COURSE DESCRIPTIONS/
KARTY PRZEDMIOTÓW

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

specjalność/specialisation:
Entrepreneurship, Innovation and Technology
Integration in Mining

Track LUT

Semester 1
WUST

Zał. nr 5 do ZW 78/2023

Attachment no. 4. to the Program of Studies

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,
Entrepreneurship, Innovation and Technology Integration in Mining
Profile: academic
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.

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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 geoengineering 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

Zał. nr 5 do ZW 78/2023
Attachment no. 4. to the Program of Studies

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: Mining and Geology
Specialization: Mining Engineering,
Geotechnical and Environmental Engineering,
Geomatics for Mineral Resource Management,
Mineral Resource Exploration,
Entrepreneurship, Innovation and Technology Integration in Mining
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

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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 estimation procedure.	3
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

Zał. nr 5 do ZW 78/2023
Attachment no. 4. to the Program of Studies

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,
Entrepreneurship, Innovation and Technology Integration in Mining
Profile: academic
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

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

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	F1.1 Grade from laboratory work's performance and its merits F.1.2 Grade from laboratory work's oral or written defence P1.Final grade (weighted average of F1.1 - 60% and F1.2 - 40%).
F2, P2	PEK_U02-PEK_U04	F2.1 Grade from activity during the lecture (questions, discussions etc) F.2.2 Grade from written exam P2.Final grade (weighted average of F2.1 - 20% and F2.2 - 80%).

LITERATURE

PRIMARY LITERATURE:

[1] LabVIEWTM 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

Zał. nr 5 do ZW 78/2023
Attachment no. 4. to the Program of Studies

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
Entrepreneurship, Innovation and Technology Integration in Mining
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					**1**
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 Lec.6	- Business Charter for Sustainable Development of the International Chamber of Commerce - ICC Business Charter for Sustainable Development - 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 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.	
Lec.7 Lec.8	Basic tools of environmental management: - 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) Examples of basic tools of environmental management: - 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	IT systems supporting environmental management: - Decision Support Systems - Expert systems - Simulation Models - Geographical Information Systems Selected types of information systems which support environmental management, their characteristics, examples of implementation both in Poland and in the world	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. Assignment of seminar topics for individual students.	2
Se2 Se3 Se4 Se5 Se6 Se7 Se8	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
	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] Wilson, G. A., & Bryant, R. L., 2021, Environmental management. Routledge.

[2] Mitchell B., 2002, Resource and Environmental Management, Routledge, London

[3] Lukasheh 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,

[4] Gregory, R., Failing, L., Harstone, M., Long, G., McDaniels, T., & Ohlson, D., 2012, Structured decision making: a practical guide to environmental management choices. John Wiley & Sons.

[5] Schaltegger, S., Burritt, R., & Petersen, H., 2017, An introduction to corporate environmental management: Striving for sustainability. Routledge.

SECONDARY LITERATURE

[1] Uberoi, N. K., 2000, Environmental management. Excel Books India.

[2] Krishna, I. M., Manickam, V., Shah, A., & Davergave, N., 2017, Environmental management: science and engineering for industry. Butterworth-Heinemann.

[3] Wehrmeyer, W. (Ed.). 2017, Greening people: Human resources and environmental management. Routledge.

[4] 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

Zał. nr 5 do ZW 78/2023
Attachment no. 4. to the Program of Studies

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,
Geotechnical and Environmental Engineering,
Mineral Resource Exploration
Entrepreneurship, Innovation and Technology
Integration in Mining
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

O1**: Develop comprehensive knowledge of mining safety and regulations**: By the end of the course, students should be able to demonstrate a thorough understanding of local and international safety regulations governing the mining industry.

O2: **Apply risk assessment and mitigation strategies in mining environments:** Upon

completion of the course, students should be capable of conducting risk assessments, identifying hazards, and implementing effective mitigation strategies in diverse mining settings

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge:

PEU_W01 Possesses general knowledge of rules of occupational risk assessment formulationPEU_W02 – Possesses knowledge of evaluating and determining the admissibility of occupational risk.

PEU _W0 3 – Possesses general knowledge of corrective and preventive actions regardinghazards 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 typicalwork posts in the mining industry

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

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

relating to social competences:

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

PROGRAMME CONTECT		
N	LECTURE	Number of hours
1	**Introduction to Mining Safety and Health Regulations**. The mining industry as one of the most hazardous occupations. Worldwide statistics. The evolution of safety standards in response to past failures or incidents. Overview of key regulations governing occupational safety and health in the mining industry. The importance of compliance with international safety standards. Definition of occupational hazards and risks. The key points of safety management system (SMS) in the mining industry.	3
2	**Hazard Identification in Mining Operations.** Exploration of hazard identification processes specific to mining environments. Analysis of common hazards in mining operations, including physical, chemical, and ergonomic hazards. Strategies for implementing control measures to mitigate identified hazards. Real-world examples of hazard control success stories in the mining industry.	3
3	**Occupational Risk Assessment in Mining.** Overview of the methods of identification, evaluation and management risks: Hazard Identification and Risk Assessment (HIRA), Job Safety Analysis (JSA) or Job Hazard Analysis (JHA), Fault Tree Analysis (FTA), Event Tree Analysis (ETA). Occupational exposure limits and their importance.	3
4	**Health risk assessment in the mining industry**. Health risks associated with mining activities. Methods for assessing occupational health risks, including exposure monitoring and health surveillance. The long-term health implications of exposure to various substances in mining. Strategies for preventing and mitigating occupational health risks in mining.	3
5	**Prevention and Control of Occupational Diseases in Mining.** Overview of common occupational diseases prevalent in the mining	3

	industry. Discussion on the identification of exposure pathways and risk factors leading to occupational diseases. Strategies for prevention and control, including the use of personal protective equipment, ventilation systems, and monitoring techniques.	
Total hours		**15**

PROJECT		
1	Developing a plan of safety management system (SMS) for roof bolting operation in underground mining.	3
2	Hazard identification for the haul truck operation in a surface mining operation.	3
3	Occupational risk assessment (by HIRA method) for the machine processing stonemason.	3
4	Occupational risk assessment (by JHA method) for manual processing stonemason.	3
5	Health risk assessment for the workplace of drilling operator.	3
Total hours		**15**

TEACHING TOOLS USED

1	Informative lectures
2	Multimedia presentations
3	Didactic discussions forums
4	Consultations

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT

Evaluation (F – forming during semester), P – concluding (at semester end)	Learning outcomes code	Way of evaluating learning outcomesachievement
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 (arithmeticaverage of F1 and F2)

PRIMARY AND SECONDARY LITERATURE

1	*ILO Guidelines on occupational safety and health management systems, ILO–OSH 2001.*
2	*ILO code of practice: Safety and health in opencast mines*. International Labour Office, Geneva, 2018
3.	Mansdorf S.Z. (Ed.).(2019) Handbook of Occupational Safety and Health. 3rd edn. Wiley.
4.	Koradecka, D. (Ed.). (2010). Handbook of Occupational Safety and Health (1st ed.). CRC Press. https://doi.org/10.1201/EBK1439806845

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Zał. nr 5 do ZW 78/2023
Attachment no. 4. to the Program of Studies

FACULTY OF GEOENGINEERING, MINING AND GEOLOGY

SUBJECT CARD

Name in Polish: Modele Decyzyjne w Zarządzaniu
Name in English: Operations Research
Main field of study: Mining and Geology
Specialization: Mining Engineering,
Mineral Resource Exploration
Entrepreneurship, Innovation and Technology Integration in Mining
Profile: academic
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 COMPETENCIES

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 an 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

C1.2 Models of planning, deposits and costs of projects
C1.3 Queuing system models
C1.4 Digital simulation models

C2. Learning of qualitative understanding, interpretation and quantitative analysis with applications of selected issues concerning optimisation

C2.1. Production systems:
C2.2. Transport issues
C2.3. Flows in networks.
C2.4. Project schedules
C2.5. Queuing system models

C3. Acquiring and consolidating the competencies of thinking and acting in a systematic way.

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	Rules of participation in the course.	1
Le2	Introduction to modelling systems and optimization methods in decisions problems.	2
Le3	Linear Programming – fundamental principles. The application of LP in transportation issues and resource utilization.	2
Le4	Network programming (CPM and PERT). Planning and resource balancing in a project.	2
Le5	Simulation of random processes. Monte Carlo method.	2
Le6	Queueing theory and models of queueing systems.	2
Le7	Phases of simulation project and model building.	2
Le8	Digital twins – case analysis.	1
Le9	Final test.	1
	Total hours	**15**

Form of classes - laboratory		Number of hours
La1	Terms of participation in laboratory classes.	1
La2	Defining linear programming problems.	2
La3	Solving LP production optimization.	2
La4	Projects scheduling.	2
La5	Monte Carlo method. Models of queueing system.	2
La6	Simulation building: spatial layout and objects in the system.	2
La7	Processes defining in the model.	2
La8	Simulation experiments and results analysis.	2
	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. Office 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	PEU_U01-02	written test
F2	PEU_U03-04	report
P=(F1+F2)/2 (laboratory)	PEU_U01-04	
P (lecture)	PEU_W01-05 PEU_K01-02	written test

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

[1] Operations Research. Applications and Algorithms. 4th Edition. Winston W. Cengage Learning. 2022.
[2] Operations Research. Theory and Applications, 6th Edition, Sharma J. K. Trinity Press.
[3] Operations Research. Examples and Exercises. Kukuła i in. PWN. Warszawa. 2011.
[4] Simulation Modeling Handbook. A Practical Approach. Chung Ch. A. CRC Press. 2004.

SECONDARY LITERATURE

[1] Operations Research. An Introduction. 10th Edition. Taha H. A. Pearson Education Limited. 2017
[2] Operations Research, Yadav S.R. Malik A. Oxford University Press. 2014.
[3] A Review of Operations Research in Mine Planning. Newman et al. Interfaces 40(3). pp. 222-245. INFORMS. 2010.
[4] Modelling and Simulation Fundamentals. Theoretical Underpinnings and Practical Domains. Sokolowski J. A. Banks C. M. John Wiley & Sons. 2010.
[5] Discrete-Event System Simulation. Banks et al. Prentice-Hall. 2014.

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Zał. nr 5 do ZW 78/2023
Attachment no. 4. to the Program of Studies

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: Mining and Geology
Specialization: Mining Engineering,
Geotechnical and Environmental Engineering,
Geomatics for Mineral Resource Management
Mineral Resource Exploration
Entrepreneurship, Innovation and Technology Integration in Mining
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 rsults
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, competencies). 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 assignements
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)

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Zał. nr 5 do ZW 78/2023
Attachment no. 4. to the Program of Studies

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,
Entrepreneurship, Innovation and Technology Integration in Mining
Profile: academic
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

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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

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Semester 2
LUT

Lappeenranta-Lahti University of Technology LUT

Course title	Modelling of Unit Operations W06GIG-SM3056G		
European Credits (ECTS)	5	**Time (hours) given to the students**	60
Type (lecture, classes, laboratory, project, seminar)	lecture: 2h/week (2 ECTS), laboratory: 3h/week (3 ECTS), blended learning	**Student whole working time (hours)**	125
Description of content	Modeling and parameter estimation using Matlab in chemical engineering and applied mathematics in general. The course presents some of the most common unit operations of chemical engineering, including batch reactors, continuously stirred tank reactors (CSTRs), both in dynamic and steady-state; tubular plug flow reactors, flash distillations, and modelling of temperature dependence of reactions and elements of heat transfer. The models are limited to ones that do not require solving partial differential equations (PDEs).		
Intended Learning Outcomes	Knowledge Upon completion of the course, a student knows - Matlab software usage in chemical engineering and applied mathematics, - most common unit operations of chemical engineering, including batch reactors, continuously stirred tank reactors (CSTRs), both in dynamic and steady-state - tubular plug flow reactors, - flash distillations, and modelling of the temperature dependence of reactions and elements of heat transfer, - basic chemical processes in chemical engineering. Skills Upon completion of the course, a student is able to - describe steady-state and transient unit operations with mathematical models, - validate models and estimate their parameters from experimental data, - apply models in process development and design, including sizing, optimization, and scale-up, - use mathematical and simulation software.		
Assessment methods and criteria	Homework and class assignments as well as quizzes passed. No exam. Grades: 0-5. Half of the grade for the laboratory is decided by the share of exercises completed by the student, and the other half by the quality of the lab work reports and homework assignments. The course is built around practical laboratory work solved individually or in groups by the students. The lectures constitute the theoretical support for assignment reports and written quizzes during the semester. The lecture i.e. the ability to explain the unit operations of chemical engineering is checked with quizzes during the semester. The practical classes: the ability to analyze and apply these processes in real cases is tested with practical examples that are given both individually and in the group.		
Recommended readings	Lecture notes and links to supplementary material are given in Moodle (Sisu student tools https://sisu.lut.fi/student/courseunit/otm.....); selected examples from international literature. Online material.		
TU Coordinator	Arto Laari, Arto.Laari@lut.fi; Miracle Amadi, Miracle.Amadi@lut.fi; Tuomas Sihvonen, Tuomas.Sihvonen@lut.fi, Esko Lahdenperä, Esko.Lahdenpera@lut.fi,		

Course title	Advanced Process Design W06GIG-SM3057G		
European Credits (ECTS)	5	**Time (hours) given to the students**	75
Type (lecture, classes, laboratory, project, seminar)	lecture: 2h/week (1 ECTS), classes: 1h/week (2 ECTS), project: 2h/week (2 ECTS), blended learning	**Student whole working time (hours)**	125
Description of content	Chemical and physical properties, determination of chemical components in process simulation; Property estimation methods; Chemical process material and energy balances, sizing, costing, and economical evaluation; Process performance analysis, process evaluation, and optimization; Chemical process synthesis; Biorefinery process synthesis: objectives and steps; Synthesis of separation sequences; Energy integration in process design.		
Intended Learning Outcomes	Knowledge Upon completion of the course, a student knows - what kind of design activities are required during the process design, - and understands how product design and process design are related, - what is the design of processes: what it is aiming at and what are the steps, - and understands the role of modern simulation packages during the process life cycle. Skills Upon completion of the course, a student is able to: - apply simulation packages to support every step during process design, - validate models and estimate their parameters from experimental data, - apply models in process development and design.		
Assessment methods and criteria	Homework and class assignments as well as quizzes passed. No exam. Grades: 0-5. Group work and reports 50%, individual assignments 50%. The lecture: the ability to explain activities required during the process design is checked with quizzes during the semester. The practical classes: the ability to analyze and apply these processes in real cases is tested with practical examples that are given both individually and in the group.		
Recommended readings	Basic study material is delivered in Moodle (Sisu student tools https://sisu.lut.fi/student/courseunit/otm.....). Online material.		
TU Coordinator	Kristian Melin, Kristian.Melin@lut.fi; Nima Rezaei, Nima.Rezaei@lut.fi; Tuomas Koiranen, Tuomas.Koiranen@lut.fi,		

Course title	Research Methodology W06GIG-SM3058G		
European Credits (ECTS)	5	**Time (hours) given to the students**	60
Type (lecture, classes, laboratory, project, seminar)	lecture: 1h/week (1 ECTS), classes: 1h/week (2 ECTS), project: 2h/week (2 ECTS), blended learning	**Student whole working time (hours)**	125
Description of content	This course includes the use of scientific databases to find research results and knowledge including critical source assessment. The students make individual or group workshops on selected research topics where they find knowledge of what is known today and based on that formulate the knowledge gap and relevant objectives for the research they have in mind, identify the relevant scientific methods, and make their research plan to study a pre-selected topic. They understand how to process the results to find the facts. The presentation of the research results in a scientifically credible way is part of the course.		
Intended Learning Outcomes	Knowledge Upon completion of the course, a student knows - the use of scientific databases to find research results and the current knowledge, - and understands critical source assessment, - how to process the results to find the facts, - the basics of data analysis. Skills Upon completion of the course, a student is able to: - search for scientific knowledge - assess the reliability of different sources of knowledge and data, - make a research plan to reach the objectives, - make a design of experiments, - do the data analysis, - present the research results, - organize and carry out the workshop, - write a scientific report or article.		
Assessment methods and criteria	Homework and class assignments as well as quizzes passed. No exam. Grades: 0-5. Online lectures and exercises, Moodle assignments, personal and group assignments. Group work and reports 50%, individual assignments 50%. The lecture: the ability to explain activities required during the process design is checked with quizzes during the semester. The practical classes: the ability to analyze and apply these processes in real cases is tested with practical examples that are given both individually and in the group.		
Recommended readings	Basic study material is delivered in Moodle (Sisu student tools https://sisu.lut.fi/student/courseunit/otm.....). Online material. Lecture notes and links to supplementary material are given in Moodle; selected examples from international literature.		
TU Coordinator	Marja Talikka, Marja.Talikka@lut.fi; Nima Rezaei, Nima.Rezaei@lut.fi,		

Course title	Circular Economy for Materials Processing W06GIG-SM3059G		
European Credits (ECTS)	5	**Time (hours) given to the students**	60
Type (lecture, classes, laboratory, project, seminar)	lecture: 1h/week (1 ECTS), project: 2h/week (3 ECTS), seminar: 1h/week (1 ECTS), blended learning	**Student whole working time (hours)**	125
Description of content	Circular economy and resource efficiency are important aspects of sustainable development within the industry. The course aim is that students gain the skills needed to ensure that circular economy concepts become adopted into the design, development and operation of mainly metal production processes, during their application, end-of-life stage and recycling. Students carry out project work in groups. The topics are from industry, for example, side stream processing in the metal and steel producing industry, circular economy, and eco-design. Different aspects are emphasized in different projects, depending on the topic.		
Intended Learning Outcomes	Knowledge Upon completion of the course, a student knows - and understands basic concepts of circular economy, materials flow (raw materials, processing, manufacturing until end-of-life recycling and re-usage), issues and drivers for changes, - and recognizes the impacts (environmental, economic and social) of the current practice of materials processing from a sustainability aspect. Skills Upon completion of the course, a student is able to: - create new business opportunities to re-enter materials into the circular economy, - apply processing technologies to accelerate the implementation during business creation, - recognize the impacts (environmental, economic and social) of the current practice of materials processing from a sustainability aspect, - work as a team member in a development project.		
Assessment methods and criteria	Homework and class assignments as well as quizzes passed. Moodle exam (lecture). Grades: 0-5. Online lectures and exercises, Moodle assignments, personal and group assignments. The project class: group project work and meetings, and reports 70%, quizzes 30%. The seminar: presentation of the project work. The lecture: the ability to explain basic concepts of circular economy is checked with exam quizzes. The practical classes: the ability to adopt circular economy concepts into the design, development and operation of mainly metal production processes.		
Recommended readings	Basic study material is delivered in Moodle (Sisu student tools https://sisu.lut.fi/student/courseunit/otm-.....). Online material. Lecture notes and links to supplementary material are given in Moodle; selected examples from international literature, and data from the industry.		
TU Coordinator	Miia John, Miia.John@lut.fi,		

Course title	Technology and Innovation Management: Introduction W06GIG-SM3060G		
European Credits (ECTS)	3	**Time (hours) given to the students**	45
Type (lecture, classes, laboratory, project, seminar)	lecture: 1h/week (1 ECTS), classes: 2h/week (2 ECTS), blended learning	**Student whole working time (hours)**	75
Description of content	Innovation as a core business process. Innovative organisation. Development of technology and innovation strategy. Innovation networks. Decision-making in technological and market uncertainty. Creation of new products and services. Innovation performance and learning. Sustainability and innovation.		
Intended Learning Outcomes	Knowledge Upon completion of the course, a student knows - various methods of technology and innovation strategy, - the process of creation of new products and services, - and identifies as well as understands the main innovation and technology management concepts and their linkages to the innovation process, innovation and technology strategy and innovative organization management, - sustainability and innovation basics. Upon completion of the course, a student is able to: - analyze and design technology and innovation strategy of a company, - analyze the usability of various methods of innovation and technology, - recognize and apply the main innovation and technology management concepts to innovative organization management.		
Assessment methods and criteria	Homework and class assignments passed. Self-learning based on online materials and online assignments. Online exam (lecture). Grades: 0-5. Online lectures and exercises, Moodle assignments, personal and group assignments. The project class: group project work and meetings, and reports 100%). The lecture: the ability to explain basic concepts of innovation as a core business process. The practical classes: the ability to recognize and apply the main innovation and technology management concepts to innovative organization management.		
Recommended readings	Joe Tidd and John Bessant. Managing Innovation – Integrating Technological, Market and Organizational Change, 6th ed. (2018), (including e-learning material), or previous editions (2009, 2013). Online material. Moodle (Sisu student tools https://sisu.lut.fi/student/courseunit/otm ....).		
TU Coordinator	Ville Ojanen, ville.ojanen@lut.fi,		

Course title	Solid-Liquid Separation W06GIG-SM3061G		
European Credits (ECTS)	4	**Time (hours) given to the students**	60
Type (lecture, classes, laboratory, project, seminar)	lecture: 1h/week (1ECTS), classes: 1h/week (2 ECTS), lab: 2h/week (2 ECTS), blended learning, Distance learning is possible, except for laboratory work measurements	**Student whole working time (hours)**	100
Description of content	The topics are as follows: Fundamentals of solid-liquid separation, filtration methods, operation of filters, cake formation and washing, deliquoring, design and modelling of filters, and scale-up. Filter media and blinding. Experimental design in filtration test work.		
Intended Learning Outcomes	Knowledge Upon completion of the course, a student knows - the fundamental phenomena in solid-liquid separation, - different methods and equipment used for solid-liquid separation, - different filter media used in filtration, Skills Upon completion of the course, a student is able to: - select and size suitable equipment for separation processes based on suspension properties and data from laboratory tests, - explain the effects of the characteristics of the solid material and the liquid on the separation and post-treatment processes, - make a preliminary selection of a medium for different cases, - perform an experimental test on a laboratory scale, - write a scientific report.		
Assessment methods and criteria	Homework, laboratory work plus report, literature review, and class assignments passed. Moodle exam. Grades: 0-5. Lecture exam 60%, laboratory work and report 20%, literature review 20%. The lecture: the ability to explain the fundamental phenomena, methods, and equipment in solid-liquid separation is checked during the Moodle Exam. The practical classes: the ability to perform an experimental test on a laboratory scale and write a scientific report.		
Recommended readings	Basic study material is delivered in Moodle (Sisu student tools https://sisu.lut.fi/student/courseunit/otm.....). Online material.		
TU Coordinator	Antti Häkkinen, Antti.Hakkinen@lut.fi,		

ELECTIVE SUBJECTS
BLOCK I

Lappeenranta-Lahti University of Technology LUT

Course title	Artificial Inventiveness W06GIG-SM3070		
European Credits (ECTS)	3	**Time (hours) given to the students**	45
Type (lecture, classes, laboratory, project, seminar)	lecture: 1h/week (1 ECTS), project: 2h/week (2 ECTS), blended learning	**Student whole working time (hours)**	75
Description of content	It is an online course for all interested in creativity, in systematic tools of ideation. The modules contain basic TRIZ (Theory for Inventive Problem Solving) tools for idea generation. Have you ever thought about why it is hard to find a new idea sometimes? How to analyze the situation where you need an out of box solution? How to deliver the list of concepts to improve a product or a service? This self-paced course includes the following modules: Introduction, Function Definition, Ideal Final Result, Function-oriented Search, and Contradictions. This course is a brief introduction to creativity and idea generation with elements of theory, everyday life examples, and tests for self-check.		
Intended Intended Learning Outcomes	Upon completion of the course, a student is able to - identify inventive problems in the complex process of product development - apply several tools for systematic idea generation (Function modelling, Ideal final result, Function-oriented search, Contradictions analysis) - act step-by-step when creative and out-of-box ideas are needed		
Assessment methods and criteria	Video lectures and examples, assessment tests, and discussion forums. Homework and class assignments as well as quizzes passed. No exam. Grades: fail/pass. The course is built around practical problems solved individually. The lectures constitute the theoretical support for assignment reports and written quizzes during the semester.		
Recommended readings	Lecture notes and links to supplementary material are given in Moodle. Course videos are available on the CEPHEI platform.		
TU Coordinator	Anastasia Chakir, Anastasia.Chakir@lut.fi, Leonid Chechurin, Leonid.Chechurin@lut.fi,		

Course title	Entrepreneurship and Career Opportunities in Raw Material Sector W06GIG-SM3071		
European Credits (ECTS)	3	**Time (hours) given to the students**	45
Type (lecture, classes, laboratory, project, seminar)	lecture: 1h/week (1 ECTS), project: 2h/week (2 ECTS), blended learning	**Student whole working time (hours)**	75
Description of content	Most industrial sectors are facing a new era that requires companies to transform their operations, create new business models, and foster a digital culture. In this context, the industry is facing a changing talent landscape, necessitating new skill sets in their workforce. Companies need to ensure that their staff are properly constituted to support this transformation process. During the course, entrepreneurship skills as well as innovative thinking for engineers will be trained using examples from the raw material sector. Case studies will bring the understanding of skills and competencies of the future workforce and current trends of the industrial revolution.		
Intended Learning Outcomes	Knowledge Upon completion of the course, a student knows - and recognizes entrepreneurship and career opportunities in the raw material sector, - and understands the primary sector of the raw materials value chain (geology, mining, mineral processing, metallurgy, and the environment). Skills Upon completion of the course, a student is able to - apply design thinking tools to enhance the creativity and innovation capacity of engineers, - develop skills and competencies to improve the mindset of entrepreneurship.		
Assessment methods and criteria	Online lectures, workshops, exercises, design thinking training, assignments, self-study. Homework and class assignments as well as quizzes passed. No exam. Grades: pass/fail. Group work and individual assignments. 25% lectures and quizzes, 25% training, 25% workshop, 25% self-study.		
Recommended readings	Lecture notes, and articles related to the topics.		
TU Coordinator	Maria Mamelkina, Maria.Mamelkina@lut.fi,		

Course title	Sustainable Water Use W06GIG-SM3072		
European Credits (ECTS)	3	**Time (hours) given to the students**	45
Type (lecture, classes, laboratory, project, seminar)	lecture: 1h/week (1 ECTS), project: 2h/week (2 ECTS), blended learning	**Student whole working time (hours)**	75
Description of content	Sustainability challenges of water use. Water footprint. Water risk assessment. Water supply, water use in different sectors and loading of water systems. Wastewater treatment in industry and municipalities. Sludge treatment. Production of drinking water. Protection of groundwater deposits. Legislation on water quality and sludge treatment. Economic efficiency of different water treatment methods. Reclaimed water.		
Intended Learning Outcomes	Knowledge Upon completion of the course, a student knows - and defines the key concepts of water pollution control, - and recognizes the main factors affecting water footprint and sustainability of water use, - and explains the operation of essential process technology and equipment related to the control of water pollution, - and recognizes means to protect groundwater and reduce the environmental load of surface waters, - and understands methods for the environmentally friendly management of side-product flows from water treatment. Skills Upon completion of the course, a student is able to: - apply risk analysis methods related to water issues, - implement different methods for water footprint calculation, - compare and give grounded proposals for water treatment methods and processes applicable to different situations, - analyze the sustainability of water management systems.		
Assessment methods and criteria	Lectures, tutorials and independent exercises. Moodle assignments. Moodle quizzes. Homework and class assignments as well as quizzes passed. Grades: 0-5. Moodle quizzes 50%, assignment 50%. Possibility to get a higher grade by giving a presentation of a scientific article - 5 points.		
Recommended readings	handouts provided by the lecturer, course environment on Moodle, Tchobanoglous: Wastewater Engineering. Treatment and Reuse, 2003		
TU Coordinator	Heli Kasurinen, Heli.Kasurinen@lut.fi, Mariia Zhaurova, Mariia.Zhaurova@lut.fi, Risto Soukka, Risto.Soukka@lut.fi,		

Semester 3
WUST

Wroclaw University of Science and Technology WUST

Course title	Field Academy Student Project W06GIG-SM3064P		
European Credits (ECTS)	2	**Time (hours) given to the students**	45
Type (lecture, classes, laboratory, project, seminar	Project-Practical classes, fieldwork: 3h/week (2 ECTS)	**Student whole working time (hours)**	50
Description of content	The goal of the course is that students should acquire a hands-on understanding of different field research methodologies, and how they can be integrated with innovation and technology in mining. Innovative techniques such as UAV (drones), UGV (robots), VR, GIS-based data analyses, lidar imaging, hyperspectral method as well as InSAR methods and digitalization trends will be explored by students. The students will investigate companies (raw materials, geological, geodesy, mining, processing plants, municipal objects, IT companies) in view of innovative management and techniques implementation.		
Intended Learning Outcomes	Knowledge Upon completion of the course, a student knows - and understands trends of product-service systems and digital transformation affecting manufacturing business, - and defines, and explains the concepts related to product data management and product life cycle management, - and recognizes the company's product and service processes and understands their interaction with the company's overall operations, - and understands the primary sector of the raw materials value chain (geology, mining, mineral processing, and the environment), - innovative techniques, digitalization trends, and the concept of innovation and technology integration in the raw material sector. Skills Upon completion of the course, a student is able to - compare systems' characteristics, technical features, and managerial functions, - see their role in product development and business management, - create new business models, and foster a digital culture, - implement innovative techniques in the raw materials chain.		
Assessment methods and criteria	The course is mainly connected with practice work in the field, but also with complementary short lectures and exercises. The investigation results will be assessed together with the report and project.		
Recommended readings	The complementary/introductory material will be provided on Moodle. The students will be responsible for the content of the material.		
TU Coordinator	Anna Gogolewska, anna.gogolewska@pwr.edu.pl		

Wroclaw University of Science and Technology WUST

Course title	Industrial Research Internship Project W06GIG-SM3062P		
European Credits (ECTS)	2	**Time (hours) given to the students**	30
Type (lecture, classes, laboratory, project, seminar, internship)	Project classes: 2h/week (2 ECTS), (Practice)	**Student whole working time (hours)**	50
Description of content	The aim of the course is to enable students to work in responsible workplaces and apply their skills and knowledge to promote entrepreneurship, innovation, and technology integration in the raw material sector. The students are to become work-ready professionals, who can implement innovative technologies and efficient managerial issues. They will learn how to actively participate in the affairs of the community and promote public interest, equality, and solidarity. The students will face environmental and technological problems such as the degradation of land, air, and water quality as a result of industrial activities. Therefore the students will be familiarized with the necessity of transparency and accountability standards in the raw materials sector and the strategy to meet them. Moreover, they will be exposed to the lack of effective information flow between the companies and society. In industrial or R&D companies the students will develop and implement innovative solutions to technological or managerial problems observed.		
Intended Learning Outcomes	Knowledge Upon completion of the course, a student knows - and understands trends of product-service systems and digital transformation affecting manufacturing business, - and defines, and explains the concepts related to product data management and product life cycle management, - and recognizes the company's product and service processes and understands their interaction with the company's overall operations, - and understands the primary sector of the raw materials value chain (geology, mining, mineral processing, and the environment), - innovative techniques, digitalization trends, and the concept of innovation and technology integration in the raw material sector. Skills Upon completion of the course, a student is able to - compare systems' characteristics, technical features, and managerial functions, - see their role in product development and business management, - create new business models, and foster a digital culture, - engage in an informal professional discussion and business communication, - implement innovative techniques in the raw materials chain.		
Assessment methods and criteria	Submission and defense of a project report		
Recommended readings			
TU Coordinator	Supervisors of the student’s Master thesis		

Zał. nr 5 do ZW 78/2023

Attachment no. 4. to the Program of Studies

FACULTY OF GEOENGINEERING, MINING AND GEOLOGY

SUBJECT CARD

Name of subject in Polish: Zintegrowana analiza deformacji w geomechanice
Name of subject in English: Integrated Analysis of Deformations in Geomechanical Engineering
Main field of study: Mining and Geology
Specialization: Mining Engineering
Geomatics for Mineral Resources Management
Entrepreneurship, Innovation and Technology Integration in Mining
Profile: academic
Level and form of studies: 2nd level, full-time
Kind of subject: obligatory
Subject code: W06GIG-SM3063G
Group of courses: Yes

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30		30		
Number of hours of total student workload (CNPS)	75		50		
Form of crediting (Examination/crediting with grade)	Examination				
For group of courses mark (X) final course	X				
Number of ECTS points	5				
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)	2,9				

*delete as not necessary

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCIES

1. Introduction to Rock Mechanics
2. Basic knowledge about mining technologies
3. Fundamentals of monitoring of rock mass deformations

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SUBJECT OBJECTIVES

C1 Fundamental understanding of integrated analysis of deformations using the combination of monitoring and numerical modelling of deformations, which is essential for studying the processes occurring in engineering structures and in rock mass at the construction and post-construction stages.
C2 To understand the fully automated monitoring principles, data collection, and processing.
C3 Fundamental understanding of analysis of deformations, which is essential for studying the processes occurring in engineering structures and in rock mass at the construction and post-construction stages.

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge:

PEU_W01 Is able to distinguish and describe the applications of deformation monitoring techniques in the spectrum of engineering disciplines such as mining and construction engineering

PEU_W02 Is able to characterize the rock mass and mining methods

PEU_W03 Has knowledge of empirical and deterministic analyzes of rock mass deformations using FEM

PEU_W04 Has knowledge of the basics and applications of the analysis of the integrated deterministic method with the results of geodetic measurements

relating to skills:

PEU_U01 Is able to determine the main assumptions for geodetic measurement of deformations caused by mining exploitation

PEU_U02 Is able to create a FEM model

PEU_U03 Is able to perform integrated analysis using deterministic modelling by means of the FEM method and using the results of geodetic and geotechnical measurements

…

relating to social competencies:

PEU_K01 Is able to assess the role of monitoring and prediction in sustainable mining throughout its entire cycle

PROGRAMME CONTENT

	Lecture	**Number of hours**
Lec 1	Introduction: course syllabus, methods of evaluation of the learning outcomes, literature	2
Lec 2	Introduction to integrated analysis of deformations. Rock mass and earth mass material characteristics; determination of in-situ rock mass parameters;	2
Lec 3	The role of monitoring in sustainable mining.	2
Lec 4	Description of physical phenomena: statics - dynamics, heat propagation, fluid flow, changes in gravitational force, applications	2
Lec 5	Geodetic and geotechnical monitoring of deformations; deterministic modelling	2
Lec 6	Deformation Monitoring Surveys, design and implementation of geodetic deformation monitoring system. Short review of monitoring requirements and available monitoring techniques.	2
Lec 7	Advantages and disadvantages of geodetic and geotechnical methods. The concept of integrated analysis.	2
Lec 8	Solid mechanics, boundary conditions problem	2
Lec 9	Principles of integrated analysis of deformations; analysis based on system theory; analysis based on continuum mechanics; approximate methods for solving continuum problems; Finite Element Method (FEM);	2
Lec. 10	Solving truss systems in FEM	2
Lec. 11	Large scale problems in rock mechanics. Empirical and deterministic methods of surface deformations modelling in underground and open pit mining. Utilization of the Finite Element Method	2
Lec 12	Examples of utilization of integrated analysis for slope stability problems in open pit mines in Chile and USA	2
Lec 13	Examples of integrated analysis used to control surface deformations caused by underground salt mining in Canada	2

Lec. 14	Problems of oil and gas mining (Venezuela, Canada)	2
Lec 15	Wrap up: conclusions, final remarks	2
	Total hours	30
Classes		**Number of hours**
Cl 1		
Cl 2		
	Total hours	
Laboratory		**Number of hours**
Lab 1	Presentation of the course scope, literature and assessment methods	2
Lab 2	Analysis of the impact of load on the rock mass – application of the GeoStudio software	2
Lab 3	In-situ stress analysis of rock mass and loaded rock mass	2
Lab 4	Designing a geodetic measurement in a mining area for underground mining based on FEM results. Discussion of the measurement project.	2
Lab 5	Determination of the mining area category. Discussion of the project results	2
Lab 6	Designing a geodetic measurement in an open-pit mine based on the FEM model. Discussion of the measurement project.	2
Lab 7	Designing a geodetic measurement of an earth dam based on an FEM model. Analysis, discussion	2
Lab 8-11	Task 1: Determining the FEM of rock mass deformations caused by underground mining, determining the terrain category. Elastic and nonlinear analysis. Monitoring overview. Summary	8
Lab 12-15	Task 2: Determination of the FEM of the deformation of the earth mound/dam in conditions of variable water level. Determination of the safety factor using Geostudio software. Monitoring overview. Summary	8
	Total hours	30
Project		**Number of hours**
Proj 1		
	Total hours	
Seminar		**Number of hours**
Semin 1		
Semin 2		
	Total hours	

TEACHING TOOLS USED

N1. Lecture, film
N2. Individual problem solving with the use of software, teacher’s support
N3. Group discussion

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	PEK_W01- PEK_W03	Marks for laboratory assignments and tasks
P	PEU_W01 – PEU_W04, PEU_U01 – PEU_U03	Examination - final mark for Lecture Final mark for laboratory classes – average from assignments and tasks

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] Szostak-Chrzanowski, A., A. Chrzanowski,(2010), „INTEGETED ANALYSIS OF DEFORMATIONS IN GEOMECHANICS “, UNB, Fredericton, N.B., 220p.

SECONDARY LITERATURE:

[1] Szostak-Chrzanowski, A., A. Chrzanowski, M. Massiera (2005) “Use of deformation monitoring results in solving geomechanical problems – case studies “, Engineering Geology, vol. 79, Issues 1-2, pp. 3-12.

[2] Chrzanowski,A. (1993):"Modern Surveying Techniques for Mining and Civil Engineering" Chapter 33 in: Comprehensive Rock Engineering, Pergamon Press,Vol.3.Chapter 33, pp.773-809.

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

Prof. dr hab. inż. Anna Chrzanowska anna.chrzanowska@pwr.edu.pl

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 Lulea

Semester 1
WUST

Zał. nr 5 do ZW 78/2023

Attachment no. 4. to the Program of Studies

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 geoengineering 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

Zał. nr 5 do ZW 78/2023
Attachment no. 4. to the Program of Studies

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

Zał. nr 5 do ZW 78/2023
Attachment no. 4. to the Program of Studies

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

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	F1.1 Grade from laboratory work's performance and its merits F.1.2 Grade from laboratory work's oral or written defence P1.Final grade (weighted average of F1.1 - 60% and F1.2 - 40%).
F2, P2	PEK_U02-PEK_U04	F2.1 Grade from activity during the lecture (questions, discussions etc) F.2.2 Grade from written exam P2.Final grade (weighted average of F2.1 - 20% and F2.2 - 80%).

LITERATURE

PRIMARY LITERATURE:

[1] LabVIEWTM 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

Zał. nr 5 do ZW 78/2023
Attachment no. 4. to the Program of Studies

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 Lec.5 Lec.6	Environmental management systems: - Business Charter for Sustainable Development of the International Chamber of Commerce - ICC Business Charter for Sustainable	6

	Development - 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 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.	
Lec.7 Lec.8	Basic tools of environmental management: - 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) Examples of basic tools of environmental management: - 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	IT systems supporting environmental management: - Decision Support Systems - Expert systems - Simulation Models - Geographical Information Systems Selected types of information systems which support environmental management, their characteristics, examples of implementation both in Poland and in the world	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 Se3 Se4 Se5 Se6 Se7 Se8	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
	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, Bialystok,

[2] Lukasheh 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, Rzeszow

[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. PZIiTS, Poznan

[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. PZIiTS, AE, Poznan – 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

Zał. nr 5 do ZW 78/2023
Attachment no. 4. to the Program of Studies

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,
Geotechnical and Environmental Engineering,
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.

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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 _W0 3 – 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, monotype.	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 bimi 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, monotype)	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. N5Computer presentation of executed occupational risk assessments. N6Consultation.

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)

[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 (IMIĘ, NAZWISKO, ADRES E-MAIL)
Dr inż. Żaklina Konopacka

Zał. nr 5 do ZW 78/2023
Attachment no. 4. to the Program of Studies

FACULTY OF GEOIENGINEERING, MINING AND GEAOLOGY

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

C1.2 Models of planning, deposits and costs of projects
C1.3 Queuing system models
C1.4 Digital simulation models

C2. Learning of qualitative understanding, interpretation and quantitative analysis with applications of selected issues concerning optimization

C2.1. Production systems:
C2.2. Transport issues
C2.3. Flows in networks.
C2.4. Project schedules
C2.5. Queuing system models

C3. Acquiring and consolidating the competencies of thinking and acting in a system way.

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

PRIMARY LITERATURE

[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

SECONDARY LITERATURE

[1] Szapiro T., Decyzje menedżerskie z Excelem, PWE 2000
[2] Trzaskalik T., Modelowanie optymalizacyjne, Absolwent
[3] Trzaskalik T., Badania operacyjne z komputerem, PWE

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

Dr inż. Witold Kawalec
Dr hab. inż. Leszek Jurdziak
Dr inż. Zbigniew Krysa

Zał. nr 5 do ZW 78/2023
Attachment no. 4. to the Program of Studies

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.

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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 rsults
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 assignements
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.paszkowska@pwr.wroc.pl

Zał. nr 5 do ZW 78/2023
Attachment no. 4. to the Program of Studies

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	Principlesand Applicationsof 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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Jan Blachowski, jan.blachowski@pwr.edu.pl

Semester 2
LTU

EIT label – Teaching units <TIMREX – T-shaped Master Programme for Innovative Mineral Resource Exploration>

LTU

Course title	Geochemical Exploration					
European Credits (ECTS)	7.5		**Time (hours) given to the students**	105		
Type (Lecture, internship, exercise etc.)	Lectures: 3, Auditorium classes: , Lab. Classes: , Project classes: 3, Practical classes: 1.5, Seminar classes: , Fieldwork:		**Student whole working time (hours)**	187,5		
Description of content	The objective of course is that the students should aqcquire an advanced understanding basic geochemical processes that control geochemical anomalies and their application during exploration Distribution of trace metals in minerals Geochemical associations Mobility of elements at the earth surface Ion exchange and sorption Interpretation of geochemical anomaly data Practical examples in geochemical prospecting					
Learning outcomes of the curricular unit (knowledge, skills and competences to be developed by the students)	Knowledge: After completing the course, the student should be able to demonstrate knowledge and understanding of: - basic geochemical processes that control geochemical anomalies - controls on the distribution of trace elements in minerals - common geochemical associations - mobility of elements at the Earth surface - ion exchange and sorption Skills: After completing the course the student should be able to - define geochemical anomalies - analyse, explain and apply the basic geochemical processes that control geochemical anomalies - apply geochemical data for mineral exploration Competences: ,					
Assessment methods and criteria	Assignment report I (Group) 3.0, Assignment report II (Individually) 1.5, Written exam 3.0 The course is built around practical field examples from geochemical prospecting which are solved individually or in groups by the students. In these examples are the fundamental geochemical principles and processes, which creates geochemical anomalies, discussed. The lectures constitute the theoretical support for assignment reports and the written exam. The ability to explain the geochemical processes that create anomalies is checked with a written exam at the end of the course (grade 3, 4, 5).The ability to analyse and apply these processes on real cases are tested with practical examples that are given both individually and in group.					
Recommended readings	Choosen examples from international literature.					
TU Coordinator	Anders Widerlund, Anders.Widerlund@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 /**	**OLO6 Leadership**

					Sustainability	
					Complex evaluation of exploration datasets with the need to satisfy environmental, legal and economic requirements	Students should compile a sampling plan during the course, to be able to lead a geochemical sampling campaign
Justification for OLO contribution						

EIT label – Teaching units <TIMREX – T-shaped Master Programme for Innovative Mineral Resource Exploration>

Course title	Mining Geology		
European Credits (ECTS)	7.5	**Time (hours) given to the students**	120
Type (Lecture, internship, exercise etc.)	Lectures: 4, Auditorium classes: , Lab. Classes: , Project classes: 2.5, Practical classes: 1, Seminar classes: , Fieldwork:	**Student whole working time (hours)**	187,5
Description of content	The purpose of the course is that the students should acquire an advanced understanding of the ore and mineral deposits' investigation and evaluation. During the course, students work with various aspects in the value chain of mining projects and advanced exploration projects, from modelling mineral resources from geological data before mining, to the process of converting mineral resources to mineral reserves by applying modifying factors, to the mining geological methods used for further characterization and evaluation of deposits in connection with mining.		
Learning outcomes of the curricular unit (knowledge, skills and competences to be developed by the students)	Knowledge: After completing the course, the student should be able to demonstrate knowledge and understanding of: - how mineral resources are modelled from geological and assay data in 3D - cut-off theory and its effect on size and grade of mineral resources - geostatistics and its application during resource estimation - the difference in confidence level between inferred, indicated and measured resources - the modifying factors which affect conversion of mineral resources to mineral reserves - the importance of different strategies for grade control and mine mapping in operating mines Skills: The student should be able to model the grade and tonnage of mineral deposits based on geological data in a 3D environment. The student should be able to explain how cut-off affects the size and grade of mineral resources and be able to use basic geostatistical methods for calculation of average content in drill cores and profiles based on grade, length and density data. The student should be able to account for the difference in confidence level between inferred, indicated and measured mineral resources, as well as their distinction from mineral reserves. This includes the ability to explain how various modifying factors such as choice of mining methods, processing methods, metallurgical factors, environmental factors, social factors, legal factors and economic factors affect the feasibility of a mining project. The student should be able to critically analyze technical reports from mining and exploration projects with regard to how well they meet the requirements set by international industry standards for reporting mineral resources. The student should be able to account for different strategies for grade control and mining mapping, and be able to choose methods based on the deposit geology and the mining method. The student should be able to collect geological information from mines to characterize ore boundaries and geological structures, and use this information to make estimates of dilution in active production environments. Competences: ,		
Assessment methods and criteria	Written exam G U 3 4 5 4.00 Project work G U 3 4 5 2.50 Exercises U G# 1.00 The subject is presented in the form of class lectures by several lecturers. In-depth study of the subject takes place through individual student projects based on a literature study of technical reports from mining projects and advanced exploration projects, written presentation, and group discussions in seminar form. Practical skills are trained through exercises in mineral resource estimation methodology on paper and in software, calculation of ore sections, mining mapping, grade control and delineation of ore contacts. The exercises will be partly linked to lectures performed in parallel. Document management takes place in the learning platform CANVAS		

	Written exam is given with differentiated grades. Grading scale: 5 4 3 U. In order to pass the course, it is also required that the student complete and report practical assignments and individual project work, and get these improved by the examiner. Reports that have not met the set quality requirements within one week after the end of the current reading period means that the grade has failed for the practical part. The practical part in its entirety may then be carried out at a future course opportunity, provided that vacant spots are available.					
Recommended readings	Evans, Whateley & Moon. Introduction to Mineral Exploration, Blackwell, 2006.					
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**
	The course covers the core legal and economic concepts of a mineral resource project from the operator's / entrepreneur's perspective, via active involvement of mining professionals in teaching and practicals on resource estimation, grade control and mine mapping.			The importance of social license to operate and stakeholder engagement is adressed in the context of the modifying factors for converting resources to reserves. Co-reading with multi-national students from the Emerald program including a seminar on the topic ensure a large diversity in terms of student background.	Students should be able to conduct a critical assessment on an advanced exploration project or a mining project, utilizing publically available technical reports within the NI43-101, JORC or PERC standard. This involves a critical assessment of the key strenths and weaknesses of projects with regards to modifying factors.	
Justification for OLO contribution						

EIT label – Teaching units <TIMREX – T-shaped Master Programme for Innovative Mineral Resource Exploration>

Course title	Senior Design Project in Ore Geology		
European Credits (ECTS)	7.5	**Time (hours) given to the students**	120
Type (Lecture, internship, exercise etc.)	Lectures: , Auditorium classes: , Lab. Classes: , Project classes: 7.5, Practical classes: , Seminar classes: , Fieldwork:	**Student whole working time (hours)**	187,5
Description of content	The goal of the course is that the student independently shall design, carry out and report a scientific project within the subject. The project theme shall be chosen in cooperation with the examiner and be related to modern research and development.		
Learning outcomes of the curricular unit (knowledge, skills and competences to be developed by the students)	Knowledge: Skills: Competences: ,		
Assessment methods and criteria	Passed oral and written presentation G U 3 4 5 7.50 The student shall gather data/information and present these both written (report) and orally (presentation). The student will work independently with guidance from the examiner or an appointed supervisor. A topic is selected from discussion between the examiner and the student, and thereafter the student works independently with the topic. The topic is reported in a written report and an oral presentation. The course goal of design, carry out and report a scientific project is examined through a written and oral reporting of the chosen topic.		
Recommended readings	Depends on the project choosen, and will therefor be decided later.		
TU Coordinator	Glenn Bark, Glenn.Bark@ltu.se		

	OLO 1 Entrepreneurship	**OLO2 Innovation**	**OLO3 Creativity**	**OLO4 Intercultural**	**OLO5 Value judgments / Sustainability**	**OLO6 Leadership**
Contribution to EIT's Overarching Learning Outcomes (tick relevant box/es)*			Students are motivated to choose multidisciplinar topics wherein theoretical frameworks and methodologies from several subjects can be integrated.			

Justification for OLO contribution	

Course title	Exploration		
European Credits (ECTS)	7.5	**Time (hours) given to the students**	105
Type (Lecture, internship, exercise etc.)	Lectures: 5, Auditorium classes: , Lab. Classes: , Project classes: 1.5, Practical classes: 1, Seminar classes: , Fieldwork:	**Student whole working time (hours)**	187,5
Description of content	The goal of the course is that students should acquire an advanced understanding of geological, geochemical and geophysical exploration methodologies, factors and trends controlling metal prices, and mapping and sampling methodologies. Commodity prices and market mechanisms. Exploration strategy. Geological, geophysical and geochemical exploration methods. Drilling methods and drilling programs. Logging of drill cores. Sampling and mapping methods. Laws and regulations. Ongoing exploration projects in Sweden and case stories.		
Learning outcomes of the curricular unit (knowledge, skills and competences to be developed by the students)	Knowledge: After completing the course, the student should be able to demonstrate knowledge and understanding of: - factors controlling metal prices and long-term trends in exploration and ore extraction. - strategies for selecting target areas in exploration and the importance of local conditions. - geological, geophysical and geochemical exploration methods and how they are used at different stages of an exploration campaign. - different drilling methods, logging and sampling of drill cores and planning of drilling programs during exploration. - methods for mapping and sampling of outcrops in field. - preparation for field work and following-up work in exploration projects, laws and regulations related to exploration, evaluation and reporting of exploration results. - ongoing exploration projects in Sweden. Skills: After completing the course, the student should also be able to - propose exploration methods for different types of ores based on available geological data - conduct mapping and sampling of outcrops in the field - integrate various types of geological, geochemical, and geophysical data for target generation - conduct exploration activites within the legal framework set by Swedish law Competences: ,		
Assessment methods and criteria	Exercises U G# 1.00 Written exam G U 3 4 5 5.00 Project work G U 3 4 5 1.50 Lectures presenting and explaining basic theory and practical applications including use of ore-related alterations, field mapping and sampling, and drill core logging. Oral presentation of a project work that includes identification of a target area for exploration, application for an exploration permit and planning of an exploration campaign. Graded written exam and project work. Approved practical exercise with written report.		
Recommended readings	Evans, Whateley & Moon. Introduction to Mineral Exploration. Blackwell, 2006.		

EIT label – Teaching units <TIMREX – T-shaped Master Programme for Innovative Mineral Resource Exploration>

TU Coordinator	Olof Martinsson, Olof.Martinsson@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**
	Students should be able to demonstrate an advanced understanding of geological, geochemical and geophysical exploration methodologies, factors and trends controlling metal prices, and mapping and sampling methodologies, and how these impact on exploration strategies.	Project-type practical exercise stimulates the creativity of the students to synthetize multi-component dataset for targeting mineral deposits, using state-of-the-art exploration models		Complex evaluation of exploration datasets with the need to satisfy environmental, legal and economic requirements		
Justification for OLO contribution						

Semester 3
WUST/LTU

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 excercises, 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**

Justification for OLO contribution	

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	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. EDUCATIONAL GOALS: 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. EXAMPLES OF SOCIAL AND CIVIC ISSUES IN MINERALS INDUSTRIES: • 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)	Knowledge: to understand that social responsibility incorporates an ethical, social and environmentally-friendly perspective to our personal and professional activities Skills: To be able to engage in an informal professional discussion and business communication Competences: To cope with complexity, uncertainty and change in global contexts		

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						

<table>
<tr><td>Course title</td><td colspan="3">Exploration entrepreneurship</td></tr>
<tr><td>European Credits (ECTS)</td><td>4</td><td>Time (hours) given to the students</td><td>60</td></tr>
<tr><td>Type (Lecture, internship, exercise etc.)</td><td>Lectures: 1, Auditorium classes: , Lab. Classes: , Project classes: 1, Practical classes: 3, Seminar classes: 2, Fieldwork:</td><td>Student whole working time (hours)</td><td>100</td></tr>
<tr><td>Description of content</td><td colspan="3">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.
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.
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.
OBJECTIVES OF THE MODULE:
• 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)
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.
• 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.</td></tr>
</table>

	• **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.
Learning outcomes of the curricular unit (knowledge, skills and competences to be developed by the students)	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. 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. 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.
Assessment methods and criteria	Practical mark 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. Slack channel will allow for student-mentor exchange and networking within the whole cohort of participants. Mentoring is a one-to-one relationship between a mentor and a student. • 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. Mentoring is a reciprocal process of "give and take". Both sides learn from each

	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.
Recommended readings	Mentoring Mindset, Skills and Tools 4th Edition: Make it easy for mentors and students, 2020, Synergetic People Development Pty Ltd, 252 pages, ISBN 0980356458 The Mentoring Guide: Helping Mentors and Students Succeed, 2019, Michigan Publishing Services, ISBN: 1607855399. 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 Entrepreneurship: A Guide To Success For Entrepreneurs And Aspiring Entrepreneurs, 2018, ISBN 978-1720221654 Entrepreneurship: Successfully Launching New Ventures, Global Edition, 2018, Pearson, ISBN: 9781292255330
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:
MINING ENGINEERING

1-st Semester

Semestr 1

Zał. nr 5 do ZW 8/2020
Załącznik nr … do programu studiów

WYDZIAŁ **Geoinżynierii, Górnictwa i Geologii**

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim Wspomagane komputerowo modelowanie geologiczne i geostatystyka. ….(zajęcia są prowadzone w języku angielskim)

Nazwa przedmiotu w języku angielskim Computer Aided Geological Modelling and Geostatistics…….

Kierunek studiów (jeśli dotyczy): Górnictwo i geologia.

Specjalność (jeśli dotyczy): Mining Engineering,
Geotechnical and Environmental Engineering,
Geomatics for Mineral Resource Management

Poziom i forma studiów: II stopień, stacjonarna

Rodzaj przedmiotu: obowiązkowy *

Kod przedmiotu W06GIG-SM0038

Grupa kursów NIE*

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)	15		45		
Liczba godzin całkowitego nakładu pracy studenta (CNPS)	30		120		
Forma zaliczenia	~~Egzamin /~~ zaliczenie na ocenę*	Egzamin / zaliczenie na ocenę*	~~Egzamin /~~ zaliczenie na ocenę*	Egzamin / zaliczenie na ocenę*	Egzamin / zaliczenie na ocenę*
Dla grupy kursów zaznaczyć kurs końcowy (X)					
Liczba punktów ECTS	**1**		4		
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)			4		
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)	1		2		

*niepotrzebne skreślić

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

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

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CELE PRZEDMIOTU

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.

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

Z zakresu wiedzy:
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.
Z zakresu umiejętności:
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

Z zakresu kompetencji społecznych:
PEK_K01 The student can think and act in a creative and enterprising way

TREŚCI PROGRAMOWE		
Forma zajęć - wykład		**Liczba godzin**
Wy1	Introduction to the course. Geological database and validation of the geological data.	2
Wy2	Geology of the seam.	2
Wy3	Structural model of the stratified deposit. Methods of the prediction of the surface layer parameters.	2
Wy4	Spatial distribution of samples values. Regionalized variable.	2
Wy5	BLUE Estimator of the mean value: Kriging.	2
Wy6	Quality model of the deposit – block model of the parameter layers. Estimation and evaluation of the block model.	2
Wy7	Reserves modelling and evaluation.	2
Wy8	Mineral resources. International reporting. The JORC Code	1
	Suma godzin	**15**

Forma zajęć - ćwiczenia		**Liczba godzin**
Ćw1		
Ćw2		
Ćw3		
Ćw4		
..		
	Suma godzin	0

Forma zajęć - laboratorium	**Liczba godzin**

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 estimation procedure.	3
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
	Suma godzin	45

Forma zajęć - projekt		Liczba godzin
Pr1		
Pr2		
Pr3		
Pr4		
…		
	Suma godzin	**0**

Forma zajęć - seminarium		Liczba godzin
Se1		
Se2		
Se3		
…		
	Suma godzin	0

STOSOWANE NARZĘDZIA DYDAKTYCZNE

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.

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ

Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
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		

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA

LITERATURA PODSTAWOWA:

[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.

LITERATURA UZUPEŁNIAJĄCA:

[10] Handouts, tutorials.

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

Dr inż. Krzysztof Hołodnik
Dr inż. Witold Kawalec, Dr Paweł Zagożdżon

Zał. nr 5 do ZW 8/2020
Załącznik nr … do programu studiów

WYDZIAŁ GEOINŻYNIERII, GÓRNICTWA i GEOLOGII

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim Geofizyka inżynierska
….(zajęcia są prowadzone w języku angielskim)
Nazwa przedmiotu w języku angielskim Engineering Geophysics
Kierunek studiów (jeśli dotyczy): górnictwo i geologia
Specjalność (jeśli dotyczy): Mining Engineering,
Geotechnical and Environmental Engineering,
Geomatics for Mineral Resource Management
Poziom i forma studiów: ~~I~~/ II stopień / ~~jednolite studia magisterskie~~*, stacjonarna / ~~niestacjonarna~~*
Rodzaj przedmiotu: ~~obowiązkowy~~ / wybieralny / ~~ogólnouczelniany~~ *
Kod przedmiotu W06GIG-SM0040
Grupa kursów ~~TAK~~ / NIE*

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)	15			15	
Liczba godzin całkowitego nakładu pracy studenta (CNPS)	40			50	
Forma zaliczenia	~~Egzamin~~ / zaliczenie na ocenę*			~~Egzamin~~ / zaliczenie na ocenę*	
Dla grupy kursów zaznaczyć kurs końcowy (X)					
Liczba punktów ECTS	1			2	
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)				2	
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)				2	

*niepotrzebne skreślić

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

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.

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CELE PRZEDMIOTU

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.

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

Z zakresu wiedzy:

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.

Z zakresu umiejętności:

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 geoengineering 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.

Z zakresu kompetencji społecznych:

PEU_K02 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.

TREŚCI PROGRAMOWE		
Forma zajęć - wykład		**Liczba godzin**
Wy1	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
Wy2	Engineering problems solved with geophysical surveying. Case studies.	2
Wy3	Electrical resistivity methods. Tomography and VSE. IP method. Physical principles. Equipment. Methods of field surveying. Interpretation and application. Case studies.	2
Wy4	Electromagnetic methods. FDEM and TDEM methods. Magnetotelluric methods. Physical principles. Methods of field surveying. Equipment. Interpretation and application. Case studies.	2
Wy5	GPR surveying. Physical principles. Methods of field surveying.	2

	Equipment. Interpretation and application. Case studies.	
Wy6	Seismic tomography. Seismic interferometry. Physical principles. Applications. Case studies.	2
Wy7	Mine geophysics. Seismology. Seismic methods. Active and passive seismic tomography. Microgravimetry. Case studies.	2
Wy8	Gravity and magnetic surveying. Equipment. Methods of field surveying. Interpretation and application. Case studies.	2
	Suma godzin	**15**

Forma zajęć - projekt		**Liczba godzin**
Pr1	One selected geophysical technique. Fundamentals and equipment. Field surveying	4
Pr2	Processing and interpretation of field data.	3
Pr3	Solving the geophysical problems.	8
	Suma godzin	**15**

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

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ

Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
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.

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA

LITERATURA PODSTAWOWA:

[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).

LITERATURA UZUPEŁNIAJĄCA:

[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.

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

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

Zał. nr 5 do ZW 8/2020
Załącznik nr … do programu studiów

WYDZIAŁ **Geoinżynierii, Górnictwa i Geologii**

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim Projektowanie wyrobisk w górnictwie odkrywkowym ….(zajęcia są prowadzone w języku angielskim)
Nazwa przedmiotu w języku angielskim Excavation Design in Open Pit Mining
Kierunek studiów (jeśli dotyczy): Górnictwo i geologia.
Specjalność (jeśli dotyczy): Mining Engineering, Geotechnical and Environmental Engineering,
Poziom i forma studiów: II stopień, stacjonarna
Rodzaj przedmiotu: obowiązkowy *
Kod przedmiotu W06GIG-SM0068
Grupa kursów NIE*

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)	30			15	
Liczba godzin całkowitego nakładu pracy studenta (CNPS)	120			30	
Forma zaliczenia	Egzamin / ~~zaliczenie na ocenę*~~	Egzamin / zaliczenie na ocenę*	Egzamin / zaliczenie na ocenę*	~~Egzamin~~ / zaliczenie na ocenę*	Egzamin / zaliczenie na ocenę*
Dla grupy kursów zaznaczyć kurs końcowy (X)					
Liczba punktów ECTS	**3**			2	
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)				2	
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)	2,5			1,5	

*niepotrzebne skreślić

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. Possesses fundamental knowledge of widely concerned mining, as one of the most important fields of technology and human activity, knows problems related to minerals search, sharing and mining.
2. Possesses knowledge of basic concepts of geology and systematized knowledge regarding resources and minerals mining in Poland.
3. Is able to use Microsoft Office to prepare Word documents and work with the spreadsheet Excel. Is able to use AutoCad, Microstation or similar.

CELE PRZEDMIOTU

C1 Introduction and explanation of problems related to technology of mechanized mining machines

of different types and size used in open pit mining.
C2 Becoming familiar with the relationships between parameters characterizing the geometry of the workplace and the process of digging, controlling machine work process in order to achieve the proper efficiency level and forecasting the efficacy in different geological -mining conditions.
C3 Preparing students to particular tasks completion in the area of work technology and the choice of technological system for the project of excavation and carrying out technological analysis of bucket-wheel excavator work.

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

Z zakresu wiedzy:
K2_GIG_W07 ma wiedzę w zakresie procesów i technologii stosowanych w przemyśle wydobywczym i przetwórczym surowców mineralnych

Z zakresu umiejętności:
K2_GIG_U01 - dysponuje odpowiednimi dla języka specjalistycznego środkami językowymi i potrafi używać języka specjalistycznego we wszystkich działaniach językowych, aby porozumiewać się w środowisku zawodowym w zakresie studiowanego kierunku studiów
K2_GIG_U07 – potrafi zaprojektować systemy technologiczne stosowane w przemyśle wydobywczym lub przetwórczym surowców mineralnych

Z zakresu kompetencji społecznych:
K2_GIG_K01 potrafi myśleć i działać w sposób kreatywny i przedsiębiorczy

TREŚCI PROGRAMOWE		
Forma zajęć - wykład		**Liczba godzin**
Wy1	The aim of the course, conditions of crediting, literature, contact with the teacher. Basic concepts, definitions related to open pit exploitation of deposits, basic technological systems	3
Wy2	Basic technologies of open pit exploitation (continuous, cycle, mixed), the ways off dredging and exploitation	2
Wy3	Bulldozers work technologies, the range of applications, divisions. Efficiency work forecasting of bulldozers, the resistance movement, cooperation with the base.	2
Wy4	Single and bucket-wheel excavator work technologies, the range of applications, divisions according to different criteria.	3
Wy5	Efficiency work forecasting of a bucket-wheel excavator using chosen methods, the resistance movement, cooperation with the base.	2
Wy6	Scraper work technologies, basic parameters, the range of applications, division, efficacy	2
Wy7	Ripper work technologies basic parameters, the range of applications, division, efficacy	2
Wy8	Loader spoon work technologies the range of applications, division, efficacy	2
Wy9	Multi-bucket-wheel excavator work technologies, basic parameters,	2

	the range of applications, division, and work principles	
Wy10	Multi-bucket-wheel excavator work technologies, types of shortwalls.	2
Wy11	Efficiency work forecasting of multi-bucket-wheel excavators, digging resistance, cooperation with the base	2
Wy12	Multi-bucket-chain excavators work technologies.	2
Wy13	Efficiency work forecasting of a multi-bucket-chain excavators, digging resistance, cooperation with a base.	2
Wy14	Heaping in open pit mining, types of heaps, KTZ. Heaping with the method of direct tossing.	2
	Suma godzin	**30**

Forma zajęć - projekt		**Liczba godzin**
Pr1	Organization classes. The scope of the Project, conditions of crediting, literature. Distribution of topics among students. Discussing the guidelines for the project titled: The excavation project, bulldozer and excavator work technology. Discussing the first stage of the project task, determining mining area and also the issue of the multilevel excavation embankment design on the slope	2
Pr2	Discussing the guidelines to the choice of a bulldozer as a machine which enables an access to the deposit. Discussing issues related to an overlay indirect heaping in the excavation neighbourhood and the bulldozer work efficiency forecast	2
Pr3	Discussing the choice of excavator as a basic machine used for mineral dredging, designing the division of an excavation into floors, forecasting and its cooperation with car transport.	2
Pr4	Students hand over projects- assessment and defence. Discussing the scope of project 2. Distribution of individual topics among students. Discussing the guidelines for the project: “Technological analysis of bucket-wheel excavator…”	2
Pr5	The core of shortwall system, discussing basic parameters of a shortwall, defining the dredging radius and the angle of inclination of dredging jib in the function of dredging height and limit angles of the inclination of the side embankment of a shortwall in the function of its height. Determining maximum distance of an axis of an excavator route from internal side embankment.	2
Pr6	Discussing the outer bottom width of a shortwall. Determining the width of a shortwall.	2
Pr7	Determining two maximum values of a take: considering the slope of the forehead embankment because of the ability to drive to the forehead of shortwall and because of the possibility of the contact of a dredging jib structure with the upper edge of the second level in a shortwall. Determining the angle of inclination of the jib structure axis in the function of the height of a bucket wheel axis and also the angle describing the dimension of a lower piece of a dredging jib structure. Forecasting the SRs efficacy considering particular groups of factors, determining the individual digging resistance and digging force in given geological-mining conditions. The final calculations concerning	2

	side and forehead shortwalls, discussing the graphic form of a project.	
Pr8	Student hand over Project – assessment	1
	Suma godzin	**15**

STOSOWANE NARZĘDZIA DYDAKTYCZNE
N1. Wykład z prezentacją multimedialną N2.Dyskusja. Rozwiązywanie przykładowych zadań N3. Konsultacje i indywidualna ocena projektów

Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1, P1	K2_GIG_U07 K2_GIG_U01 K2_GIG_K01	F1.1 Ocena z wykonania i wartości merytorycznej projektu F.1.2 Ocena z obrony ustnej lub/i pisemnej projektu P1 Ocena końcowa z projektu nr 1 (średnia ważona z F1.1- 50% oraz F1.2 – 50%)
P2	K2_GIG_W07 K2_GIG_U07 K2_GIG_K01	P2 O cena końcowa z egzaminu w formie ustnej lub sprawdzianu pisemnego

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA

LITERATURA PODSTAWOWA:

[1] Kasztelewicz, Z. (2012). Koparki wielonaczyniowe i zwałowarki taśmowe. Technologia pracy, AGH Publishing House.

[2] Hustrulid, W. A., Kuchta, M., & Martin, R. K. (2013). Open pit mine planning and design, two volume set & CD-ROM pack. CRC Press.

[3] Gogolewska, A. Surface and underground Mining Technology. Wrocław 2011

[4] Kasztelewicz, Z., Patyk, M., & Bodziony, P. (2015). Spycharki, dźwigi boczne i przesuwarki przenośników taśmowych. Budowa i technologia pracy, AW-P ART-TEKST, Kraków.

[5] Hawrylak H., Jarząbek M., Sieczyński A., Sobolski R. MASZYNY I PRACE POMOCNICZE W GÓRNICTWIE ODKRYWKOWYM

[6] Glapa W., Korzeniowski J.I., MAŁY LEKSYKON GÓRNICTWA ODKRYWKOWEGO, Wydawnictwa i Szkolenia Górnicze Burnat & Korzeniowski, Wrocław 2005

[7] Korzeniowski J.I.: GÓRNICTWO ODKRYWKOWE : RUCH ZAKŁADÓW EKSPLOATUJĄCYCH ZŁOŻA KOPALIN, 2010

[8] Bęben A.: MASZYNY I URZĄDZENIA DO WYDOBYWANIA KOPALIN POSPOLITYCH BEZ UŻYCIA MATERIAŁÓW WYBUCHOWYCH. Kraków : AGH Uczelniane Wydawnictwa Naukowo-Dydaktyczne, 2008

LITERATURA UZUPEŁNIAJĄCA:

[1] Czasopisma: Mining Science, Journal of mining science, Węgiel brunatny, Górnictwo Odkrywkowe

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

Dr hab. inż. JUSTYNA WOŹNIAK , prof. uczelni
Dr inż. Anna Nowak-Szpak

Zał. nr 5 do ZW 8/2020
Załącznik nr … do programu studiów

WYDZIAŁ GEOINŻYNIERII, GÓRNICTWA I GEOLOGII

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim: Zintegrowana analiza deformacji w geomechanice…….(zajęcia są prowadzone w języku angielskim)

Nazwa przedmiotu w języku angielskim: Integrated Analysis of Deformations in Geomechanical Engineering

Kierunek studiów (jeśli dotyczy): górnictwo i geologia

Specjalność (jeśli dotyczy): Geomatics for Mineral Resources Management

Poziom i forma studiów: ~~I~~ **/ II stopień /** ~~**jednolite studia magisterskie**~~**, stacjonarna /** ~~**niestacjonarna***~~

Rodzaj przedmiotu: ~~**obowiązkowy**~~ **/ wybieralny /** ~~**ogólnouczelniany**~~ *****

Kod przedmiotu **W06GIG-SM0041G**

Grupa kursów ~~**TAK**~~ **/ NIE***

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)	30		30		
Liczba godzin całkowitego nakładu pracy studenta (CNPS)	90		60		
Forma zaliczenia	Egzamin / ~~zaliczenie na ocenę*~~		~~Egzamin~~ / zaliczenie na ocenę*		
Dla grupy kursów zaznaczyć kurs końcowy (X)					
Liczba punktów ECTS	5				
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)	3		2		
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)	2,5		1,5		

*niepotrzebne skreślić

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. Podstawowa wiedza z zakresu goemechaniki
2. Podstawową wiedza dotycząca eksploatacji górniczej
3. Podstawowa wiedza monitorowania zmian górotworu

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CELE PRZEDMIOTU

C1 Przedstawienie roli monitorowania w górnictwie zrównoważonym

C2 Przygotowanie i przeprowadzenie analizy deformacji górotworu spowodowanych działalnością górniczą

C3 Przygotowanie i przeprowadzenie analizy deformacji zapór i usypisk ziemnych
C4 Nauczenie zasad modelowania MES
C5 Nabycie umiejętności wykorzystania analizy zintegrowanej wykorzystując modelowanie deterministyczne MES i wyniki pomiarów geodezyjnych i geotechnicznych

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

Z zakresu wiedzy:
PEU_W01 Potrafi rozróżnić i opisać zastosowania technik monitorowania deformacji w sPEUtrum dyscyplin inżynieryjnych takich jak górnictwo i inżynieria budowlana
PEU_W02 Potrafi scharakteryzować górotwór i metody górnicze
PEU_W03 . Posiada wiedzę z zakresu analiz: empirycznych i deterministycznych z zastosowaniem FEM deformacji górotworu,
PEU_W04 . Posiada wiedzę podstaw i zastosowań analizy zintegrowanej metody deterministycznej z wynikami pomiarów geodezyjnych
PEU_W05 . Potrafi wyznaczyć główne założenia pomiaru geodezyjnego deformacji wywołanych eksploatacja górniczą
PEU_W06 Ma znajomość przygotowania modelu MES
Z zakresu umiejętności:

Z zakresu kompetencji społecznych:
PEU_K01 Potrafi ocenić rolę monitorowania i predykcji w górnictwie zrównoważonym w całym jego cyklu

TREŚCI PROGRAMOWE		
Forma zajęć - wykład		**Liczba godzin**
Wy1	Syllabus, warunki zaliczenia, literatura,	2
Wy2	Wstęp do zintegrowanej analizy deformacji	2
Wy3	Rola monitorowania w górnictwie zrównoważonym	2
Wy4	Opis zjawisk fizycznych: statyka- dynamika , rozchodzenie się ciepła, przepływ cieczy, zmiany siły grawitacji, zastosowania	2
Wy5	Metody analizy deformacji: stosując analizę systemów i mechaniki ciała stałego	2
Wy6	Ogólna klasyfikacja metod monitorowania: absolutne i względne pomiary deformacji,	**2**
Wy7	zalety i wady metod geodezyjnych i geotechniczno-strukturalnych, koncepcja pomiarów zintegrowanych	**2**

Wy8	Mechanika ciała stałego, Problem warunków brzegowych	**2**
Wy9	Rozwiązanie systemu kratownicy - relacja do MES MES	**2**
Wy10	Empiryczne metody wyznaczania deformacji powierzchni wywołanych eksploatacją podziemną (gaz i nafta) i eksploatacją odkrywkową, zastosowanie MES, Kategoria terenu	**2**
Wy11	Przykłady zastosowania integracji : stabilności zboczy w kopalniach odkrywkowych, Chiquqimata, Chile, NevadaUSA	**2**
Wy12	Przykłady zastosowania integracji : deformacja górotworu na terenach podziemnej eksploatacji górniczej w kopalni soli w Kanadzie,	**2**
Wy13	Problemy wydobycia gazu naturalnego i nafty	**2**
Wy14	Podsumowanie	**2**
Wy15	Kolokwium	**2**
	Suma godzin	**30**

Forma zajęć - ćwiczenia		**Liczba godzin**
Ćw1		
Ćw2		
Ćw3		
Ćw4		
..		
	Suma godzin	

Forma zajęć - laboratorium		**Liczba godzin**
La1	Przedstawienie zakresu ćwiczeń, warunków zaliczenia oraz literatury.	2
La2	Analiza wpływu obciążenia na górotwór –zastosowanie programu GeoStudio 2007	2
La3	Analiza naprężeń in-situ górotworu i górotworu obciążonego	2
La4	Zaprojektowanie pomiaru geodezyjnego na terenie górniczym prowadzenia podziemnej eksploatacji na podstawie wyników MES. Dyskusja projektu pomiarów.	2
La5	Wyznaczenie kategorii terenu górniczego Dyskusja wyników projektu	2
La6	Zaprojektowanie pomiaru geodezyjnego na terenie kopalni odkrywkowej na podstawie modelu MES . Dyskusja projektu pomiarów.	2
La7	Zaprojektowanie pomiaru geodezyjnego ziemnej zapory wodnej na podstawie modelu MES. Dyskusja analizy	2
La8	Podsumowanie	1
	Suma godzin	15

Forma zajęć - projekt		Liczba godzin
Pr1	Wyznaczenie MES deformacji górotworu spowodowanych eksploatacją podziemną, wyznaczenie kategorii terenu. Analiza sprężysta i nieliniowa . Omowienie monitorowania	6
Pr2	Podsumowanie	1
Pr3	Wyznaczenie MES deformacji usypiska/zapory ziemnej w warunkach zmiennego poziomu wody. Wyznaczenie wspolczynnika bezpieczeństwa stosując oprogramowanie Geostudio. Omowienie monitorowania	6
Pr4	Podsumowanie	2
…		
	Suma godzin	**15**

Forma zajęć - seminarium		Liczba godzin
Se1		
Se2		
Se3		
…		
	Suma godzin	

STOSOWANE NARZĘDZIA DYDAKTYCZNE
N1. Wykład, film N2. N3.

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ

Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEK_U01 – PEK_U06	Oceny z Lab 2-7, projekt 1 i 2.
F2		
F3		
P P	PEU_W01 – PEU_W06, PEU_U01 – PEU_U06	Kolokwium , Ocena końcowa z wykładu Ocena końcowa z laboratorium . Średnia ze sprawozdań i projektu

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA

LITERATURA PODSTAWOWA:

[1] Szostak-Chrzanowski, A., A. Chrzanowski,(2010), „INTEGETED ANALYSIS OF DEFORMATIONS IN GEOMECHANICS “, UNB, Fredericton, N.B., 220p.

LITERATURA UZUPEŁNIAJĄCA:

1 Szostak-Chrzanowski, A., A. Chrzanowski, M. Massiera (2005) “Use of deformation monit results in solving geomechanical problems – case studies “, *Engineering Geology,* vol. 7 Issues 1-2, pp. 3-12.

2 Chrzanowski,A. (1993):"Modern Surveying Techniques for Mining and Civil Engineering 33 in: *Comprehensive Rock Engineering,* Pergamon Press,Vol.3.Chapter 33, pp.773-809.

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

Anna Chrzanowska anna.chrzanowska@pwr.edu.pl

Zał. nr 5 do ZW 8/2020
Załącznik nr … do programu studiów

WYDZIAŁ **Geoinżynierii, Górnictwa i Geologii**

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim Bezpieczeństwo i higiena pracy ….(zajęcia są prowadzone w języku angielskim)

Nazwa przedmiotu w języku angielskim Occupational Health and Safety

Kierunek studiów (jeśli dotyczy): Górnictwo i geologia.

Specjalność (jeśli dotyczy): Mining Engineering
Geotechnical and Environmental Engineering,
Geomatics for Mineral Resource Management

Poziom i forma studiów: II stopień, stacjonarna

Rodzaj przedmiotu: obowiązkowy *

Kod przedmiotu W06GIG-SM0042

Grupa kursów NIE*

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)	15			15	
Liczba godzin całkowitego nakładu pracy studenta (CNPS)	30			30	
Forma zaliczenia	~~Egzamin /~~ zaliczenie na ocenę*	Egzamin / zaliczenie na ocenę*	Egzamin / zaliczenie na ocenę*	~~Egzamin~~ / zaliczenie na ocenę*	Egzamin / zaliczenie na ocenę*
Dla grupy kursów zaznaczyć kurs końcowy (X)					
Liczba punktów ECTS	**1**			1	
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)				1	
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)	1			1	

*niepotrzebne skreślić

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

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.

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CELE PRZEDMIOTU

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.

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ
Z zakresu wiedzy: 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 _W0 3 – Possesses general knowledge of corrective and preventive actions regarding hazards of typical work posts in the mining industry.… Z zakresu umiejętności: 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.… Z zakresu kompetencji społecznych: 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

TREŚCI PROGRAMOWE		
Forma zajęć - wykład		**Liczba godzin**
Wy1	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
Wy2	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
Wy3	Dangerous factors - identification and assessment of risks.	3
Wy4	Nuisance factors in occupational risk assessment: psychological burden, static burden, monotype.	3
Wy 5	Methods of occupational risk assessment: STER software, the RISC SCORE method, written test	3
	Suma godzin	**15**

Forma zajęć - ćwiczenia		**Liczba godzin**
Ćw1		
Ćw2		
Ćw3		

Ćw4		
..		
	Suma godzin	

Forma zajęć - laboratorium		Liczba godzin
La1		
La2		
La3		
La4		
La5		
…		
	Suma godzin	

Forma zajęć - projekt		Liczba godzin
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 harmful factors (vibration, chemical agents)	3
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 bimi 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, monotype)	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**

Forma zajęć - seminarium		Liczba godzin
Se1		
Se2		
Se3		
…		
	Suma godzin	

STOSOWANE NARZĘDZIA DYDAKTYCZNE
N1. Informative lecture with elements of problematic lectures. N2 Multimedia presentations. N3 Didactic discussions during lectures. N4 Didactic discussions during laboratory classes. N5Computer presentation of executed occupational risk assessments. N6Consultation.

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ

Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
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)
P		

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA

LITERATURA PODSTAWOWA:

[1] Iwona Romanowska Słomka, Adam Słomka Zarządzanie ryzykiem zawodowym. Wydawnictwo TARBONUS, Krakow Tarnobrzeg, 2009

[2] Iwona Romanowska Słomka, Adam Słomka Ocena ryzyka zawodowego. Wydawnictwo TARBONUS, Krakow Tarnobrzeg, 2010

[3] Wiesława Horst Ryzyko zawodowe na stanowisku pracy. Część 1, Ergonomiczne czynniki ryzyka. Wydawnictwo Politechniki Poznańskiej, Poznan, 2004

LITERATURA UZUPEŁNIAJĄCA:

[1] PN-N-18002 Systemy zarządzania bezpieczeństwem i higieną pracy - Ogólne wytyczne do oceny ryzyka zawodowego

[2]

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

Dr inż. Żaklina Konopacka

Zał. nr 5 do ZW 8/2020
Załącznik nr … do programu studiów

WYDZIAŁ **Geoinżynierii, Górnictwa i Geologii**

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku angielskim: Project Management, Appraisal and Risk Evaluation ….(zajęcia są prowadzone w języku angielskim)

Nazwa przedmiotu w języku polskim :Zarządzanie projektami, ocena ich opłacalności i ryzyka.

Kierunek studiów (jeśli dotyczy): Górnictwo i geologia

Specjalność (jeśli dotyczy): Mining Engineering,
Geotechnical and Environmental Engineering,
Geomatics for Mineral Resource Management

Poziom i forma studiów: II stopień , stacjonarna

Rodzaj przedmiotu: obowiązkowy

Kod przedmiotu W06GIG-SM0039G

Grupa kursów TAK

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)	15		30	15	
Liczba godzin całkowitego nakładu pracy studenta (CNPS)	30		60	30	
Forma zaliczenia	Egzamin				
Dla grupy kursów zaznaczyć kurs końcowy (X)	X				
Liczba punktów ECTS	4				
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)	3				
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)	3				

*niepotrzebne skreślić

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

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.

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CELE PRZEDMIOTU

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.

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

Z zakresu wiedzy:

PEU_W01 rozumie pojęcia podaży i popytu, elastyczności popytu i ich wpływ na rynki
PEU_W02 zna pojęcia kosztów w ekonomii i rachunkowości, rozumie różnice
PEU_W03 zna sposoby klasyfikacji kosztów w przedsiębiorstwach, zna i rozumie podstawowe pojęcia rachunku kosztów
PEU_W04 ma podstawową wiedzę o treści i wzajemnych relacjach bilansu, rachunku zysków i strat oraz rachunku przepływów pieniężnych, zna sposób prezentacji danych finansowych przedsiębiorstw w ustawowych sprawozdaniach finansowych i zna ich warianty.
PEU_W05 ma podstawową wiedzę na temat metody analizy wskaźnikowej sprawozdań finansowych
PEU_W06 zna pojęcia wartości przyszłej i wartości obecnej przepływów pieniężnych i rent rocznych
PEU_W07 zna podstawowe i zaawansowane metody oceny efektywności inwestycji (NPV, IRR, MIRR, DPBP, PBP) oraz zakresy ich stosowania
PEU_W08 ma podstawową wiedzę o metodach oceny ryzyka inwestycji

Z zakresu umiejętności:

PEU_U01 potrafi przeprowadzić analizę przyczyn i skutków zmiany popytu i podaży
PEU_U02 na podstawie krzywych kosztowych potrafi przeprowadzić optymalizację wielkości produkcji w różnych przypadkach.
PEU_U03 umie zinterpretować i korzystać z informacji zawartych w ustawowych sprawozdaniach finansowych. Umie przeprowadzić analizę wskaźnikową sprawozdań finansowych w podstawowym zakresie
PEU_U03 umie korzystać z danych kosztowych przedstawionych w różnych układach ewidencyjnych kosztów, umie stosować podstawowe metody rachunkowości zarządczej do podejmowania decyzji krótkoterminowych
PEU_U04 potrafi obliczyć wartość przyszłą i obecną pieniądza dla szeregu płatności oraz rozwiązać zadania rachunkowe z zakresu wartości pieniądza w czasie
PEU_U05 potrafi przeprowadzić ocenę opłacalności inwestycji poznanymi metodami
PEU_U06 potrafi przeprowadzić analizę wrażliwości i analizę scenariuszy z wykorzystaniem modelu finansowego inwestycji
PEU_U07 potrafi przygotować dokumentację projektową w podstawowym zakresie i

zainicjować projekt
PEU_U08 potrafi zastosować podstawowe metody zarządzania projektami, monitorowania i zarządzania ryzykiem projektu
PEU_U09 potrafi zastosować podstawowe metody zarządzania konfliktami w grupie
PEU_U10 potrafi zastosować podstawowe metody zarządzania grupą i kreowania pozycji lidera, potrafi ocenić skuteczność zarządzania grupą
Z zakresu kompetencji społecznych:
PEU_K01 potrafi myśleć i działać w sposób systemowy, kreatywny i przedsiębiorczy
PEU_K02 ma utrwaloną postawę ekonomicznego działania i podejmowania decyzji w oparciu o dostępne informacje finansowe i prognozy

TREŚCI PROGRAMOWE		
Forma zajęć - wykład		**Liczba godzin**
Wy1	Supply and demand, equilibrium price, changes in demand and supply. Stock and commodity markets used by mineral industries	2
Wy2	Costs in economics and in accounting. Cost and money outflow. Relevant cost, incremental cost, marginal cost, alternative cost. Short-term decision making.	2
Wy3	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
Wy4	Variable and fixed costs. Break even point. Cost-volume –profit analysis.	1
Wy5	Basics of financial accounting. Income statement and cash flow statement. Balance sheet. Working capital. Examples of financial statements of mining companies	2
Wy6	Financial ratio analysis. Liquidity, profitability, activity and debt ratios. Financial and operating leverage.	2
Wy7	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
Wy8	The concept of risk and return. Quantification of risk. Risk analysis in project evaluation: sensitivity analysis, scenario analysis, other methods.	2
	Suma godzin	15

Forma zajęć - projekt		**Liczba godzin**
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	3

	Team roles Belbin perspective Discussion group roles Effective managerial behaviour in the context of team roles	
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; Effective managerial behaviour from the different contexts.	3
	Suma godzin	15

Forma zajęć - laboratorium		**Liczba godzin**
	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**

STOSOWANE NARZĘDZIA DYDAKTYCZNE
N1. Wykład interaktywny z pokazem slajdów i dyskusją N2. Ćwiczenia laboratoryjne: indywidualne rozwiązywanie zadań z wykorzystaniem arkusza kalkulacyjnego. N3. Ćwiczenialaboratoryjne: rozwiązywanie zadań w grupach. Prezentacja wyników. Dyskusja o otrzymanych wynikach N4. Konsultacje N5. Praca własna – rozwiązywanie zadań domowych N6. Praca własna – samodzielne studia literaturowe

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ

Oceny (F – formująca (w trakcie semestru), P	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się

– podsumowująca (na koniec semestru)		
F1	PEU_W01-W08 PEU_K01-K02	Dyskusja na zajęciach, ocena aktywności studentów na zajęciach laboratoryjnych i projektowych
F2	PEU_U01-U10 PEU_K01-K02	Ocena rozwiązań zadań uzyskanych przez studentów w trakcie zajęć laboratoryjnych i projektowych
P1	PEU_W01-W08 PEU_U01-U10 PEU_K01-K02	Egzamin pisemny
P2	PEU_W01-W08 PEU_U01-U10 PEU_K01-K02	Ocena indywidualnych rozwiązań zadań nadesłanych przez studentów po zajęciach

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA

LITERATURA PODSTAWOWA:

1. Erhardt M., Brigham E.: Financial Management Theory and Practice. South-Western Cengage Learning, USA
2. Brigham E.: Podstawy zarządzania finansami. Polskie Wydawnictwo Ekonomiczne, Warszawa 1997
3. Czekaj J., Dresler Z.: Podstawy zarządzania finansami firm. PWN Warszawa 1996
4. Jaruga A., Sobańska J., Kopczyńska L. Szychta A.: *Rachunkowość dla menedżerów*. Towarzystwo Gospodarcze RAFIB, Łódź 1996.
5. Jonson H.: Ocena projektów inwestycyjnych. Maksymalizacja wartości przedsiębiorstwa. Wyd. K.E. Liber, Warszawa 2000.
6. Nowak E.: Rachunek kosztów przedsiębiorstwa. Wydawnictwo Ekspert, Wrocław 2001
7. Sierpińska M., Jachna T.: Ocena przedsiębiorstwa według standardów światowych, PWN Warszawa 1994.
8. Świderska G. K.(red): Rachunkowość zarządcza. (praca zbiorowa) Wyd. Poltext, Warszawa 1997
9. Wysocki Robert K., McGary R., Efektywne zarządzanie projektami, OnePress, 2005
10. Lock Dennis, Podstawy zarządzania projektami, PWE, 2009

LITERATURA UZUPEŁNIAJĄCA:

1. Jajuga K., Jajuga T., 2006. Inwestycje. Instrumenty finansowe, aktywa niefinansowe, ryzyko finansowe, inżynieria finansowe, Wydawnictwo Naukowe PWN, Warszawa.
2. Jonson H.: Koszt kapitału. Klucz do wartości firmy. Wyd. K.E. Liber, Warszawa 2000
3. Turyna J., Pułaska-Turyna B.: Rachunek kosztów i wyników. Wyd. Finans-Servis, Warszawa 1997.
4. A Guide to Project Management Body of Knowledge (PMBOK®Guide Fourth Edition), Project Management Institute, 2008 (2004). wydanie polskie, MT&DC Warszawa, 2009 (2006)

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

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

Zał. nr 5 do ZW 8/2020
Załącznik nr … do programu studiów

WYDZIAŁ **Geoinżynierii, Górnictwa i Geologii**

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim Teoria i praktyka w geomechanice….(zajęcia są prowadzone w języku angielskim)

Nazwa przedmiotu w języku angielskim Theory and Practise in Geomechanics

…….

Kierunek studiów (jeśli dotyczy): Górnictwo i geologia.

Specjalność (jeśli dotyczy): Mining Engineering,
Geotechnical and Environmental Engineering,

Poziom i forma studiów: II stopień, stacjonarna

Rodzaj przedmiotu: obowiązkowy *

Kod przedmiotu W06GIG-SM0043G

Grupa kursów NIE*

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)	60	15			
Liczba godzin całkowitego nakładu pracy studenta (CNPS)	150	30			
Forma zaliczenia	Egzamin / ~~zaliczenie na ocenę*~~	~~Egzamin /~~ zaliczenie na ocenę*	Egzamin / zaliczenie na ocenę*	Egzamin / zaliczenie na ocenę*	Egzamin / zaliczenie na ocenę*
Dla grupy kursów zaznaczyć kurs końcowy (X)					
Liczba punktów ECTS	**4**	**2**			
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)		2			
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)	3,5	1,5			

*niepotrzebne skreślić

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. Introduction to Mathematical Analysis, Statics and Strength of Materials.

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CELE PRZEDMIOTU

C1 Presentation of foundations of Theory of Elasticity and its application in Rock and Soil Mechanics (The lecture will be delivered in index notation).

C2 Introduction of fundamental concepts of rock and soil mechanics and their application in surface and underground mining.

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

Z zakresu wiedzy:

PEU_W01 Student ma ugruntowaną wiedzę w zakresie podstaw teorii sprężystości – m.in. stanu naprężeń i odkształceń w masywie skalnym.

PEU_W02 Student ma wiedzę dotyczącą kryteriów wytrzymałościowych stosowanych w mechanice skał oraz gruntów.

Z zakresu umiejętności:

PEU_U01 Student potrafi zastosować metod obliczeniowe teorii sprężystości do określenia stanu naprężenia i odkształcenia w górotworze oraz wykorzystać te obliczenia do oceny jego stateczności.

Z zakresu kompetencji społecznych:

PEU_K01 Student posiada umiejętność rozwiązywania zadań oraz prezentacji otrzymanych wyników przed innymi studentami.

TREŚCI PROGRAMOWE		
Forma zajęć - wykład		**Liczba godzin**
Theory of Rock Mechanics		
Wy1	Frame of axes Cartesian coordinates. Einstein summation convention. Kroecker delta. Permutation symbol. Relationship e – δ.	2
Wy2	State of strain. Material and space coordinate. Green, Almansy and Couchy strain tensors. Gradient matrix. Geometric interpretation of infinitesimal strain components.	2
Wy3	Spherical and deviatoric tensors of state of strain. Principal strains and principal axes of strain tensor. Strain tensor invariants. Tensor of principal axes. Capability equations.	2
Wy4	State of stress. Stress vector and stress tensor. Couchy formula. Coordinate transformations for stresses. Formal definition of a tensor. Hydrostatic and stress deviation tensor.	2
Wy5	Normal and shear stresses. Principal stresses and principal axes of stress tensors and stress deviation tensors. Invariants of stress and stress deviation tensors. Octahedral stresses. Intensity of stress tensor. Mohr circle of stress components.	2
Wy6	Linear elasticity. General Hooke law. Hooke law for Isotropic materials. Stress – strain deviatoric relationship. Hydrostatic stress versus dilatation formula. Relationship between different elastic module.	2
Wy7	Elastic strain energy expressed by stress and strain tensor components. Solving theory of elasticity boundary problems using displacement approach. Navier-Stoke's equation.	3

Wy8	Classical strength criteria. Effective stresses.	2
Wy9	Coulomb- Mohr strength criterion. Safety factor.	2
Wy10	Plane stress and plane strain problems of theory of elasticity. Solving theory of elasticity boundary problems using stress approach. Airy function. Biharmonic polynomials. Airy function In polar coordinate. General form of Airy function.	3
Wy11	Introduction to Finite Element Method.	3
Wy12	Description of Phases code interface.	2
Wy13	Simple example of FEM calculation.	3
Theory of Soil Mechanics		
Wy14	Soil classification.	2
Wy15	Modeling of soil and rock behavior.	3
Wy16	Effective stresses.	2
Wy17	Water flow.	2
Wy18	Bearing capacity of foundation.	3
Wy19	Atteberg Limits and compaction characteristic of soil.	3
Practice of Rock Mechanics		
Wy20	Rock mass properties. Rock mass classification	2
Wy21	In-situ stresses. Methods for stress analysis	2
Wy22	Rock mass discontinuities and their strength. Slope stability problems and rock fall hazard.	2
Wy23	Rock bolts and cables in rock engineering. Pillar strength and its importance in room-and-pillar mining	2
Wy24	Floor strata behavior in room-and-pillar mining. Interaction of roof, pillar and floor .	2
Wy25	. Surface subsidence due to underground mining. Structures resistance against earthquake and mining related motion	2
Wy26	Pillar strength and its importance in room-and-pillar mining. Structures resistance against earthquake and mining related motion.	2
Wy27	Application of Geomechanics in underground mining.	1
	Suma godzin	**60**

Forma zajęć - ćwiczenia		**Liczba godzin**
Ćw1	Examples illustrating Einstein summation convention. Kronecker delta. Permutation tensor. Formula e – δ. Calculation of spherical and deviatoric strain tensor.	2
Ćw2	Calculation of invariants of strain tensors. Finding of principal strains and principal axes. Building deviatoric strain tensor and tensor of directions.	2
Ćw3	Building hydrostatic stress tensors and stress deviation tensors. Using Couchy formula. Transformation frame of axes by rotation.	2
Ćw4	Calculation of invariants of stress tensors. Principal stresses and principal axes. Calculation of octahedral stresses. Mohr circle for stress tensor components	2
Ćw5	Examples of calculations different elastic material coefficients.	2

Ćw6	Description of Phases 2 computer code.	1
Ćw7	Finite Element Method example calculations using Phases 2 computer programme.	2
Ćw8	Comparison of close form solution of Lame problem with corresponding Finite Element Method results of calculation	2
	Suma godzin	**15**

Forma zajęć - laboratorium		**Liczba godzin**
La1		
La2		
La3		
La4		
La5		
…		
	Suma godzin	

Forma zajęć - projekt		**Liczba godzin**
Pr1		
Pr2		
Pr3		
Pr4		
…		
	Suma godzin	

Forma zajęć - seminarium		**Liczba godzin**
Se1		
Se2		
Se3		
…		
	Suma godzin	

STOSOWANE NARZĘDZIA DYDAKTYCZNE
N1. Forma wykładów i ćwiczeń – tradycyjna, treści ilustrowane prezentacjami multimedialnymi z użyciem sprzętu audio-wizualnego
N2. Dyskusja w ramach wykładów i ćwiczeń
N3. Konsultacje

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ

Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
P	PEU_W01 PEU_W02 PEU_U01	P Ocena końcowa z grupy kursów w formie sprawdzianu pisemnego

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA

LITERATURA PODSTAWOWA:

[1] Y. C. Fung, Fundations of Solid Mechanics, Prentice-Hall, Inc. U.S.A 1964
[2] Y. C. Fung, A First Course in Continuum Mechanics, Prentice-Hall, Inc. U.S.A., 1977
[3] T.J. Chung, Applied Continuum Mechanics, Cambridge University Press,, U.S.A 1996
[4] I. Kisiel, Reologia w Budownictwie, PWN, Warszawa 1962, (In Polish)
[5] O. C. Zienkiewicz, The Finite Element Method In Engineering Science, McGraw-Hill, London, U. K. 1971

LITERATURA UZUPEŁNIAJĄCA:

[1] Compilation of review articles and book chapters of various sources. Handouts.

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

Dr Karolina Adach-Pawelus
Dr inż Jerzy Bauer
Dr inż. Marek Kawa

2-nd Semester

Semestr 2

FACULTY OF GEOENGINEERING, MINING AND GEAOLOGY

SUBJECT CARD

Name in Polish: AutoCAD
Name in English: AutoCAD
Main field of study (if applicable): Mining and Geology
Specialization (if applicable): Mining Engineering
Level and form of studies: 2nd, full-time
Kind of subject: elective
Subject code: W06GIG-SM0077
Group of courses: NO

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)			**30**		
Number of hours of total student workload (CNPS)			**60**		
Form of crediting			**crediting with grade**		
For group of courses mark (X) final course					
Number of ECTS points			**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 (BK) classes			**1,5**		

*delete as applicable

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge concerning technical drawing.

SUBJECT OBJECTIVES

C1 Acquisition by the student the ability to build geometric models of designed elements, their description and preparation for printing.

SUBJECT LEARNING OUTCOMES

Subject educational effect (skills)

PEU_U01 Ability of geometric mapping concerning the designed elements.
PEU_U02 Ability of synthetic description concerning designed elements.
PEU_U03 Ability to prepare drawings for printing.

Subject educational effect (social)

PEU_K01 Understanding the importance of correct drawing mapping of the designed elements for their proper implementation.

PROGRAMME CONTENT		
Form of classes - laboratory		**Number of hours**
L1	Familiarising with AutoCAD and preparation for work.	2
L2	Accurate drawing.	2
L3	Design of characteristical elements.	2
L4	Modification of elements.	2
L5	Modification of elements. (to be continued)	2
L6	Introducing a text.	2
L7	Adding symbols and hatches.	2
L8	Obejects drawing.	2
L9	Adding dimensions.	2
L10	Adding dimensions. (to be continued)	2
L11	Creating blocks.	2
L12	Creating dynamic blocks.	2
L13	Creating viewports and printing sheets.	2
L14	Print preparation.	2
L15	Print preparation. (to be continued)	2
	Total hours	**30**

TEACHING TOOLS USED
N1. Laboratory. Presentation and AutoCAD commend analysis while using a computer.

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
P1	PEU_U01 – U03 PEU_K01	Drawing's printing preparation and detailed analysis.

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

[1] Pikoń A., AutoCAD 2011. Pierwsze kroki;
[2] Pikoń A., AutoCAD 2007 i 2007 PL. Practical exercises;

SECONDARY LITERATURE

[1] Jaskulski A., AutoCAD 2012/LT2012/WS+. Kurs projektowania parametrycznego i nieparametrycznego 2D i 3D

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

dr inż. Dariusz Woźniak
mgr inż. Natalia Suchorab, mgr inż. Maksymilian Ozdoba

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT

AutoCAD

AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY Geodesy and Cartography AND SPECIALITY Underground and Surface Mining

SUBJECT EDUCATIONAL EFFECT	Correlation between subject educational effect and educational effects defined for main field of study and specialization	SUBJECT OBJECTIVES	PROGRAMME CONTENT	Number of educational effect
PEK_U01	K_U10	C1	L1-8, L11-12	N1
PEK_U02	K_U10	C1	L9-10	N1
PEK_U03	K_U10	C1	L13-15	N1
PEK_K01	K_K01	C1	L1-15	N1

Zał. nr 5 do ZW 8/2020
Załącznik nr … do programu studiów

WYDZIAŁ …… / STUDIUM……

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim Wspomagane komputerowo projektowanie kopalń
Nazwa przedmiotu w języku angielskim Computer Aided Mine Design
Kierunek studiów (jeśli dotyczy): Górnictwo i geologia.
Specjalność (jeśli dotyczy): Mining Engineering
Poziom i forma studiów: II stopień, stacjonarna
Rodzaj przedmiotu: wybieralny *
Kod przedmiotu W06GIG-SM0074
Grupa kursów NIE*

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)	15		45		
Liczba godzin całkowitego nakładu pracy studenta (CNPS)	30		120		
Forma zaliczenia	~~Egzamin /~~ zaliczenie na ocenę*	Egzamin / zaliczenie na ocenę*	~~Egzamin /~~ zaliczenie na ocenę*	Egzamin / zaliczenie na ocenę*	Egzamin / zaliczenie na ocenę*
Dla grupy kursów zaznaczyć kurs końcowy (X)					
Liczba punktów ECTS	**2**		3		
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)			3		
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)	2		2		

*niepotrzebne skreślić

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

The student has basic knowledge of open-cast and underground deposits excavations. The student has knowledge of the occurrence, deposits, excavation, quality parameters and the use of mineral resources and the main forms of occurrence. The student can combine and interpret data describing a deposit. The student can use knowledge concerning statistics and geostatistics to produce a numerical and spatial characteristics of the selected parameters of a deposit. The student can select and verify an interpolation model of deposits parameter which is researched. The student uses specialized software concerning structuralized building and quality of digital spatial of the deposit model. The student uses specialized software concerning estimation of resources in targeted areas. The student can present the results of digital deposit modelling using a specific software environment.

\

CELE PRZEDMIOTU

C1. Getting known the basics of open-cast and underground mines design.
C2 Getting known the concepts and methods of optimization of digital design and planning of mines

used in the mining world.
C3 Acquisition of skills of computer-aided tools for modelling and design of mining deposits in accordance with current international standards.

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

Z zakresu wiedzy (relating to knowledge):

PEU_W01 The student can describe the basics of underground mines design. The student can describe the rules of mine dimensioning and can identify criteria for an operational system selection.

PEU_W02 The student knows the basics of open-cast mines design, can choose an excavation system for the particular type of mine and distinguish concepts of formal documents and regulations for the mine design

PEU_W03 The student can identify the target excavation area in accordance with the criteria of economic viability in three-dimensional modelling

PEU_W04 The student can explain the optimization method of the target open-cast excavation

PEU_W05 The student can formulate and choose the progress direction and different mining plan in various time horizons

Z zakresu umiejętności (relating to skills):

PEU_U01 The student can calculate the parameters of underground excavations for scheduled tasks

PEU_U02 The student can choose appropriate design methods and tools to complete the project of underground excavations according to prepared parameters

PEU_U03 The student can build a digital model of economic deposits according to the alternative criteria and can estimate the value of the mine

PEU_U04 The student can choose appropriate methods and design tools to prepare the project of open- cast excavations according to prepared parameters

PEU_U05 The student can use different software to optimize open-cast excavations and for presentation of results

PEU_U06 The student can interpret the data and develop foundations of excavation calendar plan and use specialized software environment for the implementation of the plan

PEU_U07 The student can presented, in a clear form, the results of a project using numerical summaries, maps, cross-sections, visualization and simulation

Z zakresu kompetencji społecznych (relating to social competences):

PEU_K01 The student can think and act in a creative and enterprising way

TREŚCI PROGRAMOWE		
Forma zajęć - wykład		**Liczba godzin**
Wy1	Open Pit Economic Modelling – the general approach	1
Wy2	Lerchs-Grossmann open-pit optimization	1
Wy3	The method of evaluating lignite reserves in an integrated power engineering company	1
Wy4	Mining costs studies: transportation, costs of purchase land	1
Wy5	The influence of raw material processing efficiency and environmental costs on the profitability of mining. Case study: carbon costs	1
Wy6	Generating of the complex economic model of a chosen deposit with regard to its quality, mining technology and product pricing	1

Wy7	Integrated approach to mine planning: strategic, medium term and short term production plan	1
Wy8	Open-cast life-of-mine planning steps: an ultimate pit, pushbacks, alternative schedules, optimized mine flow with stockpiles	1
Wy9	Alternative scenarios of the continuous surface mine	1
Wy10	Short term scheduling and blending	1
Wy11	Processes of project management: Project cycle.	1
Wy12	Project time management processes. Methods /techniques to plan the activities.	1
Wy13	Resource planning & assignment. Scheduling resource work. Budgeting project costs, costs distribution over the time.	1
Wy14	Project risk management.	1
Wy15	Students' progress assessment	1
	Suma godzin	**15**

Forma zajęć - ćwiczenia		**Liczba godzin**
Ćw1		
..		
	Suma godzin	

Forma zajęć - laboratorium		**Liczba godzin**
La1	Economic modelling	3
La2	Pit development	3
La3	Life-of-mine planning. Mining levels	3
La4	Life-of-mine planning. Generating mining blocks on the levels. Evaluation of blocks and aggregating production plan results	3
La5	Detailed design of the selected elements of the open-cast mine (an initial cut, a final pit, an in-pit dump),	3
La6	Detailed design of the final pit reclamation,	3
La7	Underground mine design – the specialised design environment	3
La8	Underground mine design with the use of predefined rules and templates	3
La9	Underground mine planning – targets, constraints, dependency	3
La10	Underground mine planning – analysis of results, rescheduling	3
La11	Defining the project life cycle, scope and project long-term schedule based on developed Life-of-mine plan.	3
La12	Development of the main equipment specification and purchasing schedule of the excavators and spreaders. Development of the Outline reclamation plan.	3
La13	Cash Flows Analysis. Profitability evaluation of the mining project.	3
La14	Cash Flow Sensitivity Analyses. Outline risk assessment of the mining project.	3
La15	Supplementary - documentation and reporting (plots, evaluation)	3
	Suma godzin	45

Forma zajęć - projekt		**Liczba godzin**
Pr1		
…		
	Suma godzin	

Forma zajęć - seminarium	**Liczba godzin**

Se1		
…		
	Suma godzin	

STOSOWANE NARZĘDZIA DYDAKTYCZNE
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 discussion concerning lectures and laboratories, N3 individual development of project tasks within the laboratories frames, individual development of electronic reports concerning project tasks within the laboratories frames, N4 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.

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ

Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1	PEU_W01,PEU_W02, PEU_W04	Lecture grade on the basis of the written examination
F2	PEU_W01, PEU_U01, PEU_U02, PEU_U07	"design of underground excavations", laboratory task assessment
F3	PEU_W02, EK_W04, PEU_U03, PEU_U04, PEU_U07	"design of open-cast excavations", laboratory task assessment
F4	PEU_W05, PEU_U05 PEU_U06, PEU_U07	"Design of open-cast mine plan", control test covering methods and skills of digital design.
P	average of F1, F2, F3, F4	

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA

LITERATURA PODSTAWOWA:

[1] Bęben A., Maszyny i urządzenia do wydobywania kopalin pospolitych bez użycia materiałów wybuchowych, AGH Publishing, Kraków 2008
[2] Bęben A., Maszyny i urządzenia do wybranych technologii urabiania surowców skalnych, Śląsk Publishing
[3] Bęben A., Wydobywanie spod wody kruszyw naturalnych, AGH Publishing, Kraków 2006
[4] Butra J., Eksploatacja złoża rud miedzi w warunkach zagrożenia tąpaniami i zawałami, KGMH Cuprum Sp. Wrocław 2010.
[5] Hustrulid W., Kuchta M., Open Pit Mine Planning and Design, A.A.Balkema, Rotterdam 2005
[6] Kasztelewicz Z., koparki wielonaczyniowe i zwałowarki taśmowe. Technologia pracy, AGH Publishing, Kraków 2012
[7] Kołkiewicz W., Szatan M., Pomorski A., Witt A., Modelowanie i optymalizacja odkrywkowych procesów wydobywczych układami technologicznymi o pracy ciągłej, Redakcja Górnictwa Odkrywkowego, Wrocław 1996
[8] Korzeniowski J.I., Ruch zakładów eksploatujących złoża kopalin, Pub. Wikbest, Wrocław 2010
[9] Kozioł W. Uberman R., Technologia i organizacja transportu w górnictwie odkrywkowym",

AGH Publishing, Krakow 1994
[10] Piechota et al., Systemy podziemnej eksploatacji złóż węgla kamiennego, rud i soli, AGH Publishing, Kraków 2009
[11] Technologies of rock exploitation from the water - types of quarring, exploitation systems, excavators, transport of excavated material. Koncepcje i praktyki górnicze, Politechnika Wrocławska Publishing House, Wrocław 2009
[12] P.Z. pod red. K. Strzodki, J. Sajkiewicza, A. Dunikowskiego, Górnictwo Odkrywkowe Tom I, „Śląsk" Publishing, 1983

LITERATURA UZUPEŁNIAJĄCA:

[1] SME Mining Engineering Handbook Vol.1, Vol.2, SMME Inc. Littleton, Colorado, 1992
[2] Industry magazines: Górnictwo Odkrywkowe, Cuprum, Przegląd Górniczy, Gospodarka Zasobami Złóż, Mining Magazine, International Mining, Surface Mining, Braunkohle & Other Minerals Surface Mining, Braunkohle & Other Minerals
[3] Publishings of industry conferences: Mine Planning & Equipment Selection, Continuous Surface Mining, World Mining Congress, Conference of the International Association for Mathematical Geosciences (IAMG)

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

Dr inż. Witold Kawalec,
Dr inż. Krzysztof Hołodnik, Dr inż. Michał Dudek

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
Level and form of studies: 2nd level, full-time
Subject Type: Obligatory
Subject code: W06GIG-SM0076
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)	**60**				
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	**2**				

*** 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] Macioszczyk A., 1987, Hydrogeochemia. Wyd. Geol., Warsaw
[5] Macioszczyk A., Dobrzyński D., 2002, Hydrogeochemia strefy aktywnej wymiany wód podziemnych. Wydawnictwo Naukowe PWN, Warsaw
[6] Marshall C. P., Fairbridge R. W. (eds), 1999 – Encyklopedia of Geochemistry. Kluwer Academic Publishers, Dodrecht, Boston, London.
[7] McSween H. Y., Huss G. R., 2010 – Cosmochemistry. Cambridge University Press, Cambridge, UK
[8] Migaszewski Z. M., Gałuszka A., 2007 - Postawy geochemii środowiska, WNT.
[9] Polański A., 1988 - Podstawy geochemii. Wyd. Geol., Warsaw
[10] Polański A., 1986 - Geochemia ogólna i organiczna. Wydawnictwa U.W., Warsaw.
[11] Pazdro Z., Kozerski B., 1990 - Hydrogeologia ogólna. Wyd. Geol., Warsaw.
[12] Tolstikhin I. N., Kramers J. D., 2008 – The evolution of matter. From the Big Bang to the Present Day. Cambridge University Press, Cambridge, UK
[13] Zuber A., Różański K., Ciężkowski W., 2007 - Metody znacznikowe w badaniach hydrogeologicznych. Poradnik metodyczny. Oficyna Wyd. PWr

SECONDARY LITERATURE

[1] Appelo C.A.J., Postma D., 2005 - Geochemistry, groundwater and pollution. Balkema. Kabata-Pendias A., Pendias H., 1993 - Biogeochemia pierwiastków śladowych, PWN
[2] Merkel B. , Planer-Friedrich 8.,2005 - Groundwater geochemistry. Springer
[3] Westphal M., 1993 - Paleomagnetyzm i właściwości magnetyczne skał, Wydawnictwo Naukowe PWN, Warsaw
[4] Witczak S., Adamczyk A., 1995a - Katalog wybranych fizycznych i chemicznych wskaznik6w zanieczyszczeń wód podziemnych i metod ich oznaczania., T. I, Biblioteka Monitoringu Srodowiska, Warsaw
[5] Witczak S., Adamczyk A., 1995b - Katalog wybranych fizycznych i chemicznych wskaznik6w

zanieczyszczeń wód podziemnych i metod ich oznaczania., T. II, Biblioteka Monitoringu Środowiska, Warsaw
[6] Zielski A., Krąpiec M., 2004 - Dendrochronologia. Wyd. Naukowe PWN, Warsaw

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

Zał. nr 5 do ZW 8/2020
Załącznik nr … do programu studiów

WYDZIAŁ **Geoinżynierii, Górnictwa i Geologii**

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim Systemy maszynowe
kurs prowadzony jest w języku angielskim
Nazwa przedmiotu w języku angielskim Machinery systems

Kierunek studiów (jeśli dotyczy): Górnictwo i geologia.
Specjalność (jeśli dotyczy): Mining Engineering
Poziom i forma studiów: II stopień, stacjonarna
Rodzaj przedmiotu: wybieralny
Kod przedmiotu W06GIG-SM0072
Grupa kursów NIE

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)	30		15	15	
Liczba godzin całkowitego nakładu pracy studenta (CNPS)	60		30	30	
Forma zaliczenia	Egzamin~~/ zaliczenie na ocenę*~~	Egzamin / zaliczenie na ocenę*	~~Egzamin /~~ zaliczenie na ocenę*	~~Egzamin~~ / zaliczenie na ocenę*	Egzamin / zaliczenie na ocenę*
Dla grupy kursów zaznaczyć kurs końcowy (X)					
Liczba punktów ECTS	**2**		2	2	
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)			2	2	
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)	2		1,5	1,5	

*niepotrzebne skreślić

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. Knowledge of mining areas where there are conducted basic operations such as dredging, crushing, transport, handling and piling.
2. Knowledge of mining machine systems backed by the expertise in the field of machinery and equipment cooperation and the selection of machines' basic parameters.
3. Ability to determine the meaning of key equipment in systems performing the excavation, transport, handling and storage of excavated material.
4. Knowledge of the risks in the use of machines in various areas of mining, and recognition of the basic safety requirements.

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CELE PRZEDMIOTU

C1. Familiarizing students with advanced methods of calculation and design of transport equipment used in mining.
C2 Familiarizing students with the methods of evaluation of basic machines technical condition and transport equipment based on the vibroacoustic diagnosis.
C3 Ability to make basic decisions on the selection, equipment and machinery operation

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

Z zakresu wiedzy:
PEU_W01 The student has knowledge of the use and cooperation of different types of machines and transportation systems in surface and underground mining.
PEU_W02 The student has basic knowledge concerning maintenance and safety use of mining equipment
PEU_W03 The student has basic knowledge concerning the non-destructive and continuous diagnostics methods for elements of mining machines.

Z zakresu umiejętności:
PEU_U01 The student has a practical ability to measure primary resistances such as indentation rolling resistance or idler rotational resistance.
PEU_U02 The student has a practical ability to detect and recognize a change of state of mining machines
PEU_U03 The student has the ability to perform engineering calculations and selection of the components of belt conveyors drive.

Z zakresu kompetencji społecznych:
PEU_K01 The student can work in a team and together prepare and conduct a set laboratory task and to prepare the achieved results and to present the effects of the conducted research as a team paper report.
PEU-K01 The student has the ability to discuss and exchange acquired information with other students.

TREŚCI PROGRAMOWE		
Forma zajęć - wykład		**Liczba godzin**
Lec 1	Scope of the course, teaching the purpose, crediting conditions, literature, contact with the teacher. Basic information, vocabulary and mining operations	2
Lec 2	Continuous transportation systems in mining. Description of the two most commonly used conveyors and their components: - belt conveyors (idlers, pulleys, belt, feed chute, cleaning equipment) - scraper chain conveyor (scraper, chain, spillplate, chute, tail and head stations) Advantages and disadvantages of both belt and chain conveyors, cooperation with appropriate operating systems. Division of motion resistance occurring during conveyor's work (concentrated, primary	2

	and lift resistances).	
Lec 3	Conveyors of special purpose; advantages and disadvantages, applications of: bucket elevator, pipe, pouch, pocket, sandwich, wire mesh belt and steel belt conveyors	2
Lec 4, 5	Machinery systems applied in surface mining. Classification of surfaced mining machines used in open cast, open pit, quarry and placer mining (and alternative methods such as auger or punch mining). Continuously operating excavating machines: bucket wheel excavator, bucket chain excavator, continuous surface miner. Single-bucket excavators: power shovel dragline. Loading, hauling dumping and transportation systems in each mining method.	4
Lec 6, 7	Machinery systems applied in underground mining. Description of machinery applied in hard rock mining and soft rock mining. Machines used in drill and blast cycle, room and pillar system, longwall mining. Description of continues miner, roadheader, shearer, plough, drilling machine, loading machine, roof bolter, shuttle car, feeder and tunnel boring machine. Different types of transportation systems in each underground mining type.	4
Lec 8	Vocabulary quiz and sum up of the machine and transportation systems information.	2
Lec 9	Proper maintenance of mining equipment and monitoring systems. Main condition monitoring techniques applied for mining equipment and factors affecting the form of the diagnostic signal.	2
Lec 10, 11	Diagnostic of conveyor belts. Types of belt damage and place of occurrence. Non-destructive diagnostic methods: magnetic, vision, thermovision and X-ray diagnostic. Failures prediction systems.	4
Lec 12	Definition of thermovision, IR thermography as a diagnostic tool. Thermography diagnostic of gears, drives, idlers and alternative applications.	2
Lec 13, 14	Basic terms in machine diagnostics and reliability. Measurements of velocity and acceleration as a base for vibration diagnostic. Spectral emitted energy technology. Vibroacoustic diagnostics of drives, gears, and bearing. Analyze the diagnostic signal.	4
Lec 15	Selected problems with conveyor belts and possible solutions or repairs. Summary of the information about condition monitoring methods. Exam.	2
	Total hours	**30**

Forma zajęć - ćwiczenia		**Liczba godzin**
Ćw1		
Ćw2		
Ćw3		
Ćw4		
..		
	Suma godzin	

Forma zajęć - laboratorium		**Liczba godzin**
Lab 1	Scope of the course, teaching the purpose, crediting conditions, safe and healthy conditions, literature, contact with the teacher. Visiting laboratories and familiarizing with devices in which the laboratory is equipped with.	2
Lab 2,3	Indentation rolling resistance measurements: - laboratory tests of the belt on idler rolling resistance according to European standard and a new test rig for measuring rolling	4

	resistance in a small scale - test rig for determining elastic and damping properties of the belt (necessary for calculations and energy efficiency rating.	
Lab 4	Laboratory tests carried on idlers: - durability test of idlers - measuring of idler rotational resistance with immobilized shaft - measuring of idler rotational resistance under additional load.	2
Lab 5	Measurements of friction force in the intermediate - drive TT linear booster drive.	2
Lab 6	Infra-Red Thermography diagnostic of gearboxes. Impact of external factors and object parameters on the results of measurements. Comparative analysis of thermograms and temperature changes of investigated objects.	2
Lab 7	Non-destructive conveyor belts diagnostics methods. Early damage detections possibilities, discussion and comparison of different methods and equipment (magnetic and X-ray diagnostics, protect and prediction systems).	2
Lab 8	Reports grade of performed laboratory research.	1
	Total hours	**15**

Forma zajęć - projekt		**Liczba godzin**
Pr1	Scope of project, conditions of crediting, literature Giving students individual project tasks. Discussion of the draft guidelines concerning the basic calculations of the conveyor belt.	2
Pr2,3	Calculations of multi-pulleys drive on the example of two head drive pulleys. Estimation of the load distributio drive pulleys, verification and solution if one pulley is overloaded.	4
Proj 4	Calculation of belt sliding resistance the intermediate idler drive. Force distribution on the conveyor belt's route.	2
Proj 5, 6	Calculations of the TT linear booster (intermediate) drive: - selection of the length of the TT intermediate drive - checking the condition of transverse vibrations of the TT linear booster drive	4
Proj 7	Energy efficiency solutions in belt conveyors. Definition and calculations of energy efficiency and energy consumption. Alternative solutions in conveyors, reduction of motion resistances.	2
Proj 8	Handing the readymade projects and their assessment.	1
	Total hours	**15**

Forma zajęć - seminarium		**Liczba godzin**
Se1		
Se2		
Se3		
…		
	Suma godzin	

STOSOWANE NARZĘDZIA DYDAKTYCZNE
N1. Informative lecture with the elements of problem solving lecture. N2. Multimedia presentations. N3. Didactic discussion during the lecture, project. N4. Projects preparation in a report form. N5. Projects presentation and test concerning issues covered by the project

N6. Preparation and a report of conducted laboratory research. N7. Duty hours

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ

Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
P	PEK_W01- PEK_W03	P1.Final grade of written test.
F, P	PEK_U01	F1- Grade from preparation and laboratory research performance F2 - Grade from a written report and a test from laboratory research methods and knowledge concerning equipment used for research P2 - Final grade from a laboratory (weighted average of F1 - 40% and F2 - 60%).
F, P	PEK_U02	F3 Grade from performance and merits of the project F4 - Assessment of knowledge concerning the subjects' scope of the project. P3 - Final grade from a laboratory (weighted average of F3 - 30% and F4 - 70%

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA

LITERATURA PODSTAWOWA:

[1] Jacek Czaplicki, Janusz Sroka: Mining Engineering, 2016
[2] Matti Heiniö: Rock Excavation Handbook, 1999
[3] Walter Bartelmus: Condition monitoring of open cast mining machinery, 2006
[4] SKF – Vibration Diagnostic Guide (CM5003) www.skfreliability.com

LITERATURA UZUPEŁNIAJĄCA:

Publications in magazines:

[1] Mining Magazine: www.miningmagazine.com
[2] Mining Engineering: www.me.smenet.org
[3] Diagnostyka: www.diagnostyka.net.pl
[4] Bulk Solid Handling

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

Dr inż. Martyna Konieczna – Fuławka , martyna.konieczna-fulawka@pwr.edu.pl

Zał. nr 5 do ZW 8/2020
Załącznik nr … do programu studiów

WYDZIAŁ …… / STUDIUM……

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim Projektowanie górniczych wyrobisk podziemnych i tuneli

Nazwa przedmiotu w języku angielskim Tunnel and underground excavation design

Kierunek studiów (jeśli dotyczy): Górnictwo i geologia.

Specjalność (jeśli dotyczy): Mining Engineering

Poziom i forma studiów: II stopień, stacjonarna

Rodzaj przedmiotu: obowiązkowy *

Kod przedmiotu W06GIG-SM0073

Grupa kursów NIE*

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)	30			30	
Liczba godzin całkowitego nakładu pracy studenta (CNPS)	60			90	
Forma zaliczenia	Egzamin / ~~zaliczenie na ocenę*~~	Egzamin / zaliczenie na ocenę*	Egzamin / zaliczenie na ocenę*	~~Egzamin /~~ zaliczenie na ocenę*	Egzamin / zaliczenie na ocenę*
Dla grupy kursów zaznaczyć kurs końcowy (X)					
Liczba punktów ECTS	**2**			3	
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)				3	
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)	1,5			2,5	

*niepotrzebne skreślić

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

Knowledge of underground mining and rock mechanics.
Basic concepts of geology and knowledge of geomechanical parameters of rocks.
Using the Microsoft Office environment in the scope of preparing documents in Word, working with Excel spreadsheet, making presentations in PowerPoint and drawing in AutoCad.

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CELE PRZEDMIOTU

C1. Problem-solving, data-handling and evaluation skills.
C2 Opportunity for students to develop an awareness of risk assessment applied to underground excavation design.

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

Z zakresu wiedzy:

PEU_W01 Student posiada wiedzę dotyczącą systemów podziemnej eksploatacji złóż, rodzajów wyrobisk podziemnych oraz sposobów ich drążenia, a także metod drążenia tuneli w różnych rodzajach masywu skalnego.

PEU_W02 Student ma wiedzę w zakresie geomechaniki niezbędną do projektowania wyrobisk podziemnych i tuneli w różnych warunkach geologicznych.

Z zakresu umiejętności:

PEU_U01 Student potrafi ocenić stateczność podziemnych wyrobisk górniczych i tunelowych oraz zaprojektować i dobrać obudowę skutecznie je zabezpieczającą.

PEU_U02 Student umie wykorzystywać metody numeryczne do projektowania oraz oceny stateczności podziemnych wyrobisk górniczych oraz potrafi zamodelować i ustalić optymalny układ i geometrię wyrobisk kopalnianych.

Z zakresu kompetencji społecznych:

PEU_K01 Student posiada umiejętność prezentacji wyników swojej pracy oraz prowadzenia dyskusji z innymi studentami.

TREŚCI PROGRAMOWE		
Forma zajęć - wykład		**Liczba godzin**
Wy1	Use of rock engineering for the design of underground excavations.	3
Wy2	Tunneling techniques for varying rock and soil material, overview of tunnelling design/instrumentation, soft ground tunnelling methods, lining design, excavation stabilisation techniques.	3
Wy3	Introductions to mining methods, equipment and basic requirements for underground mining.	3
Wy4	Layout and design of underground mine development and equipment requirements in soft and hard rocks, equipment requirements, development workings.	3
Wy5	Underground mining methods like longwall, shortwall, sublevel caving, block caving, sublevel stopping.	3
Wy6	Drilling-and-blasting technique, mechanized extraction.	3
Wy7	Roof support, mine working support, mine backfilling, drainage systems.	3
Wy8	Natural hazards such as: methane explosion, dust explosion, coal self-ignition, gas and rock outbursts, tremors, rock-bursts and climatic conditions.	3
Wy9	Review of data for underground excavation design, design methodology.	3
Wy10	Pillar design, support dimensioning, wedge failure, rock mass support interaction	3

	Suma godzin	**30**

Forma zajęć - projekt		**Liczba godzin**
Pr1	Introduction to the project. Course scope, didactic purpose, conditions for passing, literature, contact with the teacher. Basic concepts, terms, definitions.	4
Pr2	Calculation of parameters for the mining face.	3
Pr3	Location of preparatory excavations in the mining field.	3
Pr4	Selection of parameters for the rock mass. The Hoek-Brown failure criterion and classification. The Mohr-Coulomb failure criterion.	3
Pr5	Stress field calculation. Calculation of vertical stress. Calculation of horizontal stress.	4
Pr6	Introduction to numerical methods and their application in designing underground excavations.	4
Pr7	Numerical analysis of underground excavations stability.	3
Pr8	Final choice of rock bolts.	3
Pr9	Project presentations.	3
	Suma godzin	**30**

STOSOWANE NARZĘDZIA DYDAKTYCZNE
N1. Form of lectures - traditional, multimedia presentations using specialized software and discussion concerning lectures and project classes, N2 individual development of project tasks and reports, N3 evaluation of project reports

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ

Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
P1	PEU_W01, PEU_W02	Lecture grade on the basis of the written examination
P2	PEU_U01, PEU_U02	Project evaluation based on project presentation

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA

LITERATURA PODSTAWOWA:

[1] Butra J.: Eksploatacja złoża rud miedzi w warunkach zagrożenia tąpaniami i zawałami, KGHM Cuprum sp. z o.o. CBR, Wrocław 2010
[2] Butra J., Kicki J: Ewolucja technologii eksploatacji złóż rud miedzi w polskich kopalniach, Biblioteka Szkoły Eksploatacji Podziemnej, Kraków 2003
[3] Piechota S.: Technika podziemnej eksploatacji złóż, Skrypt AGH, Kraków 2003
[4] Piechota S.: Technika podziemnej eksploatacji złóż i likwidacji kopalń, Uczelniane Wydawnictwo Naukowo-Dydaktyczne AGH, Kraków 2008

[5] Pytel W.: Geomechaniczne problemy doboru obudowy kotwowej dla wyrobisk górniczych. Wyd. KGHM Cuprum sp. z o.o. CBR. Wrocław 2012.
[6] Tajduś A., Cała M., Tajduś K.: Geomechanika w budownictwie podziemnym. Projektowanie i budowa tuneli. Wyd. AGH. Kraków 2012.

LITERATURA UZUPEŁNIAJĄCA:

[1] Chudek M: Obudowa wyrobisk górniczych, Część 1: Obudowa wyrobisk korytarzowych i komorowych, Wydawnictwo „Śląsk", Katowice 1986
[2] Goszcz A: Elementy mechaniki skał oraz tąpania w polskich kopalniach węgla i miedzi, Biblioteka Szkoły Eksploatacji Podziemnej, Kraków 1999
[3] Kidybiński A., Podstawy geotechniki kopalnianej, Wydawnictwo „Śląsk", Katowice 1982
[4] Kłeczek Z., Geomechanika górnicza, Śląskie Wydawnictwo Techniczne, Katowice 1999

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

Dr inż. Karolina Adach-Pawelus,
Dr inż. Daniel Pawelus

Zał. nr 5 do ZW 8/2020
Załącznik nr … do programu studiów

WYDZIAŁ **Geoinżynierii, Górnictwa i Geologii**

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim Wentylacja i Pożary
kurs prowadzony jest w języku angielskim
Nazwa przedmiotu w języku angielskim Ventilation and Mine Fires

Kierunek studiów (jeśli dotyczy): Górnictwo i geologia.
Specjalność (jeśli dotyczy): Mining Engineering
Poziom i forma studiów: II stopień, stacjonarna
Rodzaj przedmiotu: wybieralny*
Kod przedmiotu W06GIG-SM0075
Grupa kursów NIE*

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)	15			30	
Liczba godzin całkowitego nakładu pracy studenta (CNPS)	30			120	
Forma zaliczenia	Egzamin~~/ zaliczenie na ocenę*~~	Egzamin / zaliczenie na ocenę*	Egzamin / zaliczenie na ocenę*	~~Egzamin~~ / zaliczenie na ocenę*	Egzamin / zaliczenie na ocenę*
Dla grupy kursów zaznaczyć kurs końcowy (X)					
Liczba punktów ECTS	**2**			2	
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)				2	
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)	1,5			1,5	

*niepotrzebne skreślić

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. The student has basic knowledge concerning mathematical analysis necessary to understand mathematical issues in science of engineering character.
2. The student has basic knowledge of technical thermodynamics.
3. The student has knowledge concerning mining, mainly of provision and underground deposits excavation, and knows how to fight against natural hazards.
4. The student has basic knowledge concerning mine ventilation and fire in the air thermodynamic changes, binding rules in the mine ventilation, air distribution rules in the networks of ventilation, ventilation problems during underground fire and

conducting firefighting action.

5. The student can use word processing programs and spreadsheets (with elements of programming) in the preparation of documents, calculation and while performance of multimedia presentations.
6. The student understands the need and knows the possibilities of lifelong learning (3-rd studies, post-graduate studies, courses) improving professional, personal and social skills

CELE PRZEDMIOTU

C1 - Familiarizing students with the aerology mining tasks concerning applicable legal requirements and directions of its development.
C2 - Preparing students to develop safe and economic analysis of the actual network ventilation with the use of computer technology.
C3 - Presenting problems concerning providing people protection during underground fire and marking escape routes for the crew in the event of fire
C4 - Getting known and understanding of the factors influencing climate conditions in the mine excavations and methods of assessment and forecast climate conditions in mine.
C5 - Understanding the theoretical cooling processes used in mines air conditioning, balance calculations of air conditioning systems and preparing students to perform air conditioning projects of mine's selected areas.
C6 - Learning local and central air conditioning solutions used in the Polish mines and abroad.

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

Z zakresu wiedzy:
PEU_W01 - The student has elementary knowledge concerning the ventilation of mines in terms of natural hazards.
PEU_W02 - The student has knowledge concerning methods used in the study of safety and economics in real ventilation networks.
PEU_W03 - The student has knowledge concerning the impact of physical-thermal rock mass properties and mining operations conducted and which has influence on climate in mine and predicting thermal conditions in the excavations.
PEU_W04 - The student has knowledge concerning the cooling processes used in mine air conditioning, used thermodynamic factors and heat dissipation capabilities, particularly from underground air-conditioning equipment.
PEU_W05 - The student has knowledge concerning used in Polish and international mining, air conditioning solutions and knows the trends in their development.

Z zakresu umiejętności:
PEU_U01 - The student is able to carry out the safety and economics analysis of ventilation network.
PEU_U02 - The student can, using computational tools, determine the escape road for crew from places which are at risk of underground fire.
PEU_U03 - The student is able to perform balance calculations of air conditioning systems.
PEU_U04 - The student is able to compile air conditioning projects of mining regions.
PEU_U05 – The student can analyse local and central air conditioning solutions used in the Polish mines and abroad taking into consideration their advantages and disadvantages.

Z zakresu kompetencji społecznych:

PEU_K01 - The student can develop and present the results of his project work as spread sheets, paper report, and multimedia presentation.
PEU_K02 - The student is aware of the environmental hazards caused by the major fans noise, greenhouse gases and dust as a result of mine ventilation.
PEU_K03 - The student is aware of the influence of thermodynamic factors used in mines air conditioning on the greenhouse effect and ozone hole.

TREŚCI PROGRAMOWE		
Forma zajęć - wykład		**Liczba godzin**
Le1	Rules of mines ventilation in terms of natural hazards. Safe and economic analysis of the actual network ventilation with the use of computer technology.	2
Le2	Protecting people while underground fire. Possibilities of computer generated hazardous area at a different fire location. Determination of escape routes in case of fire.	2
Le3	Factors affecting climate conditions in mine excavations: the impact of air pressure changes, operating machinery, quantities and humidity, thermal properties of rocks. Energy balance in the rock mass and mining excavation, heat conductance equation.	2
Le4	Methods for predicting air temperature in mine excavations which are ventilated separately and with the use if streamlined ventilation.	2
Le5	Cooling processes in mines air conditioning. Development trends of conditioning mines - the use of ice. Reducing pressure in air conditioning systems. Heat dissipation capabilities from the underground air conditioning installations. Refrigerants and coolants and their impact on the environment.	3
Le6	Solutions of local and central air conditioning in mines.	2
Le7	Calculations balance of air conditioning systems. Air conditioning solutions used in mines abroad.	2
	Total hours	**15**

Forma zajęć - ćwiczenia		**Liczba godzin**
Ćw1		
Ćw2		
Ćw3		
Ćw4		
..		
	Suma godzin	

Forma zajęć - laboratorium		**Liczba godzin**
La1		
La2		
La3		
La4		
	Total hours	**15**

Forma zajęć - projekt		Liczba godzin
Pr1	Scope of design exercises, crediting conditions, literature Giving students individual project tasks. Analysing tips to design exercises regarding: 1) "Determination of escape routes in case of fire. 2) Solution of air conditioning of long wall or pillar-chamber mining unit.	2
Pr2	Analysis of the danger zone for selected crew's positions (branches) through a system of "Fire".	4
Pr3	Determination of the crew escape routes depending on the place of underground fire appearance.	4
Pr4	Forecasting thermal and moisture conditions in the excavations which deliver the air to the area and in the area.	4
Pr5	Climate assessment in the region. Determining the extent of air conditioning. The adoption of the air conditioning concept.	4
Pr6	Appointment of necessary cooling capacity and its distribution in the excavations. The choice of air conditioning machine (s).	4
Pr7	Calculation of the required pipe insulation. Determination of pressure loss in pipes. The choice of a compression pump.	4
Pr8	Solution of heat dissipation from MK to air consumed currents by the means of, specified in assignment, device (evaporator refrigerator, cooling tower, or a washing chamber). Implementation of the unit's heat balance, before and after air conditioning.	4
	Total hours	**30**

Forma zajęć - seminarium		Liczba godzin
Se1		
Se2		
Se3		
…		
	Suma godzin	

STOSOWANE NARZĘDZIA DYDAKTYCZNE
N1. Type of lectures - traditional, illustrated with multimedia presentations N2. Didactic discussion during lecture and project. N3. Duty hours

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ

Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
P1	PEK_W01-W05	Final grade of written test.
P2	PEK_U01-U05 PEK_K01 - K03	Final grade from the project in a paper form and its defence

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA

LITERATURA PODSTAWOWA:

[1] Wacławik J.: Wentylacja kopalń tom I i II, AGH Pub., Kraków 2010.
[2] Roszkowski J., Pawiński J., Strzemiński J.: Przewietrzanie kopalń, ŚWT Pub., Katowice 1995.
[3] Strumiński A.: Zwalczanie pożarów w kopalniach głębinowych, Śląsk Pub., Katowice 1996.
[4] Wacławik J., Cygankiewicz J., Knechtel J.: Warunki klimatyczne w kopalniach głębokich, PAN, Kraków 1998
[5] McPherson M. J.: Subsurface Ventilation and Environmental Engineering, Published by Chapman & Hall, London 1993.
[6] Gutkowski K. M.: Chłodnictwo i klimatyzacja, WNT, Warszawa 20

LITERATURA UZUPEŁNIAJĄCA:

[1] Łuska P., Nawrat S.: Klimatyzacja kopalń podziemnych: urządzenia chłodnicze. Biblioteka Szkoły Eksploatacji Podziemnej, Kraków 2002.
[2] Łuska P., Nawrat S.: Klimatyzacja kopalń podziemnych: systemy chłodnicze. AGH Uczelniane Wydawnictwa Naukowo-Dydaktyczne, Kraków 2008.
[3] Madeja-Strumińska B., Strumiński A.: Aerotermodynamika górnicza, Śląsk Pub., Katowice 1997.
[4] Chmura K., Chudek M.: Geotermomechanika górnicza, Księgarnia Nakładowa „SUPLEMENT”
[5] Frycz A.: Klimatyzacja kopalń. "Śląsk” Pub., Katowice 1981

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

Dr inż. Sebastian Gola
Mgr inż. Aleksandra Banasiewicz

3-rd Semester

Semestr 3

Zał. nr 5 do ZW 8/2020
Załącznik nr … do programu studiów

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,
Level and form of studies: 2nd level, full-time
Kind of subject: **elective**
Subject code: **W06GIG-SM0069**
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)	30		30		
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	1		1		

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

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	F1.1 Grade from laboratory work's performance and its merits F.1.2 Grade from laboratory work's oral or written defence P1.Final grade (weighted average of F1.1 - 60% and F1.2 - 40%).
F2, P2	PEK_U02-PEK_U04	F2.1 Grade from activity during the lecture (questions, discussions etc) F.2.2 Grade from written exam P2.Final grade (weighted average of F2.1 - 20% and F2.2 - 80%).

LITERATURE

PRIMARY LITERATURE:

[1] LabVIEWTM 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

Zał. nr 5 do ZW 8/2020
Załącznik nr … do programu studiów

FACULTY OF GEOENGINEERING, MINING AND GEOLOGY

SUBJECT CARD

Name in Polish: Zarządzanie Środowiskiem
….(zajęcia są prowadzone w języku angielskim)
Name in English: Environmental Management
Faculty of studies (if applicable): Mining and Geology
Specialisation (if applicable): Mining Engineering
Level and form of studies: 2nd level, full-time
Subject Type: Obligatory
Subject code: W06GIG-SM0078
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)	**60**				**30**
Form of crediting	**Crediting with grade**				**Crediting with grade**
For a group of courses mark (X) for the final course					
Number of ECTS points	**1**				**1**
including number of ECTS points for practical (P) classes					
including number of ECTS points for direct teacher-student contact (BU) classes	**1,5**				**0,5**

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 Lec.5 Lec.6	Environmental management systems: - Business Charter for Sustainable Development of the International Chamber of Commerce - ICC Business Charter for Sustainable	6

	Development - 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 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.	
Lec.7 Lec.8	Basic tools of environmental management: - 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) Examples of basic tools of environmental management: - 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	IT systems supporting environmental management: - Decision Support Systems - Expert systems - Simulation Models - Geographical Information Systems Selected types of information systems which support environmental management, their characteristics, examples of implementation both in Poland and in the world	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 Se3 Se4 Se5 Se6 Se7 Se8	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
	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, Bialystok,

[2] Lukasheh 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, Rzeszow

[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. PZIiTS, Poznan

[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. PZIiTS, AE, Poznan – 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

Zał. nr 5 do ZW 8/2020
Załącznik nr … do programu studiów

FACULTY OF GEOIENGINEERING, MINING AND GEAOLOGY

SUBJECT CARD

Name in Polish: Systemy przeróbcze
kurs prowadzony jest w języku angielskim
Name in English: Mineral Processing Systems
Main field of study (if applicable): Mining and Geology
Specialization (if applicable): Mining Engineering,
Level and form of studies: 2nd, full-time
Kind of subject: elective
Subject code: W06GIG-SM0069
Group of courses: NO

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	**15**			**30**	
Number of hours of total student workload (CNPS)	**30**			**60**	
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	**1**			**1**	

*delete as applicable

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Fundamentals of mineral processing and waste.
2. Basic knowledge of mathematical statics, line programming, programming in VBA.

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SUBJECT OBJECTIVES

C1 Presenting production issues in the mineral industry as an optimization problem of managing the operation of complex technological systems.
C2 Familiarising students with modern methods of off-line analysis of complex systems, mineral processing and waste.
C3 Creating skills to construct simple models and algorithms for mining operations and tailings and their implementation using a spreadsheet supported by VBA program.
C4 Creating skills to prepare and present reports of performed analyses and projects.

SUBJECT LEARNING OUTCOMES

Subject learning outcome relating to knowledge:

PEU_W01 The student has general knowledge of technologies used in refining, and processing mineral resources

PEU_W02 The student gets to know the principle of mathematical modelling of tailings operationsand problems of experimentation to determine model parameters of an operation.

PEU_W03 The student gets to know the criteria and algorithms of optimization (off-line) of complex systems of technological operations

PEU_W04 The student gets to know the examples of commercial and training functions of software for the analysis of tailings systems (JKSimMet, ModSim, WTP)

PEU_W05 The student gets to know how to perform simulation calculations of systems of qualitative and quantitative operations using calculating tools available in the spreadsheet (functions,VBA)

PEU_W06 The student gets to know how to perform simulation calculations of processes of qualitative and quantitative operations using calculating tools available in the spreadsheet (functions, VBA)

Subject learning outcome relating to skills:

PEU_U01 - The student can perform basic calculations of simple models tailings operations: crushing and classification and evaluating their performance

PEU_U02 - The student can perform an individual/ group task to optimize a simple feedback system of mining operations and / or tailings

PEU_U03 - The student can develop and present the results of his project work (paper report, multimedia presentation of sample analysis of mineral system in processing and waste

Subject learning outcome relating to social competence:

PEU_K01 - The student has created attitude of critical overview of the available knowledge on the course.

PROGRAMME CONTENT		
Form of classes - lecture		**Number of hours**
Le1	Scope of lecture, crediting conditions, literature overview. Profile characteristics of the course and the aims and methods of education. Linking the course problems with the course profile and educational programs of other courses of particular specialty and the field of study	2
Le2	The basic structures of mining, coal preparation and processing systems on the example of the construction materials industry, mining ore and coal, metallurgy, waste management	2
Le3	Types and systematics of operations, information operations model, the concept of system and process operations, performance, efficiency, reliability, productive hours.	2
Le4	Methods and tools for the analysis of complex systems operations. Spreadsheet as a calculation tool (functions, VBA)	2
Le5	Modelling crushing operations, crushing machine models, methods and problems of experimentation	2
Le6	Modelling of classification procedure (separation), classifier / separator models, methods and problems of experimentation	2
Le7	Methods of simulation of the quantitative operations processes (mass flow in systems, tanks, and machines). Knowledge control - test	3
	Total hours	**15**

Form of classes - project		Number of hours
Pr1	Introduction to the project: assumptions, aims, form, schedule	3
Pr2	Checking the initial knowledge of the students in auditorial mode.	3
Pr 3	Solving simple calculation using a spreadsheet (functions, calculus matrix).	3
Pr 4	Duty hours and exercises checking the knowledge of mathematical statistics (grain size) and the ability to operate on sets.	3
Pr 5	Handing out tasks and explanation for individual work (system analysis operations: different structures, different technologies, and different models). Variable catalogue of exercises, adjusted to current students level of knowledge and skills of).	3
Pr 6	Algorithmization and programming of tasks examples concerning the grain analysis in VBA - exercises on auxiliary examples.	3
Pr 7	Individual work: the construction of models of a given operation, individual duty hours.	3
Pr 8	Individual work: analysis (optimization) of given operation systems according to qualitative, quantitative and economics criteria, monitoring the performance, individual duty hours	3
Pr 9	Presentation/project defence of ready-made projects by students. Project settlement (course crediting). Partial crediting.	3
Pr 10	(to be continued) Presentation/project defence of ready-made projects by students, including repeats. Project settlement (course crediting). Partial crediting.	3
	Total hours	**30**

TEACHING TOOLS USED
N1. Informative lecture with the elements of problem solving lecture, multimedia presentations, N2 didactic discussion considering the lecture and the project, N3 projects preparation in a report form, written exam (knowledge test), N4 checking the progress of project, presentation and project defence, duty hours.

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 - Assessment of problem solving skills		
F2 - Form and performance.		
P1 - Partial grade from examination which covers the content of the lecture: test of control tasks specific to the subject of the course (differentiated tasks, sorted by difficulty in %, set = 100%) the best score plus bonuses for attending the lectures determine the reference level		
P2 - Partial grade of crediting the project (weighted average of projects - 70% meritum and 30% a form)		
P3.Final grade of the group of courses: mean of constituent grades from the lecture and the project.		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

[1] Drzymała J., Podstawy przeróbki kopalin, Politechnika Wrocławska Publishing House,
[2] Wrocław 2006.
[3] King R.P., Modeling & simulation of mineral processing systems, Batterworth and Heinemann,
[4] Oxford, 2001.
[5] Lynch A.J.,Mineral crushing and grinding circuits, Elsevier Sci Publ.Company, Amsterdam, Oxford, NY, 1977.
[6] 7. Wills B.A., Mineral Processing Technology.

SECONDARY LITERATURE

[1] Malewski J, Modrzejewski S., Modelowanie i optymalizacja systemów i procesów wydobycia i przeróbki kruszyw łamanych, Górnictwo Odkrywkowe Publishing, Wrocław, 2008
[2] Malewski J., Zarządzanie produkcją – kluczową technologią rozwoju przemysłu wydobywczego rud miedzi i surowców towarzyszących, Cuprum, nr 1/2008.
[3] Monografia KGHM, (pod red. Piestrzyńskiego), Lubin 2007.
[4]

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

Dr inż. Tomasz Ratajczak
Dr. inż. Danuta Szyszka

Zał. nr 5 do ZW 8/2020
Załącznik nr … do programu studiów

FACULTY OF GEOIENGINEERING, MINING AND GEAOLOGY

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,
Level and form of studies: 2nd, full-time
Kind of subject: obligatory
Subject code: W06GIG-SM0079
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)	**60**		**30**		
Form of crediting	**crediting with grade**		**Crediting with grade**		
For group of courses mark (X) final course					
Number of ECTS points	**2**		**1**		
including number of ECTS points for practical (P) classes of practical character (P)			**1**		
including number of ECTS points for direct teacher-student contact (BU) classes	**1**		**1**		

*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
C1.2 Models of planning, deposits and costs of projects

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

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

PRIMARY LITERATURE

[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

SECONDARY LITERATURE

[1] Szapiro T., Decyzje menedżerskie z Excelem, PWE 2000
[2] Trzaskalik T., Modelowanie optymalizacyjne, Absolwent
[3] Trzaskalik T., Badania operacyjne z komputerem, PWE

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

Dr inż. Witold Kawalec
Dr hab. inż. Leszek Jurdziak
Dr inż. Zbigniew Krysa

COURSE DESCRIPTIONS/
KARTY PRZEDMIOTÓW

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

specjalność/specialisation:
Geotechnical and Environmental Engineering

1-st Semester

Semestr 1

Zał. nr 5 do ZW 8/2020
Załącznik nr … do programu studiów

WYDZIAŁ **Geoinżynierii, Górnictwa i Geologii**

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim Wspomagane komputerowo modelowanie geologiczne i geostatystyka. ….(zajęcia są prowadzone w języku angielskim)

Nazwa przedmiotu w języku angielskim Computer Aided Geological Modelling and Geostatistics…….

Kierunek studiów (jeśli dotyczy): Górnictwo i geologia.

Specjalność (jeśli dotyczy): Mining Engineering,
Geotechnical and Environmental Engineering,
Geomatics for Mineral Resource Management

Poziom i forma studiów: II stopień, stacjonarna

Rodzaj przedmiotu: obowiązkowy *

Kod przedmiotu W06GIG-SM0038

Grupa kursów NIE*

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)	15		45		
Liczba godzin całkowitego nakładu pracy studenta (CNPS)	30		120		
Forma zaliczenia	~~Egzamin /~~ zaliczenie na ocenę*	Egzamin / zaliczenie na ocenę*	~~Egzamin /~~ zaliczenie na ocenę*	Egzamin / zaliczenie na ocenę*	Egzamin / zaliczenie na ocenę*
Dla grupy kursów zaznaczyć kurs końcowy (X)					
Liczba punktów ECTS	**1**		4		
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)			4		
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)	1		2		

*niepotrzebne skreślić

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

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

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CELE PRZEDMIOTU

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.

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

Z zakresu wiedzy:
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.
Z zakresu umiejętności:
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

Z zakresu kompetencji społecznych:
PEK_K01 The student can think and act in a creative and enterprising way

TREŚCI PROGRAMOWE		
Forma zajęć - wykład		**Liczba godzin**
Wy1	Introduction to the course. Geological database and validation of the geological data.	2
Wy2	Geology of the seam.	2
Wy3	Structural model of the stratified deposit. Methods of the prediction of the surface layer parameters.	2
Wy4	Spatial distribution of samples values. Regionalized variable.	2
Wy5	BLUE Estimator of the mean value: Kriging.	2
Wy6	Quality model of the deposit – block model of the parameter layers. Estimation and evaluation of the block model.	2
Wy7	Reserves modelling and evaluation.	2
Wy8	Mineral resources. International reporting. The JORC Code	1
	Suma godzin	**15**

Forma zajęć - ćwiczenia		**Liczba godzin**
Ćw1		
Ćw2		
Ćw3		
Ćw4		
..		
	Suma godzin	0

Forma zajęć - laboratorium	**Liczba godzin**

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 estimation procedure.	3
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
	Suma godzin	45

Forma zajęć - projekt		Liczba godzin
Pr1		
Pr2		
Pr3		
Pr4		
…		
	Suma godzin	**0**

Forma zajęć - seminarium		Liczba godzin
Se1		
Se2		
Se3		
…		
	Suma godzin	0

STOSOWANE NARZĘDZIA DYDAKTYCZNE

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.

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ

Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
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		

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA

LITERATURA PODSTAWOWA:

[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.

LITERATURA UZUPEŁNIAJĄCA:

[10] Handouts, tutorials.

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

Dr inż. Krzysztof Hołodnik
Dr inż. Witold Kawalec, Dr Paweł Zagożdżon

Zał. nr 5 do ZW 8/2020
Załącznik nr … do programu studiów

WYDZIAŁ GEOINŻYNIERII, GÓRNICTWA i GEOLOGII

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim Geofizyka inżynierska
….(zajęcia są prowadzone w języku angielskim)
Nazwa przedmiotu w języku angielskim Engineering Geophysics
Kierunek studiów (jeśli dotyczy): górnictwo i geologia
Specjalność (jeśli dotyczy): Mining Engineering,
Geotechnical and Environmental Engineering,
Geomatics for Mineral Resource Management
Poziom i forma studiów: ~~I~~/ II stopień / ~~jednolite studia magisterskie~~*, stacjonarna / ~~niestacjonarna~~*
Rodzaj przedmiotu: ~~obowiązkowy~~ / wybieralny / ~~ogólnouczelniany~~ *
Kod przedmiotu W06GIG-SM0040
Grupa kursów ~~TAK~~ / NIE*

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)	15			15	
Liczba godzin całkowitego nakładu pracy studenta (CNPS)	40			50	
Forma zaliczenia	~~Egzamin~~ / zaliczenie na ocenę*			~~Egzamin~~ / zaliczenie na ocenę*	
Dla grupy kursów zaznaczyć kurs końcowy (X)					
Liczba punktów ECTS	1			2	
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)				2	
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)				2	

*niepotrzebne skreślić

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

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.

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CELE PRZEDMIOTU

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.

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

Z zakresu wiedzy:

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.

Z zakresu umiejętności:

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 geoengineering 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.

Z zakresu kompetencji społecznych:

PEU_K02 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.

TREŚCI PROGRAMOWE		
Forma zajęć - wykład		**Liczba godzin**
Wy1	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
Wy2	Engineering problems solved with geophysical surveying. Case studies.	2
Wy3	Electrical resistivity methods. Tomography and VSE. IP method. Physical principles. Equipment. Methods of field surveying. Interpretation and application. Case studies.	2
Wy4	Electromagnetic methods. FDEM and TDEM methods. Magnetotelluric methods. Physical principles. Methods of field surveying. Equipment. Interpretation and application. Case studies.	2
Wy5	GPR surveying. Physical principles. Methods of field surveying.	2

	Equipment. Interpretation and application. Case studies.	
Wy6	Seismic tomography. Seismic interferometry. Physical principles. Applications. Case studies.	2
Wy7	Mine geophysics. Seismology. Seismic methods. Active and passive seismic tomography. Microgravimetry. Case studies.	2
Wy8	Gravity and magnetic surveying. Equipment. Methods of field surveying. Interpretation and application. Case studies.	2
	Suma godzin	**15**

Forma zajęć - projekt		**Liczba godzin**
Pr1	One selected geophysical technique. Fundamentals and equipment. Field surveying	4
Pr2	Processing and interpretation of field data.	3
Pr3	Solving the geophysical problems.	8
	Suma godzin	**15**

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

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ

Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
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.

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA

LITERATURA PODSTAWOWA:

[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).

LITERATURA UZUPEŁNIAJĄCA:

[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.

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

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

Zał. nr 5 do ZW 8/2020
Załącznik nr … do programu studiów

WYDZIAŁ **Geoinżynierii, Górnictwa i Geologii**

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim Bezpieczeństwo i higiena pracy ….(zajęcia są prowadzone w języku angielskim)

Nazwa przedmiotu w języku angielskim Occupational Health and Safety

Kierunek studiów (jeśli dotyczy): Górnictwo i geologia.

Specjalność (jeśli dotyczy): Mining Engineering
Geotechnical and Environmental Engineering,
Geomatics for Mineral Resource Management

Poziom i forma studiów: II stopień, stacjonarna

Rodzaj przedmiotu: obowiązkowy *

Kod przedmiotu W06GIG-SM0042

Grupa kursów NIE*

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)	15			15	
Liczba godzin całkowitego nakładu pracy studenta (CNPS)	30			30	
Forma zaliczenia	~~Egzamin /~~ zaliczenie na ocenę*	Egzamin / zaliczenie na ocenę*	Egzamin / zaliczenie na ocenę*	~~Egzamin~~ / zaliczenie na ocenę*	Egzamin / zaliczenie na ocenę*
Dla grupy kursów zaznaczyć kurs końcowy (X)					
Liczba punktów ECTS	**1**			1	
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)				1	
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)	1			1	

*niepotrzebne skreślić

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

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.

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CELE PRZEDMIOTU

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.

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ
Z zakresu wiedzy: 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 _W0 3 – Possesses general knowledge of corrective and preventive actions regarding hazards of typical work posts in the mining industry.… Z zakresu umiejętności: 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.… Z zakresu kompetencji społecznych: 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

TREŚCI PROGRAMOWE		
Forma zajęć - wykład		**Liczba godzin**
Wy1	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
Wy2	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
Wy3	Dangerous factors - identification and assessment of risks.	3
Wy4	Nuisance factors in occupational risk assessment: psychological burden, static burden, monotype.	3
Wy 5	Methods of occupational risk assessment: STER software, the RISC SCORE method, written test	3
	Suma godzin	**15**

Forma zajęć - ćwiczenia		**Liczba godzin**
Ćw1		
Ćw2		
Ćw3		

Ćw4		
..		
	Suma godzin	

Forma zajęć - laboratorium		Liczba godzin
La1		
La2		
La3		
La4		
La5		
…		
	Suma godzin	

Forma zajęć - projekt		Liczba godzin
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 harmful factors (vibration, chemical agents)	3
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 bimi 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, monotype)	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**

Forma zajęć - seminarium		Liczba godzin
Se1		
Se2		
Se3		
…		
	Suma godzin	

STOSOWANE NARZĘDZIA DYDAKTYCZNE
N1. Informative lecture with elements of problematic lectures. N2 Multimedia presentations. N3 Didactic discussions during lectures. N4 Didactic discussions during laboratory classes. N5Computer presentation of executed occupational risk assessments. N6Consultation.

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ

Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
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)
P		

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA

LITERATURA PODSTAWOWA:

[1] Iwona Romanowska Słomka, Adam Słomka Zarządzanie ryzykiem zawodowym. Wydawnictwo TARBONUS, Krakow Tarnobrzeg, 2009

[2] Iwona Romanowska Słomka, Adam Słomka Ocena ryzyka zawodowego. Wydawnictwo TARBONUS, Krakow Tarnobrzeg, 2010

[3] Wiesława Horst Ryzyko zawodowe na stanowisku pracy. Część 1, Ergonomiczne czynniki ryzyka. Wydawnictwo Politechniki Poznańskiej, Poznan, 2004

LITERATURA UZUPEŁNIAJĄCA:

[1] PN-N-18002 Systemy zarządzania bezpieczeństwem i higieną pracy - Ogólne wytyczne do oceny ryzyka zawodowego

[2]

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

Dr inż. Żaklina Konopacka

Zał. nr 5 do ZW 8/2020
Załącznik nr … do programu studiów

WYDZIAŁ **Geoinżynierii, Górnictwa i Geologii**

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku angielskim: Project Management, Appraisal and Risk Evaluation ….(zajęcia są prowadzone w języku angielskim)

Nazwa przedmiotu w języku polskim :Zarządzanie projektami, ocena ich opłacalności i ryzyka.

Kierunek studiów (jeśli dotyczy): Górnictwo i geologia

Specjalność (jeśli dotyczy): Mining Engineering,
Geotechnical and Environmental Engineering,
Geomatics for Mineral Resource Management

Poziom i forma studiów: II stopień , stacjonarna

Rodzaj przedmiotu: obowiązkowy

Kod przedmiotu W06GIG-SM0039G

Grupa kursów TAK

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)	15		30	15	
Liczba godzin całkowitego nakładu pracy studenta (CNPS)	30		60	30	
Forma zaliczenia	Egzamin				
Dla grupy kursów zaznaczyć kurs końcowy (X)	X				
Liczba punktów ECTS	4				
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)	3				
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)	3				

*niepotrzebne skreślić

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

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.

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CELE PRZEDMIOTU

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.

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

Z zakresu wiedzy:

PEU_W01 rozumie pojęcia podaży i popytu, elastyczności popytu i ich wpływ na rynki
PEU_W02 zna pojęcia kosztów w ekonomii i rachunkowości, rozumie różnice
PEU_W03 zna sposoby klasyfikacji kosztów w przedsiębiorstwach, zna i rozumie podstawowe pojęcia rachunku kosztów
PEU_W04 ma podstawową wiedzę o treści i wzajemnych relacjach bilansu, rachunku zysków i strat oraz rachunku przepływów pieniężnych, zna sposób prezentacji danych finansowych przedsiębiorstw w ustawowych sprawozdaniach finansowych i zna ich warianty.
PEU_W05 ma podstawową wiedzę na temat metody analizy wskaźnikowej sprawozdań finansowych
PEU_W06 zna pojęcia wartości przyszłej i wartości obecnej przepływów pieniężnych i rent rocznych
PEU_W07 zna podstawowe i zaawansowane metody oceny efektywności inwestycji (NPV, IRR, MIRR, DPBP, PBP) oraz zakresy ich stosowania
PEU_W08 ma podstawową wiedzę o metodach oceny ryzyka inwestycji

Z zakresu umiejętności:

PEU_U01 potrafi przeprowadzić analizę przyczyn i skutków zmiany popytu i podaży
PEU_U02 na podstawie krzywych kosztowych potrafi przeprowadzić optymalizację wielkości produkcji w różnych przypadkach.
PEU_U03 umie zinterpretować i korzystać z informacji zawartych w ustawowych sprawozdaniach finansowych. Umie przeprowadzić analizę wskaźnikową sprawozdań finansowych w podstawowym zakresie
PEU_U03 umie korzystać z danych kosztowych przedstawionych w różnych układach ewidencyjnych kosztów, umie stosować podstawowe metody rachunkowości zarządczej do podejmowania decyzji krótkoterminowych
PEU_U04 potrafi obliczyć wartość przyszłą i obecną pieniądza dla szeregu płatności oraz rozwiązać zadania rachunkowe z zakresu wartości pieniądza w czasie
PEU_U05 potrafi przeprowadzić ocenę opłacalności inwestycji poznanymi metodami
PEU_U06 potrafi przeprowadzić analizę wrażliwości i analizę scenariuszy z wykorzystaniem modelu finansowego inwestycji
PEU_U07 potrafi przygotować dokumentację projektową w podstawowym zakresie i

zainicjować projekt
PEU_U08 potrafi zastosować podstawowe metody zarządzania projektami, monitorowania i zarządzania ryzykiem projektu
PEU_U09 potrafi zastosować podstawowe metody zarządzania konfliktami w grupie
PEU_U10 potrafi zastosować podstawowe metody zarządzania grupą i kreowania pozycji lidera, potrafi ocenić skuteczność zarządzania grupą
Z zakresu kompetencji społecznych:
PEU_K01 potrafi myśleć i działać w sposób systemowy, kreatywny i przedsiębiorczy
PEU_K02 ma utrwaloną postawę ekonomicznego działania i podejmowania decyzji w oparciu o dostępne informacje finansowe i prognozy

TREŚCI PROGRAMOWE		
Forma zajęć - wykład		**Liczba godzin**
Wy1	Supply and demand, equilibrium price, changes in demand and supply. Stock and commodity markets used by mineral industries	2
Wy2	Costs in economics and in accounting. Cost and money outflow. Relevant cost, incremental cost, marginal cost, alternative cost. Short-term decision making.	2
Wy3	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
Wy4	Variable and fixed costs. Break even point. Cost-volume –profit analysis.	1
Wy5	Basics of financial accounting. Income statement and cash flow statement. Balance sheet. Working capital. Examples of financial statements of mining companies	2
Wy6	Financial ratio analysis. Liquidity, profitability, activity and debt ratios. Financial and operating leverage.	2
Wy7	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
Wy8	The concept of risk and return. Quantification of risk. Risk analysis in project evaluation: sensitivity analysis, scenario analysis, other methods.	2
	Suma godzin	15

Forma zajęć - projekt		**Liczba godzin**
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	3

	Team roles Belbin perspective Discussion group roles Effective managerial behaviour in the context of team roles	
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; Effective managerial behaviour from the different contexts.	3
	Suma godzin	15

Forma zajęć - laboratorium		**Liczba godzin**
	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**

STOSOWANE NARZĘDZIA DYDAKTYCZNE
N1. Wykład interaktywny z pokazem slajdów i dyskusją N2. Ćwiczenia laboratoryjne: indywidualne rozwiązywanie zadań z wykorzystaniem arkusza kalkulacyjnego. N3. Ćwiczenialaboratoryjne: rozwiązywanie zadań w grupach. Prezentacja wyników. Dyskusja o otrzymanych wynikach N4. Konsultacje N5. Praca własna – rozwiązywanie zadań domowych N6. Praca własna – samodzielne studia literaturowe

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ

Oceny (F – formująca (w trakcie semestru), P	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się

– podsumowująca (na koniec semestru)		
F1	PEU_W01-W08 PEU_K01-K02	Dyskusja na zajęciach, ocena aktywności studentów na zajęciach laboratoryjnych i projektowych
F2	PEU_U01-U10 PEU_K01-K02	Ocena rozwiązań zadań uzyskanych przez studentów w trakcie zajęć laboratoryjnych i projektowych
P1	PEU_W01-W08 PEU_U01-U10 PEU_K01-K02	Egzamin pisemny
P2	PEU_W01-W08 PEU_U01-U10 PEU_K01-K02	Ocena indywidualnych rozwiązań zadań nadesłanych przez studentów po zajęciach

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA

LITERATURA PODSTAWOWA:

1. Erhardt M., Brigham E.: Financial Management Theory and Practice. South-Western Cengage Learning, USA
2. Brigham E.: Podstawy zarządzania finansami. Polskie Wydawnictwo Ekonomiczne, Warszawa 1997
3. Czekaj J., Dresler Z.: Podstawy zarządzania finansami firm. PWN Warszawa 1996
4. Jaruga A., Sobańska J., Kopczyńska L. Szychta A.: *Rachunkowość dla menedżerów*. Towarzystwo Gospodarcze RAFIB, Łódź 1996.
5. Jonson H.: Ocena projektów inwestycyjnych. Maksymalizacja wartości przedsiębiorstwa. Wyd. K.E. Liber, Warszawa 2000.
6. Nowak E.: Rachunek kosztów przedsiębiorstwa. Wydawnictwo Ekspert, Wrocław 2001
7. Sierpińska M., Jachna T.: Ocena przedsiębiorstwa według standardów światowych, PWN Warszawa 1994.
8. Świderska G. K.(red): Rachunkowość zarządcza. (praca zbiorowa) Wyd. Poltext, Warszawa 1997
9. Wysocki Robert K., McGary R., Efektywne zarządzanie projektami, OnePress, 2005
10. Lock Dennis, Podstawy zarządzania projektami, PWE, 2009

LITERATURA UZUPEŁNIAJĄCA:

1. Jajuga K., Jajuga T., 2006. Inwestycje. Instrumenty finansowe, aktywa niefinansowe, ryzyko finansowe, inżynieria finansowe, Wydawnictwo Naukowe PWN, Warszawa.
2. Jonson H.: Koszt kapitału. Klucz do wartości firmy. Wyd. K.E. Liber, Warszawa 2000
3. Turyna J., Pułaska-Turyna B.: Rachunek kosztów i wyników. Wyd. Finans-Servis, Warszawa 1997.
4. A Guide to Project Management Body of Knowledge (PMBOK®Guide Fourth Edition), Project Management Institute, 2008 (2004). wydanie polskie, MT&DC Warszawa, 2009 (2006)

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

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

Zał. nr 5 do ZW 8/2020
Załącznik nr … do programu studiów

WYDZIAŁ **Geoinżynierii, Górnictwa i Geologii**

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim Teoria i praktyka w geomechanice….(zajęcia są prowadzone w języku angielskim)

Nazwa przedmiotu w języku angielskim Theory and Practise in Geomechanics

…….

Kierunek studiów (jeśli dotyczy): Górnictwo i geologia.

Specjalność (jeśli dotyczy): Mining Engineering,
Geotechnical and Environmental Engineering,

Poziom i forma studiów: II stopień, stacjonarna

Rodzaj przedmiotu: obowiązkowy *

Kod przedmiotu W06GIG-SM0043G

Grupa kursów NIE*

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)	60	15			
Liczba godzin całkowitego nakładu pracy studenta (CNPS)	150	30			
Forma zaliczenia	Egzamin / ~~zaliczenie na ocenę*~~	~~Egzamin /~~ zaliczenie na ocenę*	Egzamin / zaliczenie na ocenę*	Egzamin / zaliczenie na ocenę*	Egzamin / zaliczenie na ocenę*
Dla grupy kursów zaznaczyć kurs końcowy (X)					
Liczba punktów ECTS	**4**	**2**			
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)		2			
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)	3,5	1,5			

*niepotrzebne skreślić

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. Introduction to Mathematical Analysis, Statics and Strength of Materials.

\

CELE PRZEDMIOTU

C1 Presentation of foundations of Theory of Elasticity and its application in Rock and Soil Mechanics (The lecture will be delivered in index notation).

C2 Introduction of fundamental concepts of rock and soil mechanics and their application in surface and underground mining.

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

Z zakresu wiedzy:

PEU_W01 Student ma ugruntowaną wiedzę w zakresie podstaw teorii sprężystości – m.in. stanu naprężeń i odkształceń w masywie skalnym.

PEU_W02 Student ma wiedzę dotyczącą kryteriów wytrzymałościowych stosowanych w mechanice skał oraz gruntów.

Z zakresu umiejętności:

PEU_U01 Student potrafi zastosować metod obliczeniowe teorii sprężystości do określenia stanu naprężenia i odkształcenia w górotworze oraz wykorzystać te obliczenia do oceny jego stateczności.

Z zakresu kompetencji społecznych:

PEU_K01 Student posiada umiejętność rozwiązywania zadań oraz prezentacji otrzymanych wyników przed innymi studentami.

TREŚCI PROGRAMOWE		
Forma zajęć - wykład		**Liczba godzin**
Theory of Rock Mechanics		
Wy1	Frame of axes Cartesian coordinates. Einstein summation convention. Kroecker delta. Permutation symbol. Relationship e – δ.	2
Wy2	State of strain. Material and space coordinate. Green, Almansy and Couchy strain tensors. Gradient matrix. Geometric interpretation of infinitesimal strain components.	2
Wy3	Spherical and deviatoric tensors of state of strain. Principal strains and principal axes of strain tensor. Strain tensor invariants. Tensor of principal axes. Capability equations.	2
Wy4	State of stress. Stress vector and stress tensor. Couchy formula. Coordinate transformations for stresses. Formal definition of a tensor. Hydrostatic and stress deviation tensor.	2
Wy5	Normal and shear stresses. Principal stresses and principal axes of stress tensors and stress deviation tensors. Invariants of stress and stress deviation tensors. Octahedral stresses. Intensity of stress tensor. Mohr circle of stress components.	2
Wy6	Linear elasticity. General Hooke law. Hooke law for Isotropic materials. Stress – strain deviatoric relationship. Hydrostatic stress versus dilatation formula. Relationship between different elastic module.	2
Wy7	Elastic strain energy expressed by stress and strain tensor components. Solving theory of elasticity boundary problems using displacement approach. Navier-Stoke's equation.	3

Wy8	Classical strength criteria. Effective stresses.	2
Wy9	Coulomb- Mohr strength criterion. Safety factor.	2
Wy10	Plane stress and plane strain problems of theory of elasticity. Solving theory of elasticity boundary problems using stress approach. Airy function. Biharmonic polynomials. Airy function In polar coordinate. General form of Airy function.	3
Wy11	Introduction to Finite Element Method.	3
Wy12	Description of Phases code interface.	2
Wy13	Simple example of FEM calculation.	3
Theory of Soil Mechanics		
Wy14	Soil classification.	2
Wy15	Modeling of soil and rock behavior.	3
Wy16	Effective stresses.	2
Wy17	Water flow.	2
Wy18	Bearing capacity of foundation.	3
Wy19	Atteberg Limits and compaction characteristic of soil.	3
Practice of Rock Mechanics		
Wy20	Rock mass properties. Rock mass classification	2
Wy21	In-situ stresses. Methods for stress analysis	2
Wy22	Rock mass discontinuities and their strength. Slope stability problems and rock fall hazard.	2
Wy23	Rock bolts and cables in rock engineering. Pillar strength and its importance in room-and-pillar mining	2
Wy24	Floor strata behavior in room-and-pillar mining. Interaction of roof, pillar and floor .	2
Wy25	. Surface subsidence due to underground mining. Structures resistance against earthquake and mining related motion	2
Wy26	Pillar strength and its importance in room-and-pillar mining. Structures resistance against earthquake and mining related motion.	2
Wy27	Application of Geomechanics in underground mining.	1
	Suma godzin	**60**

Forma zajęć - ćwiczenia		**Liczba godzin**
Ćw1	Examples illustrating Einstein summation convention. Kronecker delta. Permutation tensor. Formula e – δ. Calculation of spherical and deviatoric strain tensor.	2
Ćw2	Calculation of invariants of strain tensors. Finding of principal strains and principal axes. Building deviatoric strain tensor and tensor of directions.	2
Ćw3	Building hydrostatic stress tensors and stress deviation tensors. Using Couchy formula. Transformation frame of axes by rotation.	2
Ćw4	Calculation of invariants of stress tensors. Principal stresses and principal axes. Calculation of octahedral stresses. Mohr circle for stress tensor components	2
Ćw5	Examples of calculations different elastic material coefficients.	2

Ćw6	Description of Phases 2 computer code.	1
Ćw7	Finite Element Method example calculations using Phases 2 computer programme.	2
Ćw8	Comparison of close form solution of Lame problem with corresponding Finite Element Method results of calculation	2
	Suma godzin	**15**

Forma zajęć - laboratorium		**Liczba godzin**
La1		
La2		
La3		
La4		
La5		
…		
	Suma godzin	

Forma zajęć - projekt		**Liczba godzin**
Pr1		
Pr2		
Pr3		
Pr4		
…		
	Suma godzin	

Forma zajęć - seminarium		**Liczba godzin**
Se1		
Se2		
Se3		
…		
	Suma godzin	

STOSOWANE NARZĘDZIA DYDAKTYCZNE
N1. Forma wykładów i ćwiczeń – tradycyjna, treści ilustrowane prezentacjami multimedialnymi z użyciem sprzętu audio-wizualnego
N2. Dyskusja w ramach wykładów i ćwiczeń
N3. Konsultacje

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ

Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
P	PEU_W01 PEU_W02 PEU_U01	P Ocena końcowa z grupy kursów w formie sprawdzianu pisemnego

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA

LITERATURA PODSTAWOWA:

[1] Y. C. Fung, Fundations of Solid Mechanics, Prentice-Hall, Inc. U.S.A 1964
[2] Y. C. Fung, A First Course in Continuum Mechanics, Prentice-Hall, Inc. U.S.A., 1977
[3] T.J. Chung, Applied Continuum Mechanics, Cambridge University Press,, U.S.A 1996
[4] I. Kisiel, Reologia w Budownictwie, PWN, Warszawa 1962, (In Polish)
[5] O. C. Zienkiewicz, The Finite Element Method In Engineering Science, McGraw-Hill, London, U. K. 1971

LITERATURA UZUPEŁNIAJĄCA:

[1] Compilation of review articles and book chapters of various sources. Handouts.

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

Dr Karolina Adach-Pawelus
Dr inż Jerzy Bauer
Dr inż. Marek Kawa

2-nd Semester

Semestr 2

University of Miskolc

Annex 4. ESEEGEC joint courses at the University of Miskolc

Course Title: Methods of environmental assessment	**Credits: 2**
Type of course: compulsory	
Type (lec. / sem. / lab. / consult.) and Number of Contact Hours per Week: **2 sem.**	
The degree of theoretical or practical nature of the course, " course's character "[13]: 65 (kredit%)	
Type of Assessment (exam. / pr. mark. / other): **pr. mark** Students will be assessed with using the following elements. Attendance: 15 % Individual report 40 % MFinal exam 55 % Total 100% 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): **3rd**	
Pre-requisites *(if any)*: -	
Course Description:	
Students awareness of the environmental assessment procedures, the methods can be used to make the study. **The short curriculum of the subject:** The history of environmental impact assessment. The legal regulation of the environmental impact assessment. Environmental assessment, environmental impact assessment, uniform environmental permit. The qualification of environmental test activities can be combined with the functionality and connectivity of the procedures. The phases of environmental testing, the method of the official method. The preliminary environmental study. The detailed requirements for environmental compatibility studies. Acting factors stakeholders, impact processes, the spread effects. The effect areas, control areas. The main aspects of recruitment procedures and environmental standards. In the effectiveness test methods and procedures. Impact Assessment. Monitoring. The impact assessment public of the hearing, public hearing. Analysis of practical examples. Preparation of an impact test, study management, presentation, public discussions. Practical work: self-made solutions of simple case-study problems.	
The 3-5 most important compulsory, or recommended **literature** (textbook, book) **resources**:	
Charles H. Eccleston: Environmental Impact Assessment: A Guide to Best Professional Practices. CRC Press, 2011 John Glasson: Methods of Environmental Impact Assessment. Routledge, 2009. M. Schmidt, J. Glasson, L. Emmelin, H. Helbron: Standards and Thresholds for Impact Assessment Springer, 2008. EU directives	

Responsible Instructor (*name, position, scientific degree):* **Balázs Zákányi Dr., assistant professor**
Other Faculty Member(s) Involved in Teaching, if any (*name, position, scientific degree*):

Course Title: Waste incineration, air quality control	**Credits: 4**
Type of course: compulsory	
Type (lec. / sem. / lab. / consult.) and Number of Contact Hours per Week: **2 lec. + 1 sem.**	
The degree of theoretical or practical nature of the course, " course's character "[13]: **60** (kredit%)	
Type of Assessment (exam. / pr. mark. / other): **exam.** Students will be assessed with using the following elements. Attendance: 15 % Individual report 10 % Midterm exam 40 % Final exam 35 % Total 100% **Grading Limits:** > 80%: excellent, 70-79%: good, 60-69%: medium, 50-59%: satisfactory, < 50%: unsatisfactory.	
Position in Curriculum (which semester): **3rd**	
Pre-requisites *(if any)*: -	
Course Description:	

1.) Flow diagram of waste processing; basic regulations for thermal treatment and disposal.
2.) Combustion parameters of wastes: physical state (solid, liquid, gaseous), particle composition, density, moisture and ash content; chemical composition (C, H. N, S, Cl), calorific value.
3.) Calculation of combustion parameters: the chemical reactions of combustion, minimum oxigen and air requirement of fules, optimal air excess necessary for complete combustion.
4.) Gaseous wastes, normal burning velocity of fuels, flame velocity, flammability and explosion limits, operating conditions for safe combustion; methods for flame stabilization.
5.) Flame and flue gas characteristics: specific volume, chemical composition, specific heat capacity; combustion temperature (theoretical and actual), dissociation and adiabatic flame temperature (definition, calculation methods); methods for increasing/reducing combustion temperature.
6.) Technical parameters of waste incineration, auto-ignition range; grid types and grid structures, combustion chamber geometry, the construction of refractory walls (design and structure).
7.) Hazardous waste disposal (by incineration), required minimum incineration temperature, the thermal treatment of halogenated waste, present-day waste incinerators, determination of post-combustion chamber ('afterburners').
8.) Characterization of solid combustion residues: physical-chemical properties, mineral composition, thermal behaviour, sintering and ash fusion characteristics, melting temperature. Treatment and disposal of slags and fly ash.
9.) Burners: classification, geometry, sizing, fuel injection by spray nozzles (oil burners).
10.) Air pollution control: regulatory measures and provisions for waste incineration; possible allowed

emission and immission concentrations (EU target values).
11.) Gaseous pollutants: CO, radicals, sulphur oxides, NOx formation (conditions, intensity), primary reduction methods, determination of gas emission concentrations.
12.) Characterization of gaseous pollutants; options for secondary emission reduction; flue gas cleaning methods and equipment.
13.) Definition of dust (for environmental regulations), properties of particulate matter (PM), separation and collection mechanisms, design and operation of dust collection systems (separators).
Practical work: self-made solutions of simple case-study problems.

The 3-5 most important compulsory, or recommended **literature** (textbook, book) **resources**:

- C. Baukal Jr.: Industrial Combustion Pollution and Control, Oklahoma, 2004, ISBN 0-8247-4694-5
- M. Döing: Waste to Energy, Cologne, http://www.ecoprog.com, 2014 Godfrey Boyle: Renewle Energy, Oxford, 2004, ISBN 0-19-926178-4

Responsible Instructor (*name, position, scientific degree):*
Arnold András Kállay Dr., assistant professor, PhD

Other Faculty Member(s) Involved in Teaching, if any (*name, position, scientific degree*):

Course Title: Water and waste water treatment	**Credits: 2**

Type of course: compulsory

Type (lec. / sem. / lab. / consult.) and Number of Contact Hours per Week: **1 lec. + 1 sem.**

The degree of theoretical or practical nature of the course, " course's character "[13]: **50** (kredit%)

Type of Assessment (exam. / pr. mark. / other): **pr. mark**
Students will be assessed with using the following elements.

Attendance:	15 %
Short quizzes	10 %
Midterm exam	40 %
Final exam	35 %
Total	100%

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): **3rd**

Pre-requisites *(if any)*: Water quality protection

Course Description:

Acquired store of learning:
The students will be familiar with the basic elements and concepts of modern water and waste water purification technology and processes. The students will be able to choose the right purification technology concerning environmental protection aspects.

The short curriculum of the subject:
Contamination and pollution processes in water. Pollution limits in water and in groundwater. The most typical contaminants and their physical and chemical properties. Sampling, and preparations of samples. Cleaning and purification technology for municipal and industrial waste water. Technology design.

The 3-5 most important compulsory, or recommended **literature** (textbook, book) **resources**:

- Klaus Görner- Kurt Hübner: Gewaesserschutz und Abwasserbehandlung; Springer-Verlag Berlin heidelberg, 2002.
- M Henze; P Harremoes; J la C Jansen; E Arvin: Wastewater Treatment; Springer-Verlag Berlin heidelberg, 2002
- M. Sperling: Biological Wastewater Treatment Series (Volume two): Basic Principles of Wastewater Treatment, IWA 2007
- R. Ramalho: Introduction to Wastewater Treatment Processes. Academic Press, 2013

Responsible Instructor (*name, position, scientific degree):*
Sándor Nagy Dr., associate professor, PhD

Other Faculty Member(s) Involved in Teaching, if any (*name, position, scientific degree*): Valéria Üveges Dr. Mádainé, assistant lecturer

Course Title: Environmental Geotechnics	**Credits: 2**

Type of course: compulsory

Type (lec. / sem. / lab. / consult.) and Number of Contact Hours per Week: **1 lec. + 1 sem.**

The degree of theoretical or practical nature of the course, " course's character "[13]: 55 (kredit%)

Type of Assessment (exam. / pr. mark. / other): **exam.**
Students will be assessed with using the following elements.

Attendance:	15 %
Short quizzes	10 %
Midterm exam	40 %
Final exam	35 %
Total	100%

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): **3rd**

Pre-requisites *(if any)*: -

Course Description:

Acquired store of learning:
The students will be familiar with the basic concepts of environmental geotechnics.

The short curriculum of the subject:
Physiochemistry of soils for geoenvironmental engineering. Changing of soil parameters caused by contaminants. Determination of contaminant retention capacity of soils. Barrier systems, geological and geosynthetic barrier systems, horizontal and vertical barriers. Geotechnical aspects of landfilling. Stability and deformation of waste dumps, liner systems. Geotechnical tasks of recultivation. Investigation of contaminated sites. Geotechnical problems of remediation. Waste as constructions material. Soil improvement.

The 3-5 most important compulsory, or recommended **literature** (textbook, book) **resources**:

- Sarsby, R.: Environmental Geotechnics. Thomas Telford, 2000.
- Davis, M.L.- Cornwell, D.A.: Introduction to Environmental Engineering. WCB McGraw-Hill, Boston, 1998.
- Bell, F.B.: Environmental Geology. Blackwell Science Ltd, Oxford, 1998.
- Rowe, K.R.: Geotechnical and Geoenvironmental Engineering Handbook. Kluwer Academic Publishers, 2000.

Responsible Instructor (*name, position, scientific degree):*
Andrea Tóth Kolencsikné Dr., assistant professor, PhD

Other Faculty Member(s) Involved in Teaching, if any (*name, position, scientific degree*): Zsombor Fekete, PhD student

Course Title: Chemical technologies in environmental protection	**Credits: 2**

Type of course: compulsory

Type (lec. / sem. / lab. / consult.) and Number of Contact Hours per Week: **1 lec. + 1sem.**

The degree of theoretical or practical nature of the course, " course's character "[13]: 50 (kredit%)

Type of Assessment (exam. / pr. mark. / other): **pr. mark**
During the semester the following tasks should be completed: laboratory work and report, written test.
Grading Limits:
> 80%: excellent,
70-79%: good,
60-69%: medium,
50-59%: satisfactory,
< 50%: unsatisfactory.

Position in Curriculum (which semester): **3rd**

Pre-requisites *(if any)*:

Course Description:

Acquired store of learning:
Study goals: To introduce the chemical techniques on environmental pollution treatment, waste recycling and treatment, as well as on pollution control.

Course content: Theory of mass transfer, laws, relationships, diffusion equations. Principles and fundamentals of design of chemical techniques and reactors. Solid-liquid extraction as a technique for the treatment of solid wastes, methods and equipment. Treatment of contaminated fluids: adsorption,

precipitation (cementation), ion exchange, liquid-liquid separation. Thermal techniques like rectification, thermal oxidation, pyrolisys and gasification.
Education method: Lectures, seminars and lab practice.

The 3-5 most important compulsory, or recommended **literature** (textbook, book) **resources**:

- Prof. Dr J. Clifford Jones Thermal Processing of Waste ISBN: 978-87-7681-590-5
- Robert Noyes Unit Operations in Environmental Engineering.

Responsible Instructor (*name, position, scientific degree):*
Ljudmilla Bokányi Dr., associate professor, PhD

Other Faculty Member(s) Involved in Teaching, if any (*name, position, scientific degree*): Valéria Üveges Dr. Mádainé, assistan lecturer

Course Title: Environmental Risk Assessment and Remediation (Project practice)	**Credits: 3**

Type of course: compulsory/elective

Type (lec. / sem. / lab. / consult.) and Number of Contact Hours per Week: **2 lec.**

The degree of theoretical or practical nature of the course, " course's character "[13]: 70 (kredit%)

Type of Assessment (exam. / pr. mark. / other): **exam.**
Students will be assessed with using the following elements.

Attendance:	15 %
Short quizzes	10 %
Midterm exam	40 %
Final exam	35 %
Total	100%

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): **3rd**

Pre-requisites *(if any)*: -

Course Description:

Acquired store of learning:
The students will be familiarized with the basic concept and framework of Environmental and Human Health Risk assessment and its relationship to contaminated land remediation. The students shall be competent in reading and understanding risk assessment documentation and evaluating its correctness. They will be able to work together with other field specialists in a risk assessor team. They will get a brief introduction to remediation practices and their design and the European practice of remediation planning and monitoring.
The short curriculum of the subject:
History of Risk Assessment, principles and background of RA methodology, Overview of risk related

terminology and definitions, Elements of HHRA methodology, Problem formulation, Exposure assessment, Toxicity assessment, Risk Characterization, Risk assessment and its role in site remediation, Risk interpretation, EU legislation and practice of RA methods, Hungarian legal background, various applications of RA methods, risk based target value and its determination, Case studies.
Practical work: self-made solutions of simple case-study problems.

The 3-5 most important compulsory, or recommended **literature** (textbook, book) **resources**:

- CARACAS (1998): Risk Assessment for Contaminated Sites in Europe, Volume 1: Scientific Basis; LQM Press, Nottingham,
- Vegter, J.J. (2001): A Risk-Based Land Management Approach; Land Contamination and Reclamation, Vol. 9, No. 1, Richmond, UK
- Health Canada (1993): Human Health Risk Assessment of Chemicals from Contaminated Sites, Volume 1 and 2.: Risk Assessment Guidance Manual; Ottawa, ON.
- Covello, V. – Mumpower, J. (1985): Risk Analysis and Management: A Historical Perspective, Risk Analysis, Vol. 5, No. 2
- CLARINET and NICOLE (2001): The Sustainable Management and Remediation of Contaminated Land, Special Edition of Land Contamination and Reclamation, Editors: Bardos, P. and Lewis, A., Richmond, UK.

Responsible Instructor (*name, position, scientific degree):*
Tamás Madarász Dr., associate professor, PhD

Other Faculty Member(s) Involved in Teaching, if any (*name, position, scientific degree*):

Course Title: Soil chemistry	**Credits: 3**

Type of course: compulsory

Type (lec. / sem. / lab. / consult.) and Number of Contact Hours per Week: **2 lec. + 1 sem.**

The degree of theoretical or practical nature of the course, " course's character "[13]: **65** (kredit%)

Type of Assessment (exam. / pr. mark. / other): **exam.**
During the semester the following tasks should be completed: take part the lecture min 60%, Fulfil the laboratory practice work. One missing is allowed. Answer the minimum questions properly min. 50 %, must be correct. Writing the the test from the subject of lecture. Mark: (final test mark 2x + lab practice mark 1x)/3

GradingLimits:
> 80%: excellent,
70-79%: good,
60-69%: medium,
50-59%: satisfactory,
< 50%: unsatisfactory.

Position in Curriculum (which semester): **1st**

Pre-requisites *(if any)*: AKKEM 6003 equivalent

Course Description:

To highlight the colloidal, and chemical structure of the soil, the main equilibriums take place in the soil and which has govern the possible transformation of inorganic and organic substances are present or placed into the soil. The goal is to provide a skill to solve the environmental protection problems related to the soils.
Definition and classification of soils. Characterization of the solid, solution and gas phase of the soils. Sorption, dissolution, acid-base equilibriums in the soils. Red-ox reactions. Inorganic and organic substance transformation in the soil environment. Contamination of soils and remediation possibilities. Importance of soil protection.
Education method: Oral lectures with slides, five 2 h laboratory practice focused to investigate the structure and composition of the soils (Study the soil suspensions, humidity, organic content determination of soils, investigation of acid-base character and buffer capacity of soils, preparation and investigation of soil extracts).

The 3-5 most important compulsory, or recommended **literature** (textbook, book) **resources**:

- D. L. Sparks: Environmental Soil Chemistry, Acad. Press, London (2002). Elsevier BV, ISBN: 978-0-12-656446-4
- B. Yaron, R. Calvet, R. Prost: Soil pollution, Springer, (1996).
- M.R. Ashaman and G. Puri: Essential Soil science, Blackwell Publ,(2002.)
- Kim H. Tan : Principles of Soil Chemitry, CRC Press, (1998)
- Hinrich L. Bohn, Rick A. Myer, George A. O'Connor: Soil Chemistry, 2nd Edition, ISBN: 978-0-471-27497-1, E book, Wiley (2002).

Responsible Instructor (*name, position, scientific degree):*
János Lakatos Dr., associate professor, PhD

Other Faculty Member(s) Involved in Teaching, if any (*name, position, scientific degree*):

Course Title: Numerical Methods and Optimization	**Credits: 2**

Type of course: compulsory

Type (lec. / sem. / lab. / consult.) and Number of Contact Hours per Week: **1 lec. + 1 sem.**

The degree of theoretical or practical nature of the course, " course's character "[13]: 50 (kredit%)

Type of Assessment (exam. / pr. mark. / other): **exam.**
During the semester the following tasks should be completed: one test and a computerized homework

Grading Limits:
> 80%: excellent,
70-79%: good,
60-69%: medium,
50-59%: satisfactory,
< 50%: unsatisfactory.

Position in Curriculum (which semester): **1st**

Pre-requisites *(if any)*: -

Course Description:

Acquired store of learning:

Study goals: 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.

Course content

Extrema of functions. Unconstrained and constrained optimization. Convex optimization, Minimization of functions with one variable (golden section, parabola method). Minimization of multivariable functions (Nelder-Mead, Newton, modified Newton, quasi-Newton, minimization with line search). Methods of penalty functions. Multiaided and multicriteria decision problems (Pareto effitient solutions). Linear programming. About Soft Computing (SC) methods: fuzzy systems, genetic algorithms, neural network.
Numerical solutions of ordinary diffrential equations and system of equations:
Runge-Kutta, predictor-corrector, finite differences.

The 3-5 most important compulsory, or recommended **literature** (textbook, book) **resources**:

- Égertné, M. É., Kálovics, F., Mészáros, G.: Numerical analysis I.-II. *(Egyetemi jegyzet)*, Miskolci Egyetemi Kiadó (1992), 1-175.
- 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.

Responsible Instructor (*name, position, scientific degree):*
Attila Körei Dr., associate professor, PhD

Other Faculty Member(s) Involved in Teaching, if any (*name, position, scientific degree*):

Course Title: Quality Management	**Credits: 2**

Type of course: compulsory

Type (lec. / sem. / lab. / consult.) and Number of Contact Hours per Week: **2 lec.**

The degree of theoretical or practical nature of the course, " course's character "[13]: 65 (kredit%)

Type of Assessment (exam. / pr. mark. / other): **pr. mark**
40%: successful midterm test; 20%: presentation about a chosen quality management tool; 40%: oral exam
Grading Limits:
> 80%: excellent,
70-79%: good,
60-69%: medium,
50-59%: satisfactory,
< 50%: unsatisfactory.

Position in Curriculum (which semester): **3rd**

Pre-requisites *(if any)*: -

Course Description:

The objective of the course is to prepare students to perform professional tasks on a higher level by applying the approach of quality management, including managing or participating related projects. The student will learn about principles, concept and terminology of quality management, quality-related corporate activities, requirements of the ISO 9001 standard and the specialities of project quality management.

1. week: Terminology of quality management (principles, 5 approaches, 9 influencing factors), history of quality management.
2. week: Quality management standardization. ISO 9000 family. Concept of quality management by ISO 9001.
3. week: Process approach in quality management. Kaizen.
4. week: ISO 9001 requirement: Management system.
5. week: ISO 9001 requirement: Product and production.
6. week: Auditing quality management system. ISO 19011:2011 standard.
7. week: Total Quality Management. Lean approach in quality management.
8. week: Enhancing quality management, integrated management systems.
9. week: Quality tools: 7 old&new tools, finding the root cause, 8D
10. week: Quality tools: FMEA, QFD
11. week: Business excellence. Quality Awards. Tools and methods of self-evaluation.
12. week: Project quality management: planning.
13. week: Project quality management: risk analysis.
week: Project quality management: monitoring and performance evaluation.

The 3-5 most important compulsory, or recommended **literature** (textbook, book) **resources**:

- Berényi L: Fundamentals of Quality Management. LAP, Saarbrücken, 2013.
- Vivek, N.: Quality management system handbook for product development companies, CRC Press, Boca Raton, 2005.
- Foster, S.T.: Managing Quality Integrating the Supply Chain, Pearson, London, 2011
- P. J. Lederer, U. S. Karmarka: The Practice of Quality Management, Springer, 1997.
- Kanji, G.K., Asher, M.: 100 Methods for Total Quality Management, SAGE , London, 1996
- Griffith G.: Quality Technician's Handbook, Pearson, London, 2003.

Responsible Instructor (*name, position, scientific degree):*
László Berényi Dr., associate professor, PhD

Other Faculty Member(s) Involved in Teaching, if any (*name, position, scientific degree*):

Course Title: Basics of waste management	**Credits: 3**
Type of course: compulsory	
Type (lec. / sem. / lab. / consult.) and Number of Contact Hours per Week: **2 lec. + 1 sem.**	
The degree of theoretical or practical nature of the course, " course's character "[13]: **60** (kredit%)	
Type of Assessment (exam. / pr. mark. / other): **exam.** Students will be assessed with using the following elements. Attendance: 5 % Homework: 10 % Short quizzes: 10 % Midterm exam: 40 % Final exam: 35 %	

Total: 100%
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): **1st**

Pre-requisites *(if any)*: -

Course Description:

Acquired store of learning:
The aim of the subject for students is to learn knowledge about the waste management. History and development of waste management. Generation and types of industrial and municipal wastes.
Introduction, position and aim of the subject in the course. Generation, types, composition, environmental effect of wastes. Definition and basics of sustainable development and sustainable raw material management. Determination of material characteristics (chemical and physical properties) and evaluation of the results. Material flow of production and consumption wastes. Relationship of waste management and environmental protection. Product and production integrated environmental protection. Treatment and preparation of wastes based on various utilization needs. Processes of mechanical waste preparation. General waste preparation technologies.

Competences:
Students will know the fundamentals of waste management and the generation of wastes. Furthermore, they will be able to characterize – from process engineering and chemical point of view – and utilize the various wastes.

The 3-5 most important compulsory, or recommended **literature** (textbook, book) **resources**:

- Bernd Bilitewski: Waste management. 1997. Springer Science & Business Media
- Jacqueline Vaughn: Waste Management: A Reference Handbook. 2009
- Ramesha Chandrappa: Solid Waste Management: Principles and Practice. 2012. Springer
- Lecture PowerPoint

Responsible Instructor (*name, position, scientific degree):*
Gábor Mucsi Dr., associate professor, PhD

Other Faculty Member(s) Involved in Teaching, if any (*name, position, scientific degree*):

Course Title: Environmental Geology	**Credits: 4**

Type of course: compulsory

Type (lec. / sem. / lab. / consult.) and Number of Contact Hours per Week: **2 lec + 1 sem**

The degree of theoretical or practical nature of the course, " course's character "[13]: 50 (kredit%)

Type of Assessment (exam. / pr. mark. / other): **exam.**

Assessment and grading:

Students will be assessed with using the following elements.

Attendance:	15 %
Individual report	10 %
Midterm exam	40 %
Final exam	35 %
Total	100%

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): **1st**

Pre-requisites *(if any)*: -

Course Description:

The main objective of the course is to make the students familiar with the effects of geological medium on the state and changes of the environment, and prepare them for revealing the geological background of environmental problems as well as mitigating or minimizing these problems.

The short curriculum of the subject:
System approach in geology, changes in the four main systems of the Earth. The objects, methods and legal background of environmental geology. Environmental minerals, their characteristics and role in causing and mitigating of environmental problems. Geological hazards (volcanism, earthquakes, mass movements). The role of geological medium in the anthropogenic contamination and pollution (processes of environmental geochemistry, interactions between soil, rocks and contamination, geological conditions effecting on the spreading of contamination). Geological and geochemical concerns of the effects of mining on the environment. Geological background of the radioactive waste disposal. Geology in nature protection. Geological tasks in the environmental assessment.
Practical work: self-made solutions of simple case-study problems.

The 3-5 most important compulsory, or recommended **literature** (textbook, book) **resources**:

- F. G. Bell: Geological Hazards: their assessment, avoidance and mitigation. E & FN Spon, London, 1999
- L. W. Lundgren: Environmental Geology. Prentice-Hall Inernational, London, 1999.
- C. W. Montgomery: Environmental Geology. McGraw-Hill Companies, Boston, New York, San Francisco, 2005

Responsible Instructor (*name, position, scientific degree):*
Viktór Mádai Dr., associate professor, PhD

Semestr 3

Zał. nr 5 do ZW 8/2020
Załącznik nr … do programu studiów

WYDZIAŁ **Geoinżynierii, Górnictwa i Geologii**

KARTA PRZEDMIOTU

Nazwa przedmiotu w języku polskim Projektowanie wyrobisk w górnictwie odkrywkowym ….(zajęcia są prowadzone w języku angielskim)
Nazwa przedmiotu w języku angielskim Excavation Design in Open Pit Mining
Kierunek studiów (jeśli dotyczy): Górnictwo i geologia.
Specjalność (jeśli dotyczy): Mining Engineering, Geotechnical and Environmental Engineering,
Poziom i forma studiów: II stopień, stacjonarna
Rodzaj przedmiotu: obowiązkowy *
Kod przedmiotu W06GIG-SM0068
Grupa kursów NIE*

	Wykład	Ćwiczenia	Laboratorium	Projekt	Seminarium
Liczba godzin zajęć zorganizowanych w Uczelni (ZZU)	30			15	
Liczba godzin całkowitego nakładu pracy studenta (CNPS)	120			30	
Forma zaliczenia	Egzamin / ~~zaliczenie na ocenę*~~	Egzamin / zaliczenie na ocenę*	Egzamin / zaliczenie na ocenę*	~~Egzamin~~ / zaliczenie na ocenę*	Egzamin / zaliczenie na ocenę*
Dla grupy kursów zaznaczyć kurs końcowy (X)					
Liczba punktów ECTS	**3**			2	
w tym liczba punktów odpowiadająca zajęciom o charakterze praktycznym (P)				2	
w tym liczba punktów ECTS odpowiadająca zajęciom wymagającym bezpośredniego udziału nauczycieli lub innych osób prowadzących zajęcia (BU)	2,5			1,5	

*niepotrzebne skreślić

WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I KOMPETENCJI SPOŁECZNYCH

1. Possesses fundamental knowledge of widely concerned mining, as one of the most important fields of technology and human activity, knows problems related to minerals search, sharing and mining.
2. Possesses knowledge of basic concepts of geology and systematized knowledge regarding resources and minerals mining in Poland.
3. Is able to use Microsoft Office to prepare Word documents and work with the spreadsheet Excel. Is able to use AutoCad, Microstation or similar.

CELE PRZEDMIOTU

C1 Introduction and explanation of problems related to technology of mechanized mining machines

of different types and size used in open pit mining.
C2 Becoming familiar with the relationships between parameters characterizing the geometry of the workplace and the process of digging, controlling machine work process in order to achieve the proper efficiency level and forecasting the efficacy in different geological -mining conditions.
C3 Preparing students to particular tasks completion in the area of work technology and the choice of technological system for the project of excavation and carrying out technological analysis of bucket-wheel excavator work.

PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

Z zakresu wiedzy:
K2_GIG_W07 ma wiedzę w zakresie procesów i technologii stosowanych w przemyśle wydobywczym i przetwórczym surowców mineralnych

Z zakresu umiejętności:
K2_GIG_U01 - dysponuje odpowiednimi dla języka specjalistycznego środkami językowymi i potrafi używać języka specjalistycznego we wszystkich działaniach językowych, aby porozumiewać się w środowisku zawodowym w zakresie studiowanego kierunku studiów
K2_GIG_U07 – potrafi zaprojektować systemy technologiczne stosowane w przemyśle wydobywczym lub przetwórczym surowców mineralnych

Z zakresu kompetencji społecznych:
K2_GIG_K01 potrafi myśleć i działać w sposób kreatywny i przedsiębiorczy

TREŚCI PROGRAMOWE		
Forma zajęć - wykład		**Liczba godzin**
Wy1	The aim of the course, conditions of crediting, literature, contact with the teacher. Basic concepts, definitions related to open pit exploitation of deposits, basic technological systems	3
Wy2	Basic technologies of open pit exploitation (continuous, cycle, mixed), the ways off dredging and exploitation	2
Wy3	Bulldozers work technologies, the range of applications, divisions. Efficiency work forecasting of bulldozers, the resistance movement, cooperation with the base.	2
Wy4	Single and bucket-wheel excavator work technologies, the range of applications, divisions according to different criteria.	3
Wy5	Efficiency work forecasting of a bucket-wheel excavator using chosen methods, the resistance movement, cooperation with the base.	2
Wy6	Scraper work technologies, basic parameters, the range of applications, division, efficacy	2
Wy7	Ripper work technologies basic parameters, the range of applications, division, efficacy	2
Wy8	Loader spoon work technologies the range of applications, division, efficacy	2
Wy9	Multi-bucket-wheel excavator work technologies, basic parameters,	2

	the range of applications, division, and work principles	
Wy10	Multi-bucket-wheel excavator work technologies, types of shortwalls.	2
Wy11	Efficiency work forecasting of multi-bucket-wheel excavators, digging resistance, cooperation with the base	2
Wy12	Multi-bucket-chain excavators work technologies.	2
Wy13	Efficiency work forecasting of a multi-bucket-chain excavators, digging resistance, cooperation with a base.	2
Wy14	Heaping in open pit mining, types of heaps, KTZ. Heaping with the method of direct tossing.	2
	Suma godzin	**30**

Forma zajęć - projekt		**Liczba godzin**
Pr1	Organization classes. The scope of the Project, conditions of crediting, literature. Distribution of topics among students. Discussing the guidelines for the project titled: The excavation project, bulldozer and excavator work technology. Discussing the first stage of the project task, determining mining area and also the issue of the multilevel excavation embankment design on the slope	2
Pr2	Discussing the guidelines to the choice of a bulldozer as a machine which enables an access to the deposit. Discussing issues related to an overlay indirect heaping in the excavation neighbourhood and the bulldozer work efficiency forecast	2
Pr3	Discussing the choice of excavator as a basic machine used for mineral dredging, designing the division of an excavation into floors, forecasting and its cooperation with car transport.	2
Pr4	Students hand over projects- assessment and defence. Discussing the scope of project 2. Distribution of individual topics among students. Discussing the guidelines for the project: “Technological analysis of bucket-wheel excavator…”	2
Pr5	The core of shortwall system, discussing basic parameters of a shortwall, defining the dredging radius and the angle of inclination of dredging jib in the function of dredging height and limit angles of the inclination of the side embankment of a shortwall in the function of its height. Determining maximum distance of an axis of an excavator route from internal side embankment.	2
Pr6	Discussing the outer bottom width of a shortwall. Determining the width of a shortwall.	2
Pr7	Determining two maximum values of a take: considering the slope of the forehead embankment because of the ability to drive to the forehead of shortwall and because of the possibility of the contact of a dredging jib structure with the upper edge of the second level in a shortwall. Determining the angle of inclination of the jib structure axis in the function of the height of a bucket wheel axis and also the angle describing the dimension of a lower piece of a dredging jib structure. Forecasting the SRs efficacy considering particular groups of factors, determining the individual digging resistance and digging force in given geological-mining conditions. The final calculations concerning	2

	side and forehead shortwalls, discussing the graphic form of a project.	
Pr8	Student hand over Project – assessment	1
	Suma godzin	**15**

STOSOWANE NARZĘDZIA DYDAKTYCZNE
N1. Wykład z prezentacją multimedialną N2.Dyskusja. Rozwiązywanie przykładowych zadań N3. Konsultacje i indywidualna ocena projektów

Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu uczenia się	Sposób oceny osiągnięcia efektu uczenia się
F1, P1	K2_GIG_U07 K2_GIG_U01 K2_GIG_K01	F1.1 Ocena z wykonania i wartości merytorycznej projektu F.1.2 Ocena z obrony ustnej lub/i pisemnej projektu P1 Ocena końcowa z projektu nr 1 (średnia ważona z F1.1- 50% oraz F1.2 – 50%)
P2	K2_GIG_W07 K2_GIG_U07 K2_GIG_K01	P2 O cena końcowa z egzaminu w formie ustnej lub sprawdzianu pisemnego

LITERATURA PODSTAWOWA I UZUPEŁNIAJĄCA

LITERATURA PODSTAWOWA:

[1] Kasztelewicz, Z. (2012). Koparki wielonaczyniowe i zwałowarki taśmowe. Technologia pracy, AGH Publishing House.

[2] Hustrulid, W. A., Kuchta, M., & Martin, R. K. (2013). Open pit mine planning and design, two volume set & CD-ROM pack. CRC Press.

[3] Gogolewska, A. Surface and underground Mining Technology. Wrocław 2011

[4] Kasztelewicz, Z., Patyk, M., & Bodziony, P. (2015). Spycharki, dźwigi boczne i przesuwarki przenośników taśmowych. Budowa i technologia pracy, AW-P ART-TEKST, Kraków.

[5] Hawrylak H., Jarząbek M., Sieczyński A., Sobolski R. MASZYNY I PRACE POMOCNICZE W GÓRNICTWIE ODKRYWKOWYM

[6] Glapa W., Korzeniowski J.I., MAŁY LEKSYKON GÓRNICTWA ODKRYWKOWEGO, Wydawnictwa i Szkolenia Górnicze Burnat & Korzeniowski, Wrocław 2005

[7] Korzeniowski J.I.: GÓRNICTWO ODKRYWKOWE : RUCH ZAKŁADÓW EKSPLOATUJĄCYCH ZŁOŻA KOPALIN, 2010

[8] Bęben A.: MASZYNY I URZĄDZENIA DO WYDOBYWANIA KOPALIN POSPOLITYCH BEZ UŻYCIA MATERIAŁÓW WYBUCHOWYCH. Kraków : AGH Uczelniane Wydawnictwa Naukowo-Dydaktyczne, 2008

LITERATURA UZUPEŁNIAJĄCA:

[1] Czasopisma: Mining Science, Journal of mining science, Węgiel brunatny, Górnictwo Odkrywkowe

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

Dr hab. inż. JUSTYNA WOŹNIAK , prof. uczelni
Dr inż. Anna Nowak-Szpak

Zał. nr 5 do ZW 8/2020
Załącznik nr … do programu studiów

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,
Level and form of studies: 2nd level, full-time
Kind of subject: **elective**
Subject code: **W06GIG-SM0069**
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)	30		30		
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	1		1		

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

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	F1.1 Grade from laboratory work's performance and its merits F.1.2 Grade from laboratory work's oral or written defence P1.Final grade (weighted average of F1.1 - 60% and F1.2 - 40%).
F2, P2	PEK_U02-PEK_U04	F2.1 Grade from activity during the lecture (questions, discussions etc) F.2.2 Grade from written exam P2.Final grade (weighted average of F2.1 - 20% and F2.2 - 80%).

LITERATURE

PRIMARY LITERATURE:

[1] LabVIEWTM 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)

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dr inż. Anna.Nowak-Szpak

Zał. nr 5 do ZW 8/2020
Załącznik nr … do programu studiów

FACULTY OF GEOIENGINEERING, MINING AND GEAOLOGY

SUBJECT CARD

Name in Polish: Systemy przeróbcze
kurs prowadzony jest w języku angielskim
Name in English: Mineral Processing Systems
Main field of study (if applicable): Mining and Geology
Specialization (if applicable): Mining Engineering,
Level and form of studies: 2nd, full-time
Kind of subject: elective
Subject code: W06GIG-SM0069
Group of courses: NO

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	**15**			**30**	
Number of hours of total student workload (CNPS)	**30**			**60**	
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	**1**			**1**	

*delete as applicable

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Fundamentals of mineral processing and waste.
2. Basic knowledge of mathematical statics, line programming, programming in VBA.

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SUBJECT OBJECTIVES

C1 Presenting production issues in the mineral industry as an optimization problem of managing the operation of complex technological systems.
C2 Familiarising students with modern methods of off-line analysis of complex systems, mineral processing and waste.
C3 Creating skills to construct simple models and algorithms for mining operations and tailings and their implementation using a spreadsheet supported by VBA program.
C4 Creating skills to prepare and present reports of performed analyses and projects.

SUBJECT LEARNING OUTCOMES

Subject learning outcome relating to knowledge:

PEU_W01 The student has general knowledge of technologies used in refining, and processing mineral resources

PEU_W02 The student gets to know the principle of mathematical modelling of tailings operationsand problems of experimentation to determine model parameters of an operation.

PEU_W03 The student gets to know the criteria and algorithms of optimization (off-line) of complex systems of technological operations

PEU_W04 The student gets to know the examples of commercial and training functions of software for the analysis of tailings systems (JKSimMet, ModSim, WTP)

PEU_W05 The student gets to know how to perform simulation calculations of systems of qualitative and quantitative operations using calculating tools available in the spreadsheet (functions,VBA)

PEU_W06 The student gets to know how to perform simulation calculations of processes of qualitative and quantitative operations using calculating tools available in the spreadsheet (functions, VBA)

Subject learning outcome relating to skills:

PEU_U01 - The student can perform basic calculations of simple models tailings operations: crushing and classification and evaluating their performance

PEU_U02 - The student can perform an individual/ group task to optimize a simple feedback system of mining operations and / or tailings

PEU_U03 - The student can develop and present the results of his project work (paper report, multimedia presentation of sample analysis of mineral system in processing and waste

Subject learning outcome relating to social competence:

PEU_K01 - The student has created attitude of critical overview of the available knowledge on the course.

PROGRAMME CONTENT		
Form of classes - lecture		**Number of hours**
Le1	Scope of lecture, crediting conditions, literature overview. Profile characteristics of the course and the aims and methods of education. Linking the course problems with the course profile and educational programs of other courses of particular specialty and the field of study	2
Le2	The basic structures of mining, coal preparation and processing systems on the example of the construction materials industry, mining ore and coal, metallurgy, waste management	2
Le3	Types and systematics of operations, information operations model, the concept of system and process operations, performance, efficiency, reliability, productive hours.	2
Le4	Methods and tools for the analysis of complex systems operations. Spreadsheet as a calculation tool (functions, VBA)	2
Le5	Modelling crushing operations, crushing machine models, methods and problems of experimentation	2
Le6	Modelling of classification procedure (separation), classifier / separator models, methods and problems of experimentation	2
Le7	Methods of simulation of the quantitative operations processes (mass flow in systems, tanks, and machines). Knowledge control - test	3
	Total hours	**15**

Form of classes - project		Number of hours
Pr1	Introduction to the project: assumptions, aims, form, schedule	3
Pr2	Checking the initial knowledge of the students in auditorial mode.	3
Pr 3	Solving simple calculation using a spreadsheet (functions, calculus matrix).	3
Pr 4	Duty hours and exercises checking the knowledge of mathematical statistics (grain size) and the ability to operate on sets.	3
Pr 5	Handing out tasks and explanation for individual work (system analysis operations: different structures, different technologies, and different models). Variable catalogue of exercises, adjusted to current students level of knowledge and skills of).	3
Pr 6	Algorithmization and programming of tasks examples concerning the grain analysis in VBA - exercises on auxiliary examples.	3
Pr 7	Individual work: the construction of models of a given operation, individual duty hours.	3
Pr 8	Individual work: analysis (optimization) of given operation systems according to qualitative, quantitative and economics criteria, monitoring the performance, individual duty hours	3
Pr 9	Presentation/project defence of ready-made projects by students. Project settlement (course crediting). Partial crediting.	3
Pr 10	(to be continued) Presentation/project defence of ready-made projects by students, including repeats. Project settlement (course crediting). Partial crediting.	3
	Total hours	**30**

TEACHING TOOLS USED
N1. Informative lecture with the elements of problem solving lecture, multimedia presentations, N2 didactic discussion considering the lecture and the project, N3 projects preparation in a report form, written exam (knowledge test), N4 checking the progress of project, presentation and project defence, duty hours.

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 - Assessment of problem solving skills		
F2 - Form and performance.		
P1 - Partial grade from examination which covers the content of the lecture: test of control tasks specific to the subject of the course (differentiated tasks, sorted by difficulty in %, set = 100%) the best score plus bonuses for attending the lectures determine the reference level		
P2 - Partial grade of crediting the project (weighted average of projects - 70% meritum and 30% a form)		
P3.Final grade of the group of courses: mean of constituent grades from the lecture and the project.		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

[1] Drzymała J., Podstawy przeróbki kopalin, Politechnika Wrocławska Publishing House,
[2] Wrocław 2006.
[3] King R.P., Modeling & simulation of mineral processing systems, Batterworth and Heinemann,
[4] Oxford, 2001.
[5] Lynch A.J.,Mineral crushing and grinding circuits, Elsevier Sci Publ.Company, Amsterdam, Oxford, NY, 1977.
[6] 7. Wills B.A., Mineral Processing Technology.

SECONDARY LITERATURE

[1] Malewski J, Modrzejewski S., Modelowanie i optymalizacja systemów i procesów wydobycia i przeróbki kruszyw łamanych, Górnictwo Odkrywkowe Publishing, Wrocław, 2008
[2] Malewski J., Zarządzanie produkcją – kluczową technologią rozwoju przemysłu wydobywczego rud miedzi i surowców towarzyszących, Cuprum, nr 1/2008.
[3] Monografia KGHM, (pod red. Piestrzyńskiego), Lubin 2007.
[4]

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

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Dr. inż. Danuta Szyszka