	3

	harmful factors (vibration, chemical agents)	
Pr3	Occupational risk assessment with the use of STER software for two work posts – estimation of occupational risk and determination of admissibility of dangerous factors (slippery or uneven surfaces, falling elements, moving parts, moving machinery and transported items)	3
Pr4	Occupational risk assessment with the use of STER software for two work posts – estimation of occupational risk and determination of admissibility for nuisance factors (psychological burden, static burden, monotony)	3
Pr 5	Occupational risk assessment for a selected work post with the use of the RISC SCORE method, presentation of executed exercises, test	3
	Suma godzin	15

TEACHING TOOLS USED

N1. Informative lecture with elements of problematic lectures.
 N2 Multimedia presentations.
 N3 Didactic discussions during lectures.
 N4 Didactic discussions during laboratory classes.
 N5 Computer presentation of executed occupational risk assessments.
 N6 Consultation.

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT

Evaluation (F – forming during semester), P – concluding (at semester end)	Learning outcomes code	Way of evaluating learning outcomes achievement
F1	PEU_W01-W03	grade from a test
F2	PEU_W01-W03 PEU_U01- U03	grade from a presentation
P2	PEU_W01-W03 PEU_U01- U03	final grade from project classes (arithmetic average of F1 and F2)

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

- [1] Occupational Safety and Health in Mining. Anthology on the situation in 16 mining countries. Ed.: Kaj Elgstrand and Eva Vingård. University of Gothenburg nr 2013;47(2) ([gupea.ub.gu.se > bitstream > gupea_2077_32882_1](http://gupea.ub.gu.se/bitstream/gupea_2077_32882_1))
- [2] Boyle, Tony: Health and safety: Risk management. IOSH, 2001. (<http://www.iosh.co.uk/index.cfm?go=publications.main>)
- [3] Encyclopaedia of occupational health and safety. Fourth edition Stellman, Jeanne M. (ed.). International Labour Organization, 1998 (<http://www.ilo.org/public/english/support/publ/xtextre.htm#b103>)
<http://www.ilo.org/public/english/support/publ/encyc/>)
- [4] McKeown, Céline; Twiss, Michael: Workplace ergonomics: A practical guide, IOSH, 2001, 160 p. <http://www.iosh.co.uk/index.cfm?go=publications.main>

SECONDARY LITERATURE:

Handouts, articles

OPIEKUN PRZEDMIOTU (IMIE, NAZWISKO, ADRES E-MAIL)

Dr inż. Żaklina Konopacka

FACULTY OF GEOENGINEERING, MINING AND GEOLOGY

SUBJECT CARD

Name in Polish: *Zasady i zastosowania InSAR oraz GIS w górnictwie*
Name in English: *Principles and Application of InSAR and GIS in mining*
Main field of study: Mining and geology
Specialization: Geomatics for Mineral Resources Management
Mineral Resource Exploration
Level and form of studies: 2nd level, full-time
Kind of subject: obligatory
Subject code: W06GIG-SM3007
Group of courses: No

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30		45		
Number of hours of total student workload (CNPS)	50		75		
Form of crediting	Examination		crediting with grade		
For group of courses mark (X) final course					
Number of ECTS points	2		3		
including number of ECTS points for practical (P) classes			3		
Including number of ECTS points for direct teacher-student contact (BU) classes	1,4		2,0		

*niepotrzebne skreślić

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge of C ++ and Python programming language.
2. Basic knowledge of GIS functions and spatial data acquisition techniques
3. Ability to use GIS software package
4. Basic knowledge of databases

SUBJECT OBJECTIVES

- C1 Presentation of knowledge of satellite radar interferometry, as well as the possibility of using it in the ground deformation measurements.
- C2 Acquiring the ability to determine surface displacements based on satellite radar data.
- C3 Presentation of information on the use of GIS in advanced analysis of objects, phenomena and processes occurring in space.
- C4 Acquiring the ability to formulate and solve tasks using GIS analytical functions.
- C5 Acquiring skills to use spatial data and services in accordance with the INSPIRE Directive

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge:

PEK_W01 Has expanded knowledge in the field of using geoinformation systems to collect and process data used in modeling of both natural and anthropogenic phenomena and processes

PEK_W02 Knows the principles of construction and functioning of geoinformation systems in the mining industry and public administration

relating to skills:

PEK_U01 has the ability to use advanced GIS tools in mining, studies of natural phenomena, the impact of mining on the environment and space development,

PEK_U02 has the ability to formulate and solve spatial tasks in the GIS environment

PEK_U03 has the ability to interpret the results obtained and draw conclusions

relating to social competences:

PEU_K01 has the ability to formulate and transfer knowledge on the use of geoinformation systems in spatial analysis and presentation of their results

PROGRAMME CONTENT

Lecture		Number of hours
Lec 1	Discussion of syllabus, requirements for passing the course, literature	2
Lec 2	Introduction to Microwave Signals for Earth Observation	2
Lec 3	Principles and Applications of Passive and Active Microwave Remote Sensing	2
Lec 4	Acquisition and processing of SAR data	2
Lec 5	SAR image theory (geometric properties, polarization)	2
Lec 6	Basics of SAR data calculation using the DInSAR and SBAS methods	2
Lec 7	Principles and Applications of Interferometric SAR (monitoring surface activity, natural and anthropogenic phenomena)	2
Lec 8	Fundamental concepts of geographical information systems	2
Lec 9	Data modelling in GIS. Representation of spatial data. Spatial databases. Current status and development trends	2
Lec 10	Methods of spatial analysis in GIS	2
Lec 11	Spatial data interpolation	2
Lec 12	Map algebra. Surface analysis, local and zonal functions	2
Lec 13	Basics of spatial statistics	2
Lec 14	Spatial Information Infrastructure. Inspire Directive. Open Data	2
Lec 15	Examples of applications of geoinformation systems in mining and environmental protection	2
	Total hours	30

Laboratory		Number of hours
La1	Configuration of the environment for SAR calculations	3
La2-3	Introduction to radar data calculations - calculation tasks	6
La4	Acquiring radar data and calculating the interferogram - DInSAR method	3
La5	Unwrapping of the interferometric phase - calculations	3
La6-7	Presentation of results in the GMT environment	6
La8	Discrete data interpolation. Preparation of input data for analysis (e.g. deformation measurements in the mining area)	3
La9	Discrete data interpolation. Development mining area terrain deformation maps with various interpolation methods.	3
La10	Discrete data interpolation. Analysis and assessment of the quality and uncertainty of interpolation. Prediction map. Development of maps of changes between two periods using a raster calculator.	3
La11	Spatial analysis - assessment of the suitability of the area for the location	3
La12	of mining operation. Construction of a database of spatial location criteria	3
La13	Spatial analysis - assessment of the suitability of the area for the location	3
La14	of mining operation. Selection of analytical procedures and conducting analytical operations.	3
La15	Spatial analysis - assessment of the suitability of the area for the location	3
Total hours		45

TEACHING TOOLS USED
N1. Lectures N2. Multimedia presentations N3. Preparation of individual written term paper on a given topic N4. Multimedia materials (MOOC) N5. Laboratory instructions N6. Reports from laboratory exercises N7. Consultations

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT

Evaluation (F – forming during semester), P – concluding (at semester end)	Learning outcomes code	Way of evaluating learning outcomes achievement
F, P	PEU_W01 – 02 PEU_U01 – 03 PEU_K01	F1 Final mark for the written examination F2 Mark for the written report, P Final mark for the lecture (weighted average of F1 and F2, where F1 – 80% and F2 - 20%)
F, P	PEU_W01 – 02 PEU_U01 – 03 PEU_K01	F3 Mark for the written assignment reports F4 Mark from written tests, P2 Final mark for the laboratory (weighted average of F3 and F4, where F3 – 80% and F4 - 20%)

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

- [1] Longley P. A., Goodchild M. F., Maguire D. J., Rhind D. 2015: Geographic Information Science and Systems, 4th Edition, John Wiley & Sons;
- [2] Maguire D., Batty M., Goodchild M., 2005. GIS Spatial Analysis and Modelling. ESRI Press
- [3] Berry J., 2007-2013. Beyond Mapping IV — GIS Modelling
- [4] Satellite InSAR Data: Reservoir Monitoring from Space, A. Ferretti, EAGE; 1st edition, 2014
- [5] GMTSAR: An InSAR Processing System Based on Generic Mapping Tools (Second Edition), D. Sandwell i in., Scripps Institution of Oceanography, University of California, San Diego, La Jolla, CA, USA, 2016
- [6] InSAR Principles - Guidelines for SAR Interferometry Processing and Interpretation, ESA Publications, 2008

SECONDARY LITERATURE:

- [1] Directive 2007/2/EC of the European Parliament and of the Council of 14 March 2007 establishing an Infrastructure for Spatial Information in the European Community (INSPIRE)
- [2] Kennedy M., 2009: Introducing Geographic Information Systems with ArcGIS: A Workbook Approach to Learning GIS, Second Edition, John Wiley and Sons;
- [3] Longley P. A., Goodchild M. F., Maguire D. J., Rhind D. W., 2006. GIS. Teoria i praktyka. Wydawnictwo Naukowe PWN, Warszawa
- [4] Urbański J., 2010. GIS w badaniach przyrodniczych, Wydawnictwo Uniwersytetu Gdańskiego
- [5] Dokumentacja środowiska GMT (Generic Mapping Tools) - <http://gmt.soest.hawaii.edu/projects/gmt/wiki/Documentation>

SUBJECT SUPERVISOR (NAME AND SURNAME, E-MAIL ADDRESS)

Wojciech Milczarek, wojciech.milczarek@pwr.edu.pl
Jan Blachowski, jan.blachowski@pwr.edu.pl

FACULTY OF GEOENGINEERING, MINING AND GEOLOGY

SUBJECT CARD

Name in Polish: Geochemia**Name in English: Geochemistry****Faculty of studies (if applicable): Mining and Geology****Specialisation (if applicable): Mining Engineering****Mineral Resource Exploration****Level and form of studies: 2nd level, full-time****Subject Type: Obligatory****Subject code: W06GIG- SM3055W****Group of courses: NO**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in the University (ZZU)	30				
Number of hours of total student workload (CNPS)	50				
Form of crediting	Crediting with grade				
For a group of courses mark (X) for the final course					
Number of ECTS points	2				
including number of ECTS points for practical (P) classes					
including number of ECTS points for direct teacher-student contact (BK) classes	1,4				

* delete as applicable

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Possesses basic knowledge in the area of general chemistry (inorganic and organic) and physics.
2. Possesses basic knowledge in the area of mineralogy and petrology.
3. Possesses basic knowledge and skills in the area of hydrogeology.
4. Is familiar with basic concepts of deposit and mining geology.

SUBJECT OBJECTIVES

C1 Aim of the subject is to familiarize students with fundamental physicochemical principles and processes which occur in the Earth's crust and their theoretical foundations and implications.

SUBJECT LEARNING OUTCOMES

relating to knowledge:

PEU_W01 Possesses knowledge relating to the thermodynamic and geochemical principles and processes which occur in the Earth's crust.

PEU_W02 Possesses basic knowledge in the area of rock formation and the determination of the age of rocks.

relating to skills:

PEU_U01 Is able to search for information on geochemical processes and carry out their critical evaluation and analysis.

relating to social competencies:

PEU_K01 Is able to formulate and impart knowledge regarding processes occurring in the Earth's crust and their impact on the environment.

PROGRAMME CONTENT

Form of classes - lecture		Number of hours
Lec.1	Introduction. History, present time and future of the Universe. Construction of the Earth and the structure of outer zones	3
Lec.2	The basics of thermodynamic geological processes (parameters and functions of state)	3
Lec.3	Geochemical calculations (solutions, reactions, pH, Eh, dissolution, phase diagrams, stability, rule of contradiction)	3
Lec.4	Geochemical calculations (chemical equilibria diagrams)	3
Lec.5	Global geochemical cycles	3
Lec.6	Geochemistry of elements	3
Lec.7	Geochemistry of organic compounds	3
Lec.8	Earth and life	3
Lec.9	Applied Geochemistry	3
Lec.10	Determination of the absolute age of rocks. Mineral thermometry and barometry	3
Lec.11	Mineral facies indicators	3
Lec.12	Natural non-isotope markers	3
Lec.13	Natural isotope markers	3
Lec.14	Artificial non-isotope markers	3
Lec.15	Paleomagnetism and dendrochronology	3
Total hours		45

Form of classes - seminar		Number of hours
Se1		
Se2		
Total hours		

Form of classes - laboratory		Number of hours
La1-		
La2-		
Total hours		

TEACHING TOOLS USED

N1. Traditional lecture supplemented with multimedia presentations and discussions.

EVALUATION OF SUBJECT EDUCATIONAL OUTCOME ACHIEVEMENTS

Evaluation F – forming (during semester), P – concluding (at semester end)	Educational outcome number	Method of evaluating educational outcome achievement
P	PEU_W01-W02 PEU_U01 PEU_K01	Written test
F, P		
F, P		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

- [1] Albarède F., 2009 – Geochemistry. An introduction. Cambridge University Press, Cambridge, UK.
- [2] Allègre C. J., 2008 – Isotope geology. Cambridge University Press, Cambridge, UK.
- [3] Hefferan K., O'Brien J., 2010 – Earth materials. Wiley-Blackwell, Chichester, UK.
- [4] Marshall C. P., Fairbridge R. W. (eds), 1999 – Encyklopedia of Geochemistry. Kluwer Academic Publishers, Dordrecht, Boston, London.
- [5] McSween H. Y., Huss G. R., 2010 – Cosmochemistry. Cambridge University Press, Cambridge, UK
- [6] Tolstikhin I. N., Kramers J. D., 2008 – The evolution of matter. From the Big Bang to the Present Day. Cambridge University Press, Cambridge, UK

SECONDARY LITERATURE

- [1] Appelo C.A.J., Postma D., 2005 - Geochemistry, groundwater and pollution. Balkema.
- [2] Merkel B. , Planer-Friedrich 8.,2005 - Groundwater geochemistry. Springer

SUBJECT SUPERVISOR (NAME AND SURNAME, E-MAIL ADDRESS)

Prof. dr hab. inż. Tadeusz Przylibski
dr inż. Danuta Szyszka, dr inż. Katarzyna Łuszczek, dr inż. Agata Kowalska

Semester 4
WUST

EIT label – Teaching units <TIMREX – T-shaped Master Programme for Innovative Mineral Resource Exploration>

Course title	Applied field exploration					
European Credits (ECTS)	3	Time (hours) given to the students			45	
Type (Lecture, internship, exercise etc.)	Lectures: , Auditorium classes: , Lab. Classes: , Project classes: , Practical classes: , Seminar classes: , Fieldwork: 3	Student whole working time (hours)			75	
Description of content	The goal of the course is that students should acquire a hands-on understanding of different field exploration methodologies, and how they can be integrated for targeting VMS deposits. Geological, geophysical and geochemical exploration methods in VMS exploration. Practical field mapping exercises in structural geology, stratigraphy, hydrothermal alteration. Practical geophysical surveying using UAV technology. GIS-based data synthesis for exploration target selection. Drill core logging and assaying.					
Learning outcomes of the curricular unit (knowledge, skills and competences to be developed by the students)	Knowledge: when passed the student is expected to have: -knowledge about different field methods and their use during an exploration program. -knowledge about drilling and sampling methods. -knowledge about different methods for field mapping. Skills: when passed the student is expected to have the ability to - acquire in-depth structural, volcanological and alteration data from outcrops in the field - contextualize field observations in relation to ore genetic model for VMS deposits. - synthesize different types of geological and geophysical data for targeting a VMS deposit. Competences: ,					
Assessment methods and criteria	Exercises U G# 1.20 Project work G U 3 4 5 1.80 The course is mainly presented via practicals in the field, but also with complementary lectures and exercises, in addition to project work.					
Recommended readings	Online compendium in Canvas room					
TU Coordinator	Nils Jansson, Nils.Jansson@ltu.se					
Contribution to EIT's Overarching Learning Outcomes (tick relevant box/es)*	OLO 1 Entrepreneurship	OLO2 Innovation	OLO3 Creativity	OLO4 Intercultural	OLO5 Value judgments / Sustainability	OLO6 Leadership

EIT label – Teaching units <TIMREX – T-shaped Master Programme for Innovative Mineral Resource Exploration>

Justification for OLO contribution	
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EIT label – Teaching units <TIMREX – T-shaped Master Programme for Innovative Mineral Resource Exploration>

Course title	SOC Internship		
European Credits (ECTS)	2	Time (hours) given to the students	30
Type (Lecture, internship, exercise etc.)	Lectures:, Auditorium classes: , Lab. Classes: , Project classes: 2 , Practical classes:, Seminar classes: , Fieldwork: x	Student whole working time (hours)	50
Description of content	<p>The aim of the course is to enable students to work in socially responsible workplaces, and apply their skills and knowledge to promote social good. While this develops them to become work-ready professionals, it also nurtures them to become advocates who help build a better world.</p> <p>EDUCATIONAL GOALS:</p> <ol style="list-style-type: none"> 1. To actively participate in the affairs of the community and in concrete actions on the ground that aim to promote the public interest, equality and solidarity. 2. To reflect on social license to operate issues 3. To work in direct contact with the beneficiaries of the civic activities undertaken e.g.: reception, facilitation, support, social assistance, etc. <p>EXAMPLES OF SOCIAL AND CIVIC ISSUES IN MINERALS INDUSTRIES:</p> <ul style="list-style-type: none"> • Depletion of natural capital (degradation of air, land and water quality), land use conflicts, health impacts • Digitalization and automation generate particular challenges for well-being in mining regions. Limited job opportunities for local workforce and skills mismatches. • High and continuous transparency and accountability standards of the industry, effective methods of information sharing and dialogue • A more equitable value-sharing, Corporate Social Responsibility issues • Facilitation of environmental awareness • Preservation and restoring of historic sites, 		
Learning outcomes of the curricular unit (knowledge, skills and competences to be developed by the students)	<p>Knowledge: to understand that social responsibility incorporates an ethical, social and environmentally-friendly perspective to our personal and professional activities</p> <p>Skills: To be able to engage in an informal professional discussion and business communication</p> <p>Competences: To cope with complexity, uncertainty and change in global contexts</p>		

EIT label – Teaching units <TIMREX – T-shaped Master Programme for Innovative Mineral Resource Exploration>

Assessment methods and criteria	Criterion: Submission of a project report					
Recommended readings						
TU Coordinator	Supervisors of the student’s Master thesis					
Contribution to EIT’s Overarching Learning Outcomes (tick relevant box/es)*	OLO 1 Entrepreneurship	OLO2 Innovation	OLO3 Creativity	OLO4 Intercultural	OLO5 Value judgments / Sustainability	OLO6 Leadership
	Students will be engaged in professional discussion and business communication				Students will be able to understand that social responsibility incorporates an ethical, social and environmentally-friendly perspective to our personal and professional activities	
Justification for OLO contribution						

Course title	Exploration entrepreneurship		
European Credits (ECTS)	4	Time (hours) given to the students	60
Type (Lecture, internship, exercise etc.)	Lectures: 1, Auditorium classes: , Lab. Classes: , Project classes: 1, Practical classes: 3, Seminar classes: 2, Fieldwork:	Student whole working time (hours)	100
Description of content	<p>To equip students with the professional skills to increase their employability and entrepreneurship skills to meet the current market demands. The EFGeoMentoring scheme aims at improving international networking and supporting the life-long learning and CPD requirements of experienced geology professionals. In addition, it allows students to benefit from insider knowledge about international work perspectives in different sectors of geological profession and countries.</p> <p>Mentoring within the course is a process during which an experienced professional with and EurGeol title (mentor) accompanies the student in a targeted way. Mentoring contributes to developing personal, entrepreneurial, networking, social and professional skills regarding the mineral prospecting and exploration activity. It allows learning from professional experiences that can only be acquired through practice and can't be found in any textbook. Mentoring improves the opportunities of career beginners by providing career-enhancing contacts and involvement in professional networks.</p> <p>At the beginning of the mentoring cooperation, students formulate clear goals and communicate them to their mentor. In consultation with the mentor, concrete topics and the respective roles within the mentoring process will be defined. Since the student is at the centre of the process, it is their task to become aware of their own plans and their support needs.</p> <p>OBJECTIVES OF THE MODULE:</p> <ul style="list-style-type: none"> • Intensify international networking among geologists all across Europe and beyond • Provide young professionals with contacts helping them to think through, plan and access their short, medium or long-term career development • Contribute on internship positions • Improve gender balance and increase diversity in leadership positions by providing targeted support to women and under-represented minorities • Facilitate life-long learning and Continuing Professional Development (CPD) <p>The EFG mentors are professionals who have acquired a high level of industrial and/or academic experience and work in industrial practice, business, academia, education or administration.</p> <ul style="list-style-type: none"> • Coaching: The mentor actively guides and encourages the student to develop essential skills and attitudes for the future ("How do I assert myself? How do I behave in negotiations? What do I do in challenging work contexts?") • Advice: The mentor advises the student in concrete situations, in current questions and difficulties. Mentors support students in solving problems and assist them in making tough decisions. 		

	<ul style="list-style-type: none"> • Help: The mentor can help open otherwise locked doors that allow the student to pursue their goals. • Support: The mentor supports the student in essential decisions without deciding. Mentors assist in the development of professional strategies, as well as in career planning and review of possible obstacles. • Inform: The mentor informs the student about (informal) rules and processes applied in organisations or professional life in general. According to the student's background, mentors can also inform about seminars or conferences that they consider helpful. • Participation: Mentors allow students to participate in parts of their professional career, experiences and strategic decisions. They allow students to share their professional life and invite them, for instance, to participate in meetings or appointments. • Give feedback: Mentor and student provide each other with constructive feedback about their appearance and public perception. • Networking: Mentors give the students hints on maintaining and using contacts. They introduce the students into active networks and provide professional contacts. The mentor provides the student with the chance to create a successful CV and take a chance on social networks such as LinkedIn.
<p>Learning outcomes of the curricular unit (knowledge, skills and competences to be developed by the students)</p>	<p>Knowledge: to provide background training to support the learning process; make students aware of broad professional issues; provide business and entrepreneurship skills to develop an awareness of business management and commercial practices regarding mineral prospecting and exploration.</p> <p>Skills: Develop relationships with other persons and maintain them. Can talk frankly about his ideas, fears and weaknesses. Identifying investment opportunities in the mineral resources sector.</p> <p>Competences: To define professional targets, wants to succeed and is actively committed to implementing these targets. Not afraid of making mistakes and experimenting with new ideas. Willing to question himself critically, accept external advice, and implement it.</p>
<p>Assessment methods and criteria</p>	<p>Practical mark</p> <p>At the end of the mentoring process, students will a) reflect their mentoring experience on a two-page report highlighting benefits and potential gaps for future implementation b) prepare a small business plan for an identified innovative idea of their own.</p> <p>Slack channel will allow for student-mentor exchange and networking within the whole cohort of participants.</p> <p>Mentoring is a one-to-one relationship between a mentor and a student.</p> <ul style="list-style-type: none"> • Mentoring takes place beyond a dependent relationship (e.g. supervisor-subordinate or professor-student relationships). • During the mentoring process, learning and experimentation occur in a protected environment. • An integral part of mentoring is the development of professional skills and competencies. <p>Mentoring is a reciprocal process of "give and take". Both sides learn from each</p>

	other because even the mentor will have the opportunity to critically question his professional perspective and discover new perspectives, software and applications, and previously unperceived situations.					
Recommend ed readings	<p>Mentoring Mindset, Skills and Tools 4th Edition: Make it easy for mentors and students, 2020, Synergetic People Development Pty Ltd, 252 pages, ISBN 0980356458</p> <p>The Mentoring Guide: Helping Mentors and Students Succeed, 2019, Michigan Publishing Services, ISBN: 1607855399.</p> <p>Wang, J., Shibayama, S., 2022. Mentorship and creativity: Effects of mentor creativity and mentoring style. Research Policy 51, 104451. doi:10.1016/j.respol.2021.104451</p> <p>Entrepreneurship: A Guide To Success For Entrepreneurs And Aspiring Entrepreneurs, 2018, ISBN 978-1720221654</p> <p>Entrepreneurship: Successfully Launching New Ventures, Global Edition, 2018, Pearson, ISBN: 9781292255330</p>					
TU Coordinator	Pavlos Tyrologou, pavlos.tyrologou@gmail.com					
Contribution to EIT's Overarching Learning Outcomes (tick relevant box/es)*	OLO 1 Entrepreneurship	OLO2 Innovation	OLO3 Creativity	OLO4 Intercultural	OLO5 Value judgments / Sustainability	OLO6 Leadership
	XX		X	XX	XX	XX
Justification for OLO contribution						