Zał. Nr 1 do ZW 16/2020

PROGRAM OF STUDIES

FACULTY:	GEOENGINEERING, MINING AND GEOLOGY
MAIN FIELD OF STUDY:	GEODESY AND CARTOGRAPHY (GIK)
BRANCH OF SCIENCE:	Engineering and technology
DISCIPLINES:	D1 environmental engineering, mining and energy (major discipline) D2 civil engineering, geodesy and transport
EDUCATION LEVEL:	second-level studies
FORM OF STUDIES:	full-time studies
PROFILE:	general academic
LANGUAGE OF STUDY:	English/Polish

Content:

Resolution no. … of the Senate of Wroclaw University of Science and Technology

In effect since the academic year 2022/23

*delete as applicable

Zał. Nr 2 do ZW 16/2020

ASSUMED LEARNING OUTCOMES

FACULTY: GEOENGINEERING, MINING AND GEOLOGY
MAIN FIELD OF STUDY: GEODESY AND CARTOGRAPHY (GIK)
EDUCATION LEVEL: second-level studies
PROFILE: general academic

Location of the main-field-of study:

Branch of science: Engineering and technology

Discipline / disciplines (for several disciplines, please indicate the major discipline)

environmental engineering, mining and energy (major discipline); civil engineering, geodesy and transport

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

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

W - category "knowledge"
U - category "skills"
K - category "social competences"
K (*faculty symbol*) _W1, K (*faculty symbol*) _W2, K (*faculty symbol*) _W3, … - main-field-of study learning outcomes related to the category "knowledge"
K (*faculty symbol*) _U1, K (*faculty symbol*) _U2, K (*faculty symbol*) _U3, … - main-field-of study learning outcomes related to the category "skills"
K (*faculty symbol*) _K1, K (*faculty symbol*) _K2, K (*faculty symbol*) _K3, … - main-field-of study learning outcomes related to the category "social competences"
… _inż. – learning outcomes related to the engineer competences

* delete as applicable

Main field of study learning outcomes	Description of learning outcomes for the main-field-of study GEODESY AND CARTOGRAPHY (GIK) After completion of studies, the graduate:	Reference to PRK characteristics		
		Universal first degree characteristics (U)	Second degree characteristics typical for qualifications obtained in higher education (S)	
			Characteristics for qualifications on 7 levels of PRK	Characteristics for qualifications on 7 levels of PRK, enabling acquiring engineering competences
KNOWLEDGE (W)				
K2_GIK_W01	Students possess background knowledge in physics, including quantum mechanics, atomic nucleus physics, solid state physics, semiconductor physics and semiconductor devices.	P7U_W	P7S_WK	
K2_GIK_W02	Students possess knowledge and skills in processing spatial measurements and producing their accuracy characteristics.	P7U_W	P7S_WG	P7S_WG_inż
K2_GIK_W03	Students possess knowledge and skills in the practical application of geospatial systems and technologies for analysing real-life phenomena.	P7U_W	P7S_WG	P7S_WG_inż
K2_GIK_W04	Students possess knowledge and skills in geostatistical modelling of real-life phenomena.	P7U_W	P7S_WG	P7S_WG_inż
K2_GIK_W05	Students possess knowledge and skills in executing complex engineering surveying tasks.	P7U_W	P7S_WG	P7S_WG_inż
K2_GIK_W06	Students possess knowledge and skills in formulating surveying requirements for the management of complex engineering tasks, including a selection of the optimal spatial reference system and map projection.	P7U_W	P7S_WG	P7S_WG_inż

K2_GIK_W07	Students can develop a dedicated computer application using also the UML script in the GIS environment. Knows the process of creating a computer program. Students are aware of the 'life cycle of a computer application.	P7U_W	P7S_WG	P7S_WG_inż
K2_GIK_W08	Students possess skills in a processing point cloud of terrestrial laser scanning, including the development of the CAD 2D/3D, MESH and BIM for various LOD.	P7U_W	P7S_WG	P7S_WG_inż
K2_GIK_W09	Students possess detailed knowledge in the management of geoinformation projects.	P7U_W	P7S_WK	
K2_GIK_W10	Students possess knowledge of the theory of the Earth's gravity field, including the determination of the local geoid and the definition of the vertical datum.	P7U_W	P7S_WG	
K2_GIK_W11	Students possess basic knowledge of the handling of the cartographic models, state geospatial records and principles of generalisation of objects stored in the Database of Topographic Objects.	P7U_W	P7S_WG	P7S_WG_inż
K2_GIK_W12	Students possess knowledge and skills in programming in a GIS environment to perform tasks related to the acquisition, harmonisation, processing and dissemination of geodata.	P7U_W	P7S_WG	P7S_WG_inż
K2_GIK_W13	Students possess knowledge and skills in the acquisition and processing of remote sensing imagery allowing for identifying LCLU and the prediction of changes.	P7U_W	P7S_WG	P7S_WG_inż
K2_GIK_W14	Students possess knowledge of the origins, resources and types of groundwater, their protection from pollution, and regulations regarding water management.	P7U_W	P7S_WK	
K2_GIK_W15	Students possess the knowledge of structured and object-oriented computer programming, including the development of selected models, data structures and algorithms, is able to program in a web environment and selected web technologies.	P7U_W	P7S_WG	P7S_WG_inż
K2_GIK_W16	Students possess the knowledge of presenting, using and disseminating geodata using OGC tools. Students are familiar with the architecture of WebGIS systems.	P7U_W	P7S_WG	P7S_WG_inż
K2_GIK_W17	Students possess knowledge of trends and the latest developments in the field of geodesy and geomatics.	P7U_W	P7S_WK	

K2_GIK_W18	Students possess knowledge of the economy and commodities and capital markets. Students possess the knowledge of financial analysis in a mining and geo-information companies.	P7U_W	P7S_WK	
SKILLS (U)				
K2_GIK_U01	Students are able to perform the accuracy analysis and assessment using statistical and AI-based methods.	P7U_U	P7S_UW P7S_UK	P7S_UW_inż P7S_UK_inż
K2_GIK_U02	Students possess the skills to use advanced GIS tools to study natural and anthropogenic phenomena, interpret the results and draw conclusions.	P7U_U	P7S_UW P7S_UK P7S_UO	P7S_UW_inż P7S_UK_inż
K2_GIK_U03	Students can design and develop a geostatistical model of a selected fragment of environment, including geodata models and structures for simulation experiments.	P7U_U	P7S_UW	P7S_UW_inż
K2_GIK_U04	Students can design and perform field surveys, process geodata and produce documentation and 3D models. Students possess the skills to estimate displacement deformations and interpret the results.	P7U_U	P7S_UW P7S_UK P7S_UO	P7S_UW_inż P7S_UK_inż
K2_GIK_U05	Students possess the knowledge and skills to design surveying networks using GNSS techniques and to use the GNSS augmentation systems.	P7U_U	P7S_UW P7S_UK P7S_UO	P7S_UW_inż P7S_UK_inż
K2_GIK_U06	Students are able to create an application in a GIS environment for performing designated tasks.	P7U_U	P7S_UW P7S_UK	P7S_UW_inż P7S_UK_inż
K2_GIK_U07	Students possess skills in a processing point cloud, including the development of the CAD 3D for various LOD.	P7U_U	P7S_UW P7S_UK P7S_UO	P7S_UW_inż P7S_UK_inż
K2_GIK_U08	Students understand the financial report of a company; possess the knowledge and skills to prepare a quotation for a geoinformation-related project proposal.	P7U_U		
K2_GIK_U09	Students are able to formulate specifications for the tasks related to gravity data processing, geoid modelling and elevation determination by satellite methods.	P7U_U	P7S_UW	P7S_UW_inż
K2_GIK_U10	Students can select appropriate methods and tools for building cartographic models; maintain quality control, feeding, updating of geodatabase; perform generalization and editing of maps.	P7U_U	P7S_UW P7S_UK	P7S_UW_inż P7S_UK_inż
K2_GIK_U11	Students can acquire and process geodata acquired using remote sensing, laser and radar methods.	P7U_U	P7S_UW P7S_UK	P7S_UW_inż P7S_UK_inż

K2_GIK_U12	Students are able to acquire and process SAR data using DInSAR, SBAS and/or PsInSAR methods for the determination of ground deformations.	P7U_U	P7S_UW P7S_UK	P7S_UW_inż P7S_UK_inż
K2_GIK_U13	Students possess the skills to solve complex surveying assignments related to engineering infrastructure.	P7U_U	P7S_UK P7S_UU	
K2_GIK_U14	Students can effectively use foreign-languages references. Students are able to design and carry out an experiment, including computer simulations, interpret the results and draw conclusions.	P7U_U	P7S_UK P7S_UU P7S_UO	
K2_GIK_U15	Students are able to identify the constraints of a geo-information project, define its aim, objectives, and scope, and conduct a preliminary risk analysis.	P7U_U	P7S_UK P7S_UO	P7S_UK_inż
K2_GIK_U16	Students are able to design and develop applications for data collection, processing and presentation using selected web-based techniques; to assess the suitability, applicability and use of selected models, data structures and algorithms to effectively solve geoinformation-related tasks and projects.	P7U_U	P7S_UW P7S_UK	P7S_UW_inż P7S_UK_inż
K2_GIK_U17	Students can effectively operate a geodatabase; design and implement a WebGIS type system; develop a geoportal.	P7U_U	P7S_UW P7S_UK	P7S_UW_inż P7S_UK_inż
K2_GIK_U18	Students are able to use the recent developments in the field of geodesy and geomatics.	P7U_U	P7S_UW P7S_UK P7S_UU P7S_UO	
K2_GIK_U19	Students are able to effectively communicate, both oral and in writing, at the B2+ language proficiency level.	P7U_U	P7S_UW P7S_UK P7S_UU	
SOCIAL COMPETENCES (K)				
K2_GIK_K01	Students are able to work in an interdisciplinary team environment; managing a team while implementing various types of projects.	P7U_K	P7S_KK P7S_KR	
K2_GIK_K02	Students are aware of the beyond-the-technical side of the surveyor and cartographer's activities.	P7U_K	P7S_KK P7S_KO P7S_KR	
K2_GIK_K03	Students are aware of the impact of human activities on the environment, and understand the responsibilities for the decisions taken.	P7U_K	P7S_KK P7S_KO P7S_KR	

K2_GIK_K04	Students are familiar with the intellectual and industrial property protection; principles of operation maintaining the workplace health and safety standards.	P7U_K	P7S_KK P7S_KO P7S_KR	

*delete as applicable

Zał. nr 3 do ZW 16/2020

Attachment no. 2. to the Program of Studies

DESCRIPTION OF THE PROGRAM OF STUDIES

Main field of study: GEODESY AND CARTOGRAPHY (GIK)

Profile general: academic

Level of studies: second-level studies

Form of studies: full-time studies

1. General description

1.1 Number of semesters: 3	*1.2 Total number of ECTS points necessary to complete studies at a given level: 90*
1.3 Total number of hours: 990	*1.4 Prerequisites (particularly for second-level studies): first degree engineering studies diploma*
1.5 Upon completion of studies graduate obtains professional degree of: Master of Science	*1.6 Graduate profile, employability:* *Geomatics is a scientific and technical discipline dealing with the acquisition, analysis, interpretation, dissemination and practical application of geoinformation. Geomatics analyzes and synthesizes information about spatial processes and phenomena and their changes. Geodata is used to create precise computer models that help us better understand spatial processes and shape future activities. Geodata is an element of almost every intelligent IT*

	system. Stimulating the demand for geoinformation may affect the innovativeness of the Polish economy and allow it to play a significant, noticeable role of Polish entrepreneurs and Polish science on the global market. *The universality of geoinformation and the prospect of a further increase in its use (processing and analyzing large collections of geodata) generate a demand for specialists in the field of construction and management of geoinformatics knowledge. Education in the field of Geodesy and Cartography with a specialization in Geomatics at the Faculty of Geoengineering, Mining and Geology of the Wrocław University of Science and Technology meets these needs.*
1.7 Possibility of continuing studies *Eligibility to apply for admission to a doctoral school, non-degree postgraduate programs*	*1.8 Indicate connection with University's mission and its development strategy:* *The second level study program in the field of study Geodesy and Cartography is in line with the mission and responds to the following strategic goals of Wroclaw University of Science and Technology:* *a) transferring knowledge and skills while maintaining high-quality education,* *b) increasing the level of entrepreneurship and involvement in research processes of students and doctoral students,* *c) increasing the level of correlation between the University activities and the needs of the market.*

[1]BU – number of ECTS points assigned to hours of classes requiring direct participation of academic teachers and other persons conducting classes
[2]Traditional – enter T, remote – enter Z
[3]Exam – enter E, crediting – enter Z. For the group of courses – after the letter E or Z - enter in brackets the final course form (lec, cl, lab, pr, sem)
[4]University-wide course /group of courses – enter O
[5]DN - number of ECTS points assigned to the classes related to the University's academic activity in the discipline/disciplines to which the main field of study is assigned
[6]Practical course / group of courses – enter P. For the group of courses – in brackets enter the number of ECTS points assigned to practical courses
[7]KO – general education courses, PD – basic sciences courses, K – main field of study courses, S – specialization courses

2. Detailed description

2.1 Total number of learning outcomes in the program of study: W (knowledge) = 18, U (skills) = 19, K (competences) = 4, W + U + K = 41

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

D1 (major) 22 (this number must be greater than half the total number of learning outcomes)

D2 19

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

D1 55.6 % ECTS points

D2 44.4 % ECTS points

2.4a. For the general academic profile of the main field of study – the number of ECTS points assigned to the classes related to the University's academic activity in the discipline or disciplines to which the main field of study is assigned – DN (must be greater than 50% of the total number of ECTS points from 1.2) - is 62 ECTS points, or 68.8 percent of ECTS points

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

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

Graduates of the second-degree studies in Geodesy and Cartography with a specialization in Geomatics will acquire extended theoretical knowledge and practical skills needed in the implementation of specialized tasks, commonly set by innovative economy in relation to geoinformation systems. They will be prepared for professional work in the field of handling geoinformation projects, acquiring, analyzing and interpreting large collections of geodata, as well as designing and using spatial information systems. They will acquire managerial knowledge necessary to function in the business environment, including managing project teams, effectively fulfilling roles within task teams, establishing and managing companies, and using the law to the extent necessary to practice their profession and run a business. Graduates can work for companies or offices dealing with, among other things: geodetic investment service, inventory, monitoring and documenting of construction and architectural structures, control of the execution of facilities, management and shaping of the environment, spatial development, landscape architecture, documenting and analysis of the location of anthropogenic and natural events, and other users of spatial information.

2.6. The total number of ECTS points that a student must obtain in classes requiring direct participation of academic teachers or other persons conducting classes and students (enter the sum of ECTS points for courses / groups of courses marked with the BU[1] code) - **50.5 ECTS points, or 56.1 percent of ECTS points**

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

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

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

Number of ECTS points for obligatory subjects	36
Number of ECTS points for optional subjects	21
Total number of ECTS points	57

2.9. Minimum number of ECTS points, which student has to obtain doing education blocks offered as part of University-wide classes or other main field of study (enter number of ECTS points for courses/groups of courses denoted with code O) - is 7 ECTS credits

2.10. Total number of ECTS points, which student may obtain doing optional blocks (min. 30% of total number of ECTS points) - is 27 ECTS points, or 30% of ECTS points

[1]BU – number of ECTS points assigned to hours of classes requiring direct participation of academic teachers and other persons conducting classes
[2]Traditional – enter T, remote – enter Z
[3]Exam – enter E, crediting – enter Z. For the group of courses – after the letter E or Z - enter in brackets the final course form (lec, cl, lab, pr, sem)
[4]University-wide course /group of courses – enter O
[5]DN - number of ECTS points assigned to the classes related to the University's academic activity in the discipline/disciplines to which the main field of study is assigned
[6]Practical course / group of courses – enter P. For the group of courses – in brackets enter the number of ECTS points assigned to practical courses
[7]KO – general education courses, PD – basic sciences courses, K – main field of study courses, S – specialization courses

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

- the student participates in classes organized at the University,
- when starting classes in a given subject, the student has the level of knowledge and skills appropriate to the prerequisites of this course (it is verified by the teacher or the dean's office),
- the student carries out the assigned work in and outside of the University and studies the literature and materials recommended by the teacher,
- the student uses the appointed hours of the teacher's consultation, explaining his doubts and verifying the correct understanding of the content,
- the student and the teacher use the e-learning platform of Wrocław University of Science and Technology in order to support the implementation of didactic classes, the student may use the University's Open Educational Resources,
- the student participates in periodic tests of knowledge and skills and gets acquainted with the correct answers, grades and comments from the teacher,
- the student is working on a diploma thesis,
- the student is encouraged to participate in meetings with representatives of the economy and administration, takes part in job fairs, tries to gain knowledge about the labour market and additional advantages when applying for a job,
- the student is encouraged to participate in conferences and scientific seminars,
- the student is encouraged to become involved in the activities of research clubs, student organizations, sports groups, participation in social life by working in public welfare organizations, volunteering (e.g. as part of the Lower Silesian Science Festival), thus gaining valuable interpersonal skills and social competences,
- the student is encouraged to participate in international student exchange and thus acquires additional interpersonal, cultural and linguistic competences,
- the Faculty has a Faculty Education Quality Assurance System, student surveys and hospitals are used, the study program is periodically verified and adapted to the current and anticipated needs of the labour market.

4. List of education blocks:

4.1. List of obligatory blocks:

4.1.1 List of general education blocks

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

No.	Course/ group of courses code	Name of course/group of courses (denote group of courses with symbol **GK**)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form[2] of course/group of courses	Way[3] of crediting	Course/group of courses			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN[5] classes	BU[1] classes			University-wide[4]	Concerning scientific activities[5]	Practical[6]	Type[7]
1	W08NW 06-SM1921	Humanistic-managerial course	1					K2_GIK_W09, K2_GIK_W17, K2_GIK_K01, K2_GIK_K03	15	60	2	-	0.5	T/Z	Z	O	-	-	KO
2	W06GIK -SM0107	Financial Analysis	1		1			K2_GIK_W18, K2_GIK_U08	30	60	2	-	1	T/Z	Z(w) Z(l)		DN	P(1)	KO
3	W06GIK -SM0118	Management of Company Development	1				1	K2_GIK_W18, K2_GIK_U14, K2_GIK_K01, K2_GIK_K02, K2_GIK_K04	30	60	2	-	1	T/Z	Z(w) Z(s)		DN	P(1)	KO
		Total	**3**	**0**	**1**	**0**	**1**		**75**	**180**	**6**	**-**	**2.5**				**-**	**2**	

Altogether for general education blocks

Total number of hours					Total number of ZZU hours	Total number of CNPS hours	Total number of ECTS points	Total number of ECTS points for DN classes[5]	Number of ECTS points for BU classes[1]
lec	cl	lab	pr	sem					
3	**0**	**1**	**0**	**1**	**75**	**180**	**6**	**-**	**2.5**

[1]BU – number of ECTS points assigned to hours of classes requiring direct participation of academic teachers and other persons conducting classes
[2]Traditional – enter T, remote – enter Z
[3]Exam – enter E, crediting – enter Z. For the group of courses – after the letter E or Z - enter in brackets the final course form (lec, cl, lab, pr, sem)
[4]University-wide course /group of courses – enter O
[5]DN - number of ECTS points assigned to the classes related to the University's academic activity in the discipline/disciplines to which the main field of study is assigned
[6]Practical course / group of courses – enter P. For the group of courses – in brackets enter the number of ECTS points assigned to practical courses
[7]KO – general education courses, PD – basic sciences courses, K – main field of study courses, S – specialization courses

4.1.2 List of basic sciences blocks

4.1.2.1 *Mathematics* block

No.	Course/ group of courses code	Name of course/group of courses (denote group of courses with symbol **GK**)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form[2] of course/group of courses	Way[3] of crediting	Course/group of courses			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN[5] classes	BU[1] classes			University-wide[4]	Concerning scientific activities[5]	Practical[6]	Type[7]
1	W06GIK-SM0100	Advanced Numerical Calculation Methods	1			2		K2_GIK_W0, K2_GIK_U01	45	120	4	2	1.5	T/Z	E(w) Z(p)		2	P(3)	PD
		Total	**1**			**2**			**45**	**120**	**4**	**2**	**1.5**						

4.1.2.2 *Physics* block

No.	Course/ group of courses code	Name of course/group of courses (denote group of courses with symbol **GK**)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form[2] of course/group of courses	Way[3] of crediting	Course/group of courses			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN[5] classes	BU[1] classes			University-wide[4]	Concerning scientific activities[5]	Practical[6]	Type[7]
1	W11GIK-SM1138	Physics - the structure of matter	2					K2_GIK_W01	30	60	2	-	1	T/Z	Z	O	-	-	PD
		Total	**2**						**30**	**60**	**2**	**-**	**1**				**-**	**-**	

Altogether for basic sciences blocks:

Total number of hours					Total number of ZZU hours	Total number of CNPS hours	Total number of ECTS points	Total number of ECTS points for DN classes[5]	Number of ECTS points for BU classes[1]
lec	cl	lab	pr	sem					
3	**0**	**0**	**2**	**0**	**75**	**180**	**6**	**2**	**2.5**

[1]BU – number of ECTS points assigned to hours of classes requiring direct participation of academic teachers and other persons conducting classes
[2]Traditional – enter T, remote – enter Z
[3]Exam – enter E, crediting – enter Z. For the group of courses – after the letter E or Z - enter in brackets the final course form (lec, cl, lab, pr, sem)
[4]University-wide course /group of courses – enter O
[5]DN - number of ECTS points assigned to the classes related to the University's academic activity in the discipline/disciplines to which the main field of study is assigned
[6]Practical course / group of courses – enter P. For the group of courses – in brackets enter the number of ECTS points assigned to practical courses
[7]KO – general education courses, PD – basic sciences courses, K – main field of study courses, S – specialization courses

4.1.3 List of the main field of study blocks

4.1.3.1 *Obligatory main field of study* blocks

No.	Course/ group of courses code	Name of course/group of courses (denote group of courses with symbol **GK**)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form[2] of course/group of courses	Way[3] of crediting	Course/group of courses			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN[5] classes	BU[1] classes			University-wide[4]	Concerning scientific activities[5]	Practical[6]	Type[7]
1	W06GIK-SM0101	Advanced Geospatial Analysis	1		2			K2_GIK_W03, K2_GIK_U02, K2_GIK_K02, K2_GIK_K03	45	150	5	5	2.5	T/Z	Z(w) Z(l)		DN	P(3)	S
2	W06GIK-SM0102	Geostatistics	1		3			K2_GIK_W04, K2_GIK_U03, K2_GIK_K02, K2_GIK_K03	60	150	5	4	2	T/Z(w) T(l)	E(w) Z(l)		DN	P(3)	K
3	W06GIK-SM0103	Special Measurements	1		2			K2_GIK_W05, K2_GIK_U04, K2_GIK_K01	45	120	4	3	1.5	T/Z(w) T(l)	Z(w) Z(l)		DN	P(2)	S
4	W06GIK-SM0104	Selected Topics in GNSS	1		1	1		K2_GIK_W06, K2_GIK_U05, K2_GIK_K01	45	120	4	3	1.5	T/Z(w) T(l) T(p)	E(w) Z(l) Z(p)		DN	P(2)	S
5	W06GIK-SM0105	GIS Programming I	1		2			K2_GIK_W07, K2_GIK_U06	45	120	4	3	1.5	T/Z	Z(w) Z(l)		DN	P(2)	S
6	W06GIK-SM0106	Selected Topics in Geospatial Modelling	1		2			K2_GIK_W08, K2_GIK_U07, K2_GIK_K01	45	90	3	2	1.5	T/Z(w) T(l)	Z(w) Z(l)		DN	P(2)	S
7	W06GIK-SM0108	Physical Geodesy	1		1			K2_GIK_W10, K2_GIK_U09, K2_GIK_K02	30	60	2	-	1	T/Z	Z(w) Z(l)		DN	P(1)	K
8	W06GIK-SM0116	Selected Topics in Information Technologies	2		2			K2_GIK_W15, K2_GIK_U16	60	90	3	2	1.5	T/Z	Z(w) Z(l)		DN	P(2)	S
9	W06GIK-SM0110	GIS Programming II	1		2			K2_GIK_W12, K2_GIK_U06	45	120	4	3	2	T/Z	Z(w) Z(l)		DN	P(3)	S
10	W06GIK-SM0111	Remote Sensing and Processing of Digital Images	1		2			K2_GIK_W13, K2_GIK_U11, K2_GIK_K02, K2_GIK_K03	45	150	5	5	2.5	T/Z	E(w) Z(l)		DN	P(3)	S

[1]BU – number of ECTS points assigned to hours of classes requiring direct participation of academic teachers and other persons conducting classes
[2]Traditional – enter T, remote – enter Z
[3]Exam – enter E, crediting – enter Z. For the group of courses – after the letter E or Z - enter in brackets the final course form (lec, cl, lab, pr, sem)
[4]University-wide course /group of courses – enter O
[5]DN - number of ECTS points assigned to the classes related to the University's academic activity in the discipline/disciplines to which the main field of study is assigned
[6]Practical course / group of courses – enter P. For the group of courses – in brackets enter the number of ECTS points assigned to practical courses
[7]KO – general education courses, PD – basic sciences courses, K – main field of study courses, S – specialization courses

11	W06GIK-SM0112L	Selected Topics in Displacement Monitoring			3			K2_GIK_U12, K2_GIK_K03	45	90	3	3	2.5	T	Z(l)		DN	P(3)	S
12	W06GIK-SM0114W	Hydrology II	1					K2_GIK_W14, K2_GIK_K02, K2_GIK_K03	15	30	1	-	0.5	T/Z	Z(w)		DN	-	S
13	W06GIK-SM0115	Geoinformation Project Management	1		1			K2_GIK_W09, K2_GIK_U15, K2_GIK_K01	30	60	2	1	1	T/Z	Z(w) Z(l)		DN	P(1)	K
14	W06GIK-SM0109	Digital Cartographic Models	1		2			K2_GIK_W11, K2_GIK_U10	45	90	3	3	1.5	T/Z	E(w) Z(l)		DN	P(2)	S
15	W06GIK-SM0117	Distributed Spatial Databases	1		2			K2_GIK_W16, K2_GIK_U17	45	90	3	2	1.5	T/Z	E(w) Z(l)		DN	P(2)	S
		Total	**15**	**0**	**27**	**1**	**0**		**645**	**1530**	**51**	**39**	**24.5**					**31**	

Altogether (for main field of study blocks):

Total number of hours					Total number of ZZU hours	Total number of CNPS hours	Total number of ECTS points	Total number of ECTS points for DN classes[5]	Number of ECTS points for BU classes[1]
lec	cl	lab	pr	sem					
15	**0**	**27**	**1**	**0**	**645**	**1530**	**51**	**39**	**24.5**

[1]BU – number of ECTS points assigned to hours of classes requiring direct participation of academic teachers and other persons conducting classes
[2]Traditional – enter T, remote – enter Z
[3]Exam – enter E, crediting – enter Z. For the group of courses – after the letter E or Z - enter in brackets the final course form (lec, cl, lab, pr, sem)
[4]University-wide course /group of courses – enter O
[5]DN - number of ECTS points assigned to the classes related to the University's academic activity in the discipline/disciplines to which the main field of study is assigned
[6]Practical course / group of courses – enter P. For the group of courses – in brackets enter the number of ECTS points assigned to practical courses
[7]KO – general education courses, PD – basic sciences courses, K – main field of study courses, S – specialization courses

4.2 List of optional blocks

4.2.1 List of general education blocks

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

No.	Course/ group of courses code	Name of course/group of courses (denote group of courses with symbol **GK**)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form[2] of course/group of courses	Way[3] of crediting	Course/group of courses			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN[5] classes	BU[1] classes			University-wide[4]	Concerning scientific activities[5]	Practical[6]	Type[7]
1	SJO-SM0003BK	Foreign Language I		3				K2_GIK_U19, K2_GIK_K01	45	60	2	-	1.5	T	Z	O	-	P(2)	KO
1	SJO-SM0004BK	Foreign Language II		1				K2_GIK_U19, K2_GIK_K01	15	30	1	-	0.5	T	E	O	-	P(1)	KO
		Total		**4**					**60**	**90**	**3**	**-**	**2.0**				**-**	**3**	

Altogether (for main field of study blocks):

Total number of hours					Total number of ZZU hours	Total number of CNPS hours	Total number of ECTS points	Total number of ECTS points for DN classes[5]	Number of ECTS points for BU classes[1]
lec	cl	lab	pr	sem					
	4				**60**	**90**	**3**	**-**	**2.0**

[1]BU – number of ECTS points assigned to hours of classes requiring direct participation of academic teachers and other persons conducting classes
[2]Traditional – enter T, remote – enter Z
[3]Exam – enter E, crediting – enter Z. For the group of courses – after the letter E or Z - enter in brackets the final course form (lec, cl, lab, pr, sem)
[4]University-wide course /group of courses – enter O
[5]DN - number of ECTS points assigned to the classes related to the University's academic activity in the discipline/disciplines to which the main field of study is assigned
[6]Practical course / group of courses – enter P. For the group of courses – in brackets enter the number of ECTS points assigned to practical courses
[7]KO – general education courses, PD – basic sciences courses, K – main field of study courses, S – specialization courses

4.2.3 List of blocks

4.2.3.1 Optional block *(min. 6 ECTS points):*

No.	Course/ group of courses code	Name of course/group of courses (denote group of courses with symbol **GK**)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form[2] of course/group of courses	Way[3] of crediting	Course/group of courses			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN[5] classes	BU[1] classes			University-wide[4]	Concerning scientific activities[5]	Practical[6]	Type[7]
1	GIK-SM2233ANG	Elective course I	2					K2_GIK_W17, K2_GIK_U13, K2_GIK_K03	30	90	3	3	2	T/Z	Z		DN	-	S
2	GIK-SM3333ANG	Elective course II	2					K2_GIK_W17, K2_GIK_U13, K2_GIK_K03	30	90	3	3	2	T/Z	Z		DN	-	S
		Total	**4**	**4**						**60**	**180**	**6**	**6**	**4**					**-**

Altogether for blocks:

Total number of hours					Total number of ZZU hours	Total number of CNPS hours	Total number of ECTS points	Total number of ECTS points for DN classes[5]	Number of ECTS points for BU classes[1]
lec	cl	lab	pr	sem					
4	**0**	**0**	**0**	**0**	**60**	**180**	**6**	**6**	**4**

[1]BU – number of ECTS points assigned to hours of classes requiring direct participation of academic teachers and other persons conducting classes
[2]Traditional – enter T, remote – enter Z
[3]Exam – enter E, crediting – enter Z. For the group of courses – after the letter E or Z - enter in brackets the final course form (lec, cl, lab, pr, sem)
[4]University-wide course /group of courses – enter O
[5]DN - number of ECTS points assigned to the classes related to the University's academic activity in the discipline/disciplines to which the main field of study is assigned
[6]Practical course / group of courses – enter P. For the group of courses – in brackets enter the number of ECTS points assigned to practical courses
[7]KO – general education courses, PD – basic sciences courses, K – main field of study courses, S – specialization courses

4.2.4 List of specialization blocks

4.2.4.2 Specialization (*Geomatics*) blocks *(min. 18 ECTS points):*

No.	Course/ group of courses code	Name of course/group of courses (denote group of courses with symbol **GK**)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form[2] of course/group of courses	Way[3] of crediting	Course/group of courses			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN[5] classes	BU[1] classes			University-wide[4]	Concerning scientific activities[5]	Practical[6]	Type[7]
1	W06GIK-SM0113S	Graduate Seminar I					1	K2_GIK_U14, K2_GIK_U18, K2_GIK_K02, K2_GIK_K04	15	30	1	-	1	T/Z	Z		-	P(1)	S
2	W06GIK-SM0118S	Graduate Seminar II					2	K2_GIK_U14, K2_GIK_U18, K2_GIK_K02, K2_GIK_K04	30	60	2	-	2	T	Z		-	P(2)	S
3	W06GIK-SM0120D	Master thesis				2		K2_GIK_U14, K2_GIK_U18, K2_GIK_K03, K2_GIK_K04	30	450	15	15	12	T	Z		DN	P(15)	S
		Total				**2**	**3**		**75**	**540**	**18**	**15**	**15**					**18**	

Altogether for specialization blocks:

Total number of hours					Total number of ZZU hours	Total number of CNPS hours	Total number of ECTS points	Total number of ECTS points for DN classes[5]	Number of ECTS points for BU classes[1]
lec	cl	lab	pr	sem					
0	**0**	**0**	**2**	**3**	**75**	**540**	**18**	**15**	**15**

[1]BU – number of ECTS points assigned to hours of classes requiring direct participation of academic teachers and other persons conducting classes
[2]Traditional – enter T, remote – enter Z
[3]Exam – enter E, crediting – enter Z. For the group of courses – after the letter E or Z - enter in brackets the final course form (lec, cl, lab, pr, sem)
[4]University-wide course /group of courses – enter O
[5]DN - number of ECTS points assigned to the classes related to the University's academic activity in the discipline/disciplines to which the main field of study is assigned
[6]Practical course / group of courses – enter P. For the group of courses – in brackets enter the number of ECTS points assigned to practical courses
[7]KO – general education courses, PD – basic sciences courses, K – main field of study courses, S – specialization courses

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

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

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

Type of diploma dissertation	Licencjat / inżynier / magister / magister inżynier*	
Number of diploma dissertation semesters	**Number of ECTS points**	**Code**
1	**15**	W06GIK-SM0120D
Character of diploma dissertation		
Literature survey, project, computer program, etc.		
Number of BU[1] ECTS points	**12**	
Number of DN[5] ECTS points	**15**	

5. Ways of verifying assumed learning outcomes

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

[1]BU – number of ECTS points assigned to hours of classes requiring direct participation of academic teachers and other persons conducting classes
[2]Traditional – enter T, remote – enter Z
[3]Exam – enter E, crediting – enter Z. For the group of courses – after the letter E or Z - enter in brackets the final course form (lec, cl, lab, pr, sem)
[4]University-wide course /group of courses – enter O
[5]DN - number of ECTS points assigned to the classes related to the University's academic activity in the discipline/disciplines to which the main field of study is assigned
[6]Practical course / group of courses – enter P. For the group of courses – in brackets enter the number of ECTS points assigned to practical courses
[7]KO – general education courses, PD – basic sciences courses, K – main field of study courses, S – specialization courses

training	e.g. report from training
diploma dissertation	prepared diploma dissertation

6. Range of diploma examination

Geodesy, spatial modeling, GIS programming

1. Discuss the difference between interpolation, approximation, and prediction for measurement data.
2. Discuss the principles of approximation of 2D and 3D data using the least squares method.
3. Discuss geodetic control measurements of hyperboloid cooling towers.
4. What is strain and what is stress?
5. Discuss the classification of laser scanners, the principles of planning measurement with a scanner and processing of acquired point clouds (registration, filtering and modeling).
6. Discuss the principles of measurement and the development of a 3D CAD model of an industrial installation element.
7. HTML components.

Photogrammetry and remote sensing

8. Discuss standard parameters of multispectral remote sensing imaging.
9. Discuss the digital imagery filtering operation.
10. Discuss two operations in mathematical morphology.
11. Discuss Copernicus programme.
12. Give examples and characterize selected remote sensing programs.
13. Discuss the methods of geodetic use of SAR images.
14. Discuss examples of active remote sensing systems applications
15. List the advantages and disadvantages of multispectral and hyperspectral imaging.
16. Discuss the model of numerical errors of terrain models.
17. Discuss the use of remote sensing in crisis management.

[1]BU – number of ECTS points assigned to hours of classes requiring direct participation of academic teachers and other persons conducting classes
[2]Traditional – enter T, remote – enter Z
[3]Exam – enter E, crediting – enter Z. For the group of courses – after the letter E or Z - enter in brackets the final course form (lec, cl, lab, pr, sem)
[4]University-wide course /group of courses – enter O
[5]DN - number of ECTS points assigned to the classes related to the University's academic activity in the discipline/disciplines to which the main field of study is assigned
[6]Practical course / group of courses – enter P. For the group of courses – in brackets enter the number of ECTS points assigned to practical courses
[7]KO – general education courses, PD – basic sciences courses, K – main field of study courses, S – specialization courses

18. Applications of remote sensing in environmental protection and management of the Earth's natural resources.
19. Describe the chosen method of quantifying the dynamics of riverbed erosion.
20. List the advantages and disadvantages of using satellite radar interferometry in monitoring the activity of the land surface.
21. Discuss the differences between PsInSAR and SBAS methods.

Physical geodesy, GNSS positioning systems, spatial reference systems

22. Methods of measuring the acceleration of gravity.
23. National Spatial Reference System.
24. International Terrestrial Frame of Reference (ITRF).
25. Height systems used in Poland historically and presently.
26. Cartesian coordinate systems used in Poland.
27. Discuss the parameters of the Kepler orbit?
28. Global Satellite Positioning Systems (GPS, GLONASS, GALILEO).
29. GNSS measurement techniques (static, fast static, stop and go, kinematic).
30. Field correction in gravimetric measurements and principles of its determination.
31. Discuss the measurement techniques: VLBI, SLR and Doris and their role in creating the global IRTF system.
32. Characterize the ASG_EUPOS system.

Geographic information systems

33. Characteristics of the Spatial Information Infrastructure in Poland.
34. Features of spatial databases. Examples of spatial database systems.
35. Spatial statistics in GIS analyzes.
36. Compare the methods of density and hot spot analysis.
37. Discuss the methods and applications of spatial regression.
38. Characteristics of network data and network analysis in GIS.
39. Methods of interpolation of measurement data.

[1]BU – number of ECTS points assigned to hours of classes requiring direct participation of academic teachers and other persons conducting classes
[2]Traditional – enter T, remote – enter Z
[3]Exam – enter E, crediting – enter Z. For the group of courses – after the letter E or Z - enter in brackets the final course form (lec, cl, lab, pr, sem)
[4]University-wide course /group of courses – enter O
[5]DN - number of ECTS points assigned to the classes related to the University's academic activity in the discipline/disciplines to which the main field of study is assigned
[6]Practical course / group of courses – enter P. For the group of courses – in brackets enter the number of ECTS points assigned to practical courses
[7]KO – general education courses, PD – basic sciences courses, K – main field of study courses, S – specialization courses

40. Spatial data models in GIS.
41. Building an application based on MapServer.

Cartography

42. Qualitative and quantitative generalization methods used in the cartographic development of topographic objects in the scale 1: 50,000 (BDOT50k), based on the Database of Topographic Objects (BDOT10k).
43. Possibilities of harmonization of the Database of Topographic Objects (BDOT10k) and the Sozological Map (SOZO). Provide examples of groups of BDOT10k objects that should supply the SOZO base and the possibility of attribute supplying BDOT10k from SOZO.
44. Ways of representation and visualization of digital terrain models (DTM).
45. What tasks should be performed when building a digital mapping model (DCM) based on a digital landscape model (DLM)?
46. The general idea of a multi-resolution database.

Geostatistics

47. Stochastic interpretation of numerical values of a given feature, measured at points with known spatial location. The concept of a regionalized variable.
48. Covariance, correlation and semivariance as measures of continuity of a regionalized variable.
49. Variogram and methods of its modeling.
50. Assessment of the linear error of the estimator of the local value of a given feature. Factors influencing the size of the error.
51. Kriging, its properties and varieties.

Project management, management of the development of geological and mining companies

52. Project management methods.
53. Project preparation processes. Project environment analysis. Defining the goals of the project.
54. Project initiation processes. Methods and tools for planning the scope, activities and resources.
55. Project risk management, Risk register. Communication in the project, Communication plan.
56. Business cycles and their division.
57. Ways of financing development in an enterprise.
58. What is an IPO?

[1]BU – number of ECTS points assigned to hours of classes requiring direct participation of academic teachers and other persons conducting classes
[2]Traditional – enter T, remote – enter Z
[3]Exam – enter E, crediting – enter Z. For the group of courses – after the letter E or Z - enter in brackets the final course form (lec, cl, lab, pr, sem)
[4]University-wide course /group of courses – enter O
[5]DN - number of ECTS points assigned to the classes related to the University's academic activity in the discipline/disciplines to which the main field of study is assigned
[6]Practical course / group of courses – enter P. For the group of courses – in brackets enter the number of ECTS points assigned to practical courses
[7]KO – general education courses, PD – basic sciences courses, K – main field of study courses, S – specialization courses

Financial analysis, economics and economics of mining

59. Profitability threshold for sales and its application.
60. Cost account for reporting purposes

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

No.	*Course / group of courses code*	*Name of course / group of courses*	*Crediting by deadline of... (number of semester)*
1	W06GIK-SM0100	Advanced Numerical Calculation Methods	*1*
2	W06GIK-SM0101	Advanced Geospatial Analysis	*1*
3	W06GIK-SM0102	Geostatistics	*1*
4	W06GIK-SM0103	Special Measurements	*1*
5	W06GIK-SM0104	Selected Topics in GNSS	*1*
6	W06GIK-SM0105	GIS Programming I	*1*
7	W11GIK-SM1138	Physics - the structure of matter	*1*
8	SJO-SM0003BK	Foreign Language I	*1*
9	W06GIK-SM0106	Selected Topics in Geospatial Modelling	*2*
10	W06GIK-SM0108	Physical Geodesy	*2*
11	W06GIK-SM0107	Financial Analysis	*2*
12	W06GIK-SM0109	Digital Cartographic Models	*2*
13	W06GIK-SM0110	GIS Programming II	*2*

[1]BU – number of ECTS points assigned to hours of classes requiring direct participation of academic teachers and other persons conducting classes
[2]Traditional – enter T, remote – enter Z
[3]Exam – enter E, crediting – enter Z. For the group of courses – after the letter E or Z - enter in brackets the final course form (lec, cl, lab, pr, sem)
[4]University-wide course /group of courses – enter O
[5]DN - number of ECTS points assigned to the classes related to the University's academic activity in the discipline/disciplines to which the main field of study is assigned
[6]Practical course / group of courses – enter P. For the group of courses – in brackets enter the number of ECTS points assigned to practical courses
[7]KO – general education courses, PD – basic sciences courses, K – main field of study courses, S – specialization courses

14	W06GIK-SM0111	Remote Sensing and Processing of Digital Images	*2*
15	W06GIK-SM0112L	Selected Topics in Displacement Monitoring	*2*
16	W06GIK-SM0114W	Hydrology II	*2*
17	SJO-SM0004BK	Foreign Language II	*2*
18	W08NW06-SM1921	HMC	*2*
19	W06GIK-SM0113S	Graduate seminar I	*2*
20	GIK-SM2233ANG	Elective course I	*2*
21	W06GIK-SM0115	Geoinformation Project Management	*3*
22	W06GIK-SM0116	Selected Topics in Information Technologies	*3*
23	W06GIK-SM0117	Distributed Spatial Databases	*3*
24	W06GIK-SM0118	Management of Company Development	*3*
25	GIK-SM3333ANG	Elective course II	*3*
26	W06GIK-SM0119S	Graduate Seminar II	*3*
27	W06GIK-SM0120D	Master Thesis	*3*

8. Plan of studies (attachment no. 4)

[1]BU – number of ECTS points assigned to hours of classes requiring direct participation of academic teachers and other persons conducting classes
[2]Traditional – enter T, remote – enter Z
[3]Exam – enter E, crediting – enter Z. For the group of courses – after the letter E or Z - enter in brackets the final course form (lec, cl, lab, pr, sem)
[4]University-wide course /group of courses – enter O
[5]DN - number of ECTS points assigned to the classes related to the University's academic activity in the discipline/disciplines to which the main field of study is assigned
[6]Practical course / group of courses – enter P. For the group of courses – in brackets enter the number of ECTS points assigned to practical courses
[7]KO – general education courses, PD – basic sciences courses, K – main field of study courses, S – specialization courses

Approved by faculty student government legislative body:

Patrycja Haraj
President of the Student Government
of the Faculty of Geoengineerin, Mining and Geology

.....
Date 21.10.2022

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

DZIEKAN
prof. dr hab. inż. Radosław Zimroz

.....
Date 21.10.2022

.....
Dean's signature

Zał. nr 4 do ZW 16/2020
Attachment no. 2 to Program of Studies

PLAN OF STUDIES

FACULTY: GEOENGINEERING, MINING AND GEOLOGY

MAIN FIELD OF STUDY: GEODESY AND CARTOGRAPHY (GIK)

EDUCATION LEVEL: second-level studies

FORM OF STUDIES: full-time studies

PROFILE: general academic

SPECIALIZATION: GEOMATICS

LANGUAGE OF STUDY: English

In effect since 2022/23

*delete as applicable

Plan of studies structure (optionally)

1) in ECTS point layout

sem/hours	1	points	2	points	3	points
1	Physics - the structure of matter 20000Z *W11GIK-SM1138*	2	Selected Topics in Geospatial Modelling 10200Z *W06GIK-SM0106*	3	Geoinformation Project Management 10100Z *W06GIK-SM0115*	2
2						
3	Foreign Language I 03000Z *JSO-SM0003BK*	2			Selected Topics in Information Technologies 20200Z *W06GIK-SM0116*	3
4			Financial Analysis 10100Z *W06GIK-SM0107*	2		
5						
6	Advanced Numerical Calculation Methods 10200E *W06GIK-SM0100*	4	Physical Geodesy 10100Z *W06GIK-SM0108*	2	Distributed Spatial Databases 10200E *W06GIK-SM0117*	3
7						
8			Digital Cartographic Models 10200E *W06GIK-SM0109*	3		
9	Advanced Geospatial Analysis 10200Z *W06GIK-SM0101*	5			Management of Company Development 10001Z *W06GIK-SM0118*	2
10						
11					Graduate Seminar II 00002Z *W06GIK-SM0119S*	2
12	Geostatistics 10300E *W06GIK-SM0102*	5	GIS Programming II 10200Z *W06GIK-SM0110*	4		
13					Elective course II 20000Z *GIK-SM3333ANG*	3
14						
15			Remote Sensing and Processing of Digital Images 10200E *W06GIK-SM0111*	5	Master thesis *W06GIK-SM0120D*	15
16	Special Measurements 10200Z *W06GIK-SM0103*	4				
17						
18			Selected Topics in Displacement Monitoring 00300Z *W06GIK-SM0112L*	3		
19	Selected Topics in GNSS 10110E *W06GIK-SM0104*	4				
20			Foreign Language II 01000E *SJO-SM0004BK*	1		
21			HMC 10000Z *W08NW06-SM1921*	2		
22	GIS Programming I 10200Z *W06GIK-SM0105*	4	Elective course I 20000Z *GIK-SM2233ANG*	3		
23						
24			Graduate Seminar I 00001Z *W06GIK-SM0113S*	1		
25			Hydrology II 10000Z *W06GIK-SM0114W*	1		
sum		**30**		**30**		**30**

1. Set of obligatory and optional courses and groups of courses in semestral arrangement

Semester 1

Obligatory courses / groups of courses Number of ECTS points 28

No.	Course/ group of courses code	Name of course/group of courses (denote group of courses with symbol **GK**)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form[2] of course/group of courses	Way[3] of crediting	Course/group of courses			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN[5] classes	BU[1] classes			University-wide[4]	Concerning scientific activities[5]	Practical[6]	Type[7]
1	W06GIK-SM0100	Advanced Numerical Calculation Methods	1			2		K2_GIK_W02, K2_GIK_U01	45	120	4	2	1.5	T/Z	E(w) Z(p)	-	DN	P(3)	PD
2	W06GIK-SM0101	Advanced Geospatial Analysis	1		2			K2_GIK_W03, K2_GIK_U02, K2_GIK_K02, K2_GIK_K03	45	150	5	5	2.5	T/Z	Z(w) Z(l)	-	DN	P(3)	S
3	W06GIK-SM0102	Geostatistics	1		3			K2_GIK_W04, K2_GIK_U03, K2_GIK_K02, K2_GIK_K03	60	150	5	4	2	T/Z(w) T(l)	E(w) Z(l)	-	DN	P(3)	K
4	W06GIK-SM0103	Special Measurements	1		2			K2_GIK_W05, K2_GIK_U04, K2_GIK_K01	45	120	4	3	1.5	T/Z(w) T(l)	Z(w) Z(p)	-	DN	P(2)	S
5	W06GIK-SM0104	Selected Topics in GNSS	1		1	1		K2_GIK_W06, K2_GIK_U05, K2_GIK_K01	45	120	4	3	1.5	T/Z(w) T(l) T(p)	E(w) Z(l)	-	DN	P(2)	S
6	W06GIK-SM0105	GIS Programming I	1		2			K2_GIK_W07, K2_GIK_U06	45	120	4	3	1.5	T/Z	Z(w) Z(l)	-	DN	P(2)	S
7	W11GIK-SM1138	Physics - the structure of matter	2					K2_GIK_W01	30	60	2	-	1	T/Z	Z	O	-	-	PD
		Total	**8**	**0**	**10**	**3**	**0**		**315**	**840**	**28**	**20**	**11.5**					**15**	

[1]BU – number of ECTS points assigned to hours of classes requiring direct participation of academic teachers and other persons conducting classes
[2]Traditional – enter T, remote – enter Z
[3]Exam – enter E, crediting – enter Z. For the group of courses – after the letter E or Z - enter in brackets the final course form (lec, cl, lab, pr, sem)
[4]University-wide course /group of courses – enter O
[5]DN - number of ECTS points assigned to the classes related to the University's academic activity in the discipline/disciplines to which the main field of study is assigned
[6]Practical course / group of courses – enter P. For the group of courses – in brackets enter the number of ECTS points assigned to practical courses
[7]KO – general education courses, PD – basic sciences courses, K – main field of study courses, S – specialization courses

Optional courses / groups of courses (minimum 45 hours in semester, 2 ECTS points)

No.	Course/ group of courses code	Name of course/group of courses (denote group of courses with symbol **GK**)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form[2] of course/group of courses	Way[3] of crediting	Course/group of courses			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN[5] classes	BU[1] classes			University-wide[4]	Concerning scientific activities[5]	Practical[6]	Type[7]
1	JSO-SM0003BK	Foreign Language I		3				K2_GIK_U19, K2_GIK_K01	45	60	2	-	1.5	T	Z	O	-	P(2)	KO
		Total	**0**	**3**	**0**	**0**	**0**		**45**	**60**	**2**	**-**	**1.5**					**2**	

Altogether in semester

Total number of hours					Total number of ZZU hours	Total number of CNPS hours	Total number of ECTS points	Total number of ECTS points for DN classes[5]	Number of ECTS points for BU classes[1]
lec	cl	lab	pr	sem					
8	**3**	**10**	**3**	**0**	**360**	**900**	**30**	**20**	**13**

Semester 2

Obligatory courses / groups of courses Number of ECTS points 25

No.	Course/ group of courses code	Name of course/group of courses (denote group of courses with symbol **GK**)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form[2] of course/group of courses	Way[3] of crediting	Course/group of courses			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN[5] classes	BU[1] classes			University-wide[4]	Concerning scientific activities[5]	Practical[6]	Type[7]
1	W06GIK-SM0106	Selected Topics in Geospatial Modelling	1		2			K2_GIK_W08, K2_GIK_U07, K2_GIK_K01	45	90	3	2	1.5	T/Z(w) T(l)	Z(w) Z(l)		DN	P(2)	S
2	W06GIK-SM0107	Financial Analysis	1		1			K2_GIK_W18, K2_GIK_U08	30	60	2	-	1	T/Z	Z(w) Z(l)		DN	P(1)	KO

[1]BU – number of ECTS points assigned to hours of classes requiring direct participation of academic teachers and other persons conducting classes
[2]Traditional – enter T, remote – enter Z
[3]Exam – enter E, crediting – enter Z. For the group of courses – after the letter E or Z - enter in brackets the final course form (lec, cl, lab, pr, sem)
[4]University-wide course /group of courses – enter O
[5]DN - number of ECTS points assigned to the classes related to the University's academic activity in the discipline/disciplines to which the main field of study is assigned
[6]Practical course / group of courses – enter P. For the group of courses – in brackets enter the number of ECTS points assigned to practical courses
[7]KO – general education courses, PD – basic sciences courses, K – main field of study courses, S – specialization courses

3	W06GIK-SM0108	Physical Geodesy	1		1			K2_GIK_W10, K2_GIK_U09, K2_GIK_K02	30	60	2	-	1	T/Z	Z(w) Z(l)		DN	P(1)	K
4	W06GIK-SM0109	Digital Cartographic Models	1		2			K2_GIK_W11, K2_GIK_U10	45	90	3	3	1.5	T/Z	E(w) Z(l)		DN	P(2)	S
5	W06GIK-SM0110	GIS Programming II	1		2			K2_GIK_W12, K2_GIK_U06	45	120	4	3	2	T/Z	Z(w) Z(l)		DN	P(3)	S
6	W06GIK-SM0111	Remote Sensing and Processing of Digital Images	1		2			K2_GIK_W13, K2_GIK_U11, K2_GIK_K02, K2_GIK_K03	45	150	5	5	2.5	T/Z	E(w) Z(p)		DN	P(3)	S
7	W06GIK-SM0112L	Selected Topics in Displacement Monitoring			3			K2_GIK_U12, K2_GIK_K03	45	90	3	3	2.5	T	Z(l)		DN	P(3)	S
8	W06GIK-SM0114W	Hydrology II	1					K2_GIK_W14, K2_GIK_K02, K2_GIK_K03	15	30	1	-	0.5	T/Z	Z(w)		DN	-	S
9	W08NW06-SM1921	Humanistic-managerial course (HMC)	1					K2_GIK_W09, K2_GIK_W17, K2_GIK_K01, K2_GIK_K03	15	60	2	-	0.5	T/Z	Z	O	-	-	KO
		Total	**8**	**0**	**13**	**0**	**0**		**315**	**750**	**25**	**16**	**13**					**15**	

Optional courses / groups of courses (minimum 60 hours in semester, 5 ECTS points)

No.	Course/ group of courses code	Name of course/group of courses (denote group of courses with symbol **GK**)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form[2] of course/ group of courses	Way[3] of crediting	Course/group of courses			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN[5] classes	BU[1] classes			University-wide[4]	Concerning scientific activities[5]	Practical[6]	Type[7]
1	SJO-SM0004BK	Foreign Language II		1				K2_GIK_U19, K2_GIK_K01	15	30	1	-	0.5	T	E	O	-	P(1)	KO
2	GIK-SM2233ANG	Elective course I	2					K2_GIK_W17, K2_GIK_U13, K2_GIK_K03	30	90	3	3	2	T/Z	Z		DN	-	S

[1]BU – number of ECTS points assigned to hours of classes requiring direct participation of academic teachers and other persons conducting classes
[2]Traditional – enter T, remote – enter Z
[3]Exam – enter E, crediting – enter Z. For the group of courses – after the letter E or Z - enter in brackets the final course form (lec, cl, lab, pr, sem)
[4]University-wide course /group of courses – enter O
[5]DN - number of ECTS points assigned to the classes related to the University's academic activity in the discipline/disciplines to which the main field of study is assigned
[6]Practical course / group of courses – enter P. For the group of courses – in brackets enter the number of ECTS points assigned to practical courses
[7]KO – general education courses, PD – basic sciences courses, K – main field of study courses, S – specialization courses

3	W06GIK-SM0113S	Graduate Seminar I					1	K2_GIK_U14, K2_GIK_U18, K2_GIK_K02, K2_GIK_K04	15	30	1	-	1	T/Z	Z		-	P(1)	S
		Total	**2**	**1**	**0**	**0**	**1**		**60**	**150**	**5**	**3**	**3.5**					**2**	

Altogether in semester

Total number of hours					Total number of ZZU hours	Total number of CNPS hours	Total number of ECTS points	Total number of ECTS points for DN classes[5]	Number of ECTS points for BU classes[1]
lec	cl	lab	pr	sem					
10	**1**	**13**	**0**	**1**	**375**	**900**	**30**	**19**	**16.5**

Semester 3

Obligatory courses / groups of courses Number of ECTS points 10

No.	Course/ group of courses code	Name of course/group of courses (denote group of courses with symbol **GK**)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form[2] of course/ group of courses	Way[3] of crediting	Course/group of courses			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN[5] classes	BU[1] classes			University-wide[4]	Concerning scientific activities[5]	Practical[6]	Type[7]
1	W06GIK-SM0115	Geoinformation Projects Management	1		1			K2_GIK_W09, K2_GIK_U15, K2_GIK_K01	30	60	2	1	1	T/Z	Z(w) Z(l)		DN	P(1)	K
2	W06GIK-SM0116	Selected Topics in Information Technologies	2		2			K2_GIK_W15, K2_GIK_U16	60	90	3	2	1.5	T/Z	Z(w) Z(l)		DN	P(2)	S
3	W06GIK-SM0117	Distributed Spatial Databases	1		2			K2_GIK_W16, K2_GIK_U17	45	90	3	2	1.5	T/Z	E(w) Z(l)		DN	P(2)	S

[1]BU – number of ECTS points assigned to hours of classes requiring direct participation of academic teachers and other persons conducting classes
[2]Traditional – enter T, remote – enter Z
[3]Exam – enter E, crediting – enter Z. For the group of courses – after the letter E or Z - enter in brackets the final course form (lec, cl, lab, pr, sem)
[4]University-wide course /group of courses – enter O
[5]DN - number of ECTS points assigned to the classes related to the University's academic activity in the discipline/disciplines to which the main field of study is assigned
[6]Practical course / group of courses – enter P. For the group of courses – in brackets enter the number of ECTS points assigned to practical courses
[7]KO – general education courses, PD – basic sciences courses, K – main field of study courses, S – specialization courses

4	W06GIK-SM0118	Management of Company Development	1				1	K2_GIK_W18, K2_GIK_U14, K2_GIK_K01, K2_GIK_K02, K2_GIK_K04	30	60	2	-	1	T/Z	Z(w) Z(s)		DN	P(1)	KO
		Total	**5**	**0**	**5**	**0**	**1**		**165**	**300**	**10**	**5**	**5**					**6**	

Optional courses / groups of courses (minimum 90 hours in semester, 20 ECTS points)

No.	Course/ group of courses code	Name of course/group of courses (denote group of courses with symbol **GK**)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form[2] of course/group of courses	Way[3] of crediting	Course/group of courses			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN[5] classes	BU[1] classes			University-wide[4]	Concerning scientific activities[5]	Practical[6]	Type[7]
1	GIK-SM3333ANG	Elective course II	2					K2_GIK_W17, K2_GIK_U13, K2_GIK_K03	30	90	3	3	2	T/Z	Z		DN	-	S
2	W06GIK-SM0119S	Graduate Seminar II					2	K2_GIK_U14, K2_GIK_U18, K2_GIK_K02, K2_GIK_K04	30	60	2	-	2	T	Z		-	P(2)	S
3	W06GIK-SM0120D	Master thesis				2		K2_GIK_U14, K2_GIK_U18, K2_GIK_K03, K2_GIK_K04	30	450	15	15	12	T	Z		DN	P(15)	S
		Total	**2**	**0**	**0**	**2**	**2**		**90**	**600**	**20**	**18**	**16**					**17**	

Altogether in semester

Total number of hours					Total number of ZZU hours	Total number of CNPS hours	Total number of ECTS points	Total number of ECTS points for DN classes[5]	Number of ECTS points for BU classes[1]
lec	cl	lab	pr	sem					
7	**0**	**5**	**2**	**3**	**255**	**900**	**30**	**23**	**21**

[1]BU – number of ECTS points assigned to hours of classes requiring direct participation of academic teachers and other persons conducting classes
[2]Traditional – enter T, remote – enter Z
[3]Exam – enter E, crediting – enter Z. For the group of courses – after the letter E or Z - enter in brackets the final course form (lec, cl, lab, pr, sem)
[4]University-wide course /group of courses – enter O
[5]DN - number of ECTS points assigned to the classes related to the University's academic activity in the discipline/disciplines to which the main field of study is assigned
[6]Practical course / group of courses – enter P. For the group of courses – in brackets enter the number of ECTS points assigned to practical courses
[7]KO – general education courses, PD – basic sciences courses, K – main field of study courses, S – specialization courses

2. Set of examinations in semestral arrangement

Course / group of courses code	Names of courses / groups of courses ending with examination	Semester
W06GIK-SM0100 W06GIK-SM0102 W06GIK-SM0104	1. Advanced Numerical Calculation Methods 2. Geostatistics 3. Selected Topics in GNSS	1
W06GIK-SM0109 W06GIK-SM0111 SJO-SM0004	1. Digital Cartographic Models 2. Remote Sensing and Processing of Digital Images 3. Foreign Language II	2
W06GIK-SM0117	1. Distributed Spatial Databases	3

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

Semester	Allowable deficit of ECTS points after semester
1	5
2	3
3	0

[1]BU – number of ECTS points assigned to hours of classes requiring direct participation of academic teachers and other persons conducting classes
[2]Traditional – enter T, remote – enter Z
[3]Exam – enter E, crediting – enter Z. For the group of courses – after the letter E or Z - enter in brackets the final course form (lec, cl, lab, pr, sem)
[4]University-wide course /group of courses – enter O
[5]DN - number of ECTS points assigned to the classes related to the University's academic activity in the discipline/disciplines to which the main field of study is assigned
[6]Practical course / group of courses – enter P. For the group of courses – in brackets enter the number of ECTS points assigned to practical courses
[7]KO – general education courses, PD – basic sciences courses, K – main field of study courses, S – specialization courses

Opinion of student government legislative body

Patrycja Haraj

Patrycja Haraj
President of the Student Government
of the Faculty of Geoengineerin, Mining and Geology

.....
Date 21.10.2022

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

DZIEKAN
prof. dr hab. inż. Radosław Zimroz

.....
Date 21.10.2022

.....
Dean's signature

SUBJECT CARDS

FACULTY: **GEOENGINEERING, MINING AND GEOLOGY**

MAIN FIELD OF STUDY: **GEODESY AND CARTOGRAPHY (GIK)**

ASSIGNED TO THE DISCIPLINES:

D1 ENVIRONMENTAL ENGINEERING, MINING AND ENERGY (major discipline)

D2 CIVIL ENGINEERING, GEODESY AND TRANSPORT

EDUCATION LEVEL: **second-level studies**

FORM OF STUDIES: **full-time studies**

PROFILE: **general academic**

SPECIALIZATION: **GEOMATICS**

LANGUAGE OF STUDY: **English**

IN EFFECT SINCE: **2022/2023**

SEMESTER 1

Zał. nr 5 do ZW 16/2020

FACULTY OF GEOENGINEERING, MINING AND GEOLOGY

SUBJECT CARD

Name of subject in Polish	Fizyka – budowa materii
Name of subject in English	Physics - the Structure of Matter
Main field of study (if applicable):	Geodesy and Cartography
Specialization (if applicable):	Geomatics
Profile:	academic / ~~practical~~*
Level and form of studies:	~~1st~~/ 2nd level, ~~uniform magister studies~~*, full-time / ~~part-time~~*
Kind of subject:	obligatory / ~~optional~~ / university-wide*
Subject code	**W11GIK-SM1138**
Group of courses	~~YES~~ / 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	~~Examination~~ / crediting with grade*				
For group of courses mark (X) final course					
Number of ECTS points	**2**				
including number of ECTS points for practical classes (P)					
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	**1**				

*delete as not necessary

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Competence in the field of the basics of mathematical analysis and algebra

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SUBJECT OBJECTIVES

C1. Obtaining basic knowledge, considering its application aspects, from the following fields of modern physics:
- C1.1. Quantum mechanics
- C1.2 Nuclear physics
- C1.3 Solid state physics
- C1.4 Physics of semiconductors and semiconductor devices

C2. Obtaining and consolidation of social competences including emotional intelligence consisting in the ability to cooperate in a student group aimed at effective problem solving. Responsibility, honesty and fairness in proceedings; observing the customs of the academic community and society.

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge:

PEU_W01 has knowledge of energy units;
PEU_W02 knows the physical basis of the operation of heat engines;
PEU_W03 knows the physical basis of the operation of generators;

PEU_W04	knows the structure of the atom and understands the arrangement of atoms in the periodic table of elements;
PEU_W05	has knowledge of the phenomena of fusion and fission of atomic nuclei;
PEU_W06	knows the physical basis of the operation of a nuclear power plant;
PEU_W07	knows the crystallographic structure of solids and understands the relationship between the properties of solids and their electronic structure;
PEU_W08	understands the relationship between the dimensionality of semiconductor structures and their physical properties;
PEU_W09	knows the physical basics of solar cells;
PEU_W10	has knowledge of the circulation of CO2 in the atmosphere and the physical basis of formulating the theory of the greenhouse effect;
relating to skills:	
PEU_U01	can convert energy from one unit to another and can estimate orders of magnitude of energy for individual physical phenomena;
PEU_U02	has the ability to identify and name physical phenomena realized in heat engines;
PEU_U03	has the ability to identify and name physical phenomena realized in generators;
PEU_U04	knows how to justify the position of elements in the periodic table and extract relevant information about them;
PEU_U05	has the ability to identify and name physical phenomena realized in a nuclear power plant;
PEU_U06	can estimate the power of solar cells;
PEU_U07	can estimate the amount of CO2 emissions in selected combustion processes;
relating to social competences:	
PEU_K01	can think and act creatively and set priorities for the implementation of a specific task;
PEU_K02	can search for information and subject it to critical analysis;
PEU_K03	understands the need for self-education, including improving the ability to concentrate attention and focus on important things as well as develop the ability to independently apply the knowledge and skills;
PEU_K04	understands the impact of the discoveries and achievements of physics on technical and social progress;
PEU_K05	has the ability to objectively evaluate arguments, rationally translate and justify his own point of view with the use of knowledge in the field of modern physics;

PROGRAMME CONTENT

	Lecture	**Number of hours**
Lec 1	Organizational matters. Energy, units of energy, types of energy, methods of energy transfer between systems, the role of energy in the development of civilization.	2
Lec 2	Converting heat to work. Physical basis of the operation of heat engines.	4
Lec 3	Converting work to electricity. Faraday's law and the physical basis of the operation of generators.	2
Lec 4	Structure of atoms, electronic orbitals, electron shells, ionization energy of atoms, periodic table of elements, isotopes of elements, radioactive elements.	2
Lec 5	Reactions of the synthesis and fission of atomic nuclei.	2

Lec 6	Physical basis for the operation of a nuclear power plant. Analysis of the various stages of energy conversion, from nuclear energy to electricity.	2
Lec 7	Crystalline structure of solids. Types of bonds in crystals. Metals, superconductors, semiconductors and dielectrics.	4
Lec 8	Band model of solids, Bloch theorem, electronic structure of metals, semiconductors and dielectrics.	2
Lec 9	Semiconductor structures and quantum wells, wires and dots. Application of quantum mechanics to the determination of the electronic structure of the low dimensional quantum systems. Doping of semiconductors.	4
Lec 10	Converting the energy of solar radiation into electricity: solar cells.	2
Lec 11	CO_2 circulation in the atmosphere, the greenhouse effect and a summary of the lectures.	2
Lec 12	Credit for the lecture.	2
	Total hours	**30**

TEACHING TOOLS USED

N1. Traditional lecture with the use of transparencies and slides.
N2. Own work - independent studies and preparation for passing.
N3. Consultations.
N4. Written-oral test

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
P	PEU_W01-PEU_W10, PEU_U01-PEU_U07, PEU_K01-PEU_K05	P1. Written-oral test

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1]. Halliday, R. Resnick, J. Walker; *Podstawy Fizyki, tom 5, PWN.*

[2] Jay Orear, *Fizyka, tom 2, WNT.*

SECONDARY LITERATURE:

[1] Materials for the lecture in the form of .ppt files, available via the Internet on the lecturer's website.

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

prof. dr hab. inż. Robert Kudrawiec, robert.kudrawiec@pwr.edu.pl

Zał. nr 5 do ZW 16/2020

FACULTY OF GEOENGINEERING, MINING AND GEOLOGY

SUBJECT CARD

Name of subject in Polish	Zaawansowane metody obliczeń numerycznych
Name of subject in English	Advanced Numerical Calculation Methods
Main field of study (if applicable):	Geodesy and Cartography
Specialization (if applicable):	Geomatics
Profile:	academic / ~~practical~~*
Level and form of studies:	~~1st~~/ 2nd level, ~~uniform magister studies~~*, full-time / ~~part-time~~*
Kind of subject:	obligatory / ~~optional~~ / ~~university-wide~~*
Subject code	**W06GIK-SM0100**
Group of courses	~~YES~~ / 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**			**90**	
Form of crediting	Examination / ~~crediting with grade~~*			~~Examination~~ / crediting with grade*	
For group of courses mark (X) final course					
Number of ECTS points	**1**			**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)	**1**			**0.5**	

*delete as not necessary

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Has knowledge and skills in the field of differential and integral calculus
2. Has basic knowledge and skills in the application of mathematical statistics in tasks (mean, mode, median, standard deviation, normal distribution and chi-square)

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SUBJECT OBJECTIVES

C1 Understanding the principles of developing measurement data sets with the accuracy assessment

C2 Acquiring practical skills of approximation, estimation and forecasting of one- and multidimensional data

C3 Understanding and using big data filtering methods

C4 Understanding the principles of free and robust alignment of survey data

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge:

PEU_W01 has knowledge of the sources and distributions of errors in measurements of physical quantities and is able to limit their impact on the measurement results;

PEU_W02 has knowledge of the approximation and interpolation of functions of one and many variables with various statistical methods;

PEU_W03 knows the methods of filtering and predicting measurement data at various levels of confidence with the use of various calculation methods.

relating to skills:

PE_U01 can count measurement errors with the assessment of the accuracy of measurements of physical quantities;

PE_U02 is able to align measurement observations considering outliers, gross errors using statistical and artificial intelligence methods.

relating to social competences:

PEU_K01 can think and act creatively and define priorities for the implementation of a specific task;

PEU_K02 can search for information and subject it to critical analysis;

PEU_K03 understands the need for self-education, including improving the ability to concentrate attention and focus on important things, and to develop the ability to independently apply the knowledge and skills.

PROGRAMME CONTENT

	Lecture	**Number of hours**
Lec 1	Approximation of any mathematical function of one and more variables using the least squares method.	2
Lec 2	Measurement error analysis. Systematic errors of measurements: instrumental and environmental as well as random errors of measurements of physical values.	2
Lec 3	Distribution of observation functions, observation errors, observation results, corrections. Properties of the measurement density function. Confidence level, covariances and correlation coefficients of multivariate observations.	2
Lec 4	Descriptions of mathematical models that best reflect the studied physical phenomenon. Introduction to neural networks and genetic algorithms.	2
Lec 5	Selected types of estimation. Point and interval estimation. M-estimators, strong estimation.	2
Lec 6	Alignment resistant to coarse errors. Methods of aligning the observations without taking into account the pseudo-inverse and the suppression function. Network defects. Free geodetic networks. Free alignments. Multi-step alignments	2
Lec 7	Filtering and prediction of random functions. Filtration methods, Kalman filter. Least squares collocation. Spectral analysis.	2
Lec 8	Approximation of functions 1 and 2 with a polynomial of second and higher degrees. Regression analysis of one and multivariate functions, time series.	1
	Total hours	**15**

Project		Number of hours
Proj 1	Analysis of the distribution of random measurement values with the plot of the histogram, calculation of mean values and measurement errors of the measured values.	2
Proj 2	Linear models - model parameters estimation based on direct observations.	2
Proj 3	Determination of the value of covariance and correlation coefficients of functionally dependent quantities.	2
Proj 4	Point and interval estimation of the expected value and variance of the examined function	2
Proj 5	Nonlinear models. Approximation of functions of one and many variables.	2
Proj 6	Linear and nonlinear models. Function regression analysis and time series.	2
Proj 7	Coarse error-tolerant alignment of an exemplary height network	2
Proj 8	Coarse lattice error-tolerant alignment.	2
Proj 9	Analysis of the accuracy of aligned observations with the identification of outliers. Verification of measurement data.	2
Proj 10	Analysis of measurement results using a neural network.	2
Proj 11	Alignment of a free geodetic network with the use of pseudo-inverse, analysis of results and assessment of accuracy.	2
Proj 12	Multi-stage alignment of geodetic networks, including accuracy assessment.	2
Proj 13	Estimation methods of robust equalization of measurement results. Huber method.	2
Proj 14	Robust estimation methods. Hampel and Linear methods.	2
Proj 15	Analysis of measurement results and selection of an appropriate adjustment method to the assumed accuracy.	2
	Total hours	**30**

TEACHING TOOLS USED

N1. Traditional lecture with multimedia presentations.
N2. Laboratory - work with measuring equipment or in a computer room.
N3. Preparation of reports in the form of reports with the results of measurements and calculations.
N4. Own work - continuation of chamber work and independent study, preparation for the exam.
N5. Consultation

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT

Evaluation (F – forming during semester), P – concluding (at semester end)	Learning outcomes code	Way of evaluating learning outcomes achievement
P	PEU_W01-PEU_W03, PEU_K01-PEU_K03	P1. Written exam (N1, N4, N5), credit for the final written exam according to the specified scope of

		the material
F, P	PEU_U01-PEU_U02, PEU_K01-PEU_K03	F1. Assessments of reports and surveys (N2-N5) F2. Test grades (N4) P2. Final grade for laboratory classes issued on the basis of the formula: (arithmetic mean from F1 + arithmetic mean from F2) / 2 converted to the academic grading scale.

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] Ghilani Ch. Adjustment computations : spatial data analysis, John Wiley & Sons, 2018 ISBN:978-1-119-38598-1 1-119-38598-9

[2] Wolf P.R. Solutions Manual for Adjustment Computations: Statistics and Least Squares in Surveying and GIS, John Wiley & Sons 1997

[3] Pham, D, Karaboga, D. Intelligent Optimisation Techniques Genetic Algorithms, Tabu Search, Simulated Annealing and Neural Networks, Springer 2000, ISBN 978-1-4471-0721-7

SECONDARY LITERATURE:

[1] Lakhmi C. Jain, N.M. Martin Fusion of Neural Networks, Fuzzy Systems and Genetic Algorithms: Industrial Applications, Published 1998 by CRC Press ISBN 9780849398049

[2] Leick A, Rapoport L., Tatarnikov D. GPS Satellite Surveying John Wiley & Sons 2015, ISBN: 978-1-119-01826-1

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

dr inż. Tadeusz Głowacki, tadeusz.glowacki@pwr.wroc.pl

Zał. nr 5 do ZW 16/2020

FACULTY OF GEOENGINEERING, MINING AND GEOLOGY

SUBJECT CARD

Name of subject in Polish	Zaawansowane metody analiz przestrzennych
Name of subject in English	Advanced Geospatial Analysis
Main field of study (if applicable):	Geodesy and Cartography
Specialization (if applicable):	Geomatics
Profile:	academic / ~~practical~~*
Level and form of studies:	~~1st~~/ 2nd level, ~~uniform magister studies~~*, full-time / ~~part-time~~*
Kind of subject:	obligatory / ~~optional~~ / ~~university-wide~~*
Subject code	**W06GIK-SM0101**
Group of courses	~~YES~~ / 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)	**60**		**90**		
Form of crediting	~~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)	**1**		**1.5**		

*delete as not necessary

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Has basic knowledge of the role of geoinformation tools (GIS) and spatial data acquisition techniques
2. Has the ability to use practically GIS software package (eg. ArcGIS ESRI, QGIS) in a wide range of its functionalities.
3. Has basic knowledge of databases

SUBJECT OBJECTIVES

C1 Transfer of knowledge related to development, implementation and operation of geoinformation systems in organizations, with examples

C2 Presentation of information on the use of GIS in advanced spatial analysis of objects, phenomena and processes

C3 Acquiring the ability to formulate and solve tasks using GIS analytical functions

C4 Acquiring the ability to create simple algorithms in Python to solve spatial problems

C5 Acquiring the ability to work with geoinformation systems in accordance with the provisions of the INSPIRE directive

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge:

PEU_W01 Has broadened knowledge of the effective use of geoinformation systems to collect and process data used in modelling natural and anthropogenic phenomena and processes

PEU_W02 Has knowledge of the principles of construction and operation of geoinformation systems in various administrative units and industries

relating to skills:

PEU_U01 Has the ability to use advanced GIS tools in the study of natural phenomena and spatial development,

PEU_U02 Has the ability to formulate and solve spatial tasks in the GIS environment

PEU_U03 Has the ability to interpret the obtained results and draw meaningful conclusions

relating to social competences:

PEU_K01 Has the ability to formulate and pass knowledge on the use of geoinformation systems in spatial analyzes and to present their results

PROGRAMME CONTENT

	Lecture	**Number of hours**
Lec 1	Presentation of the syllabus, course completion requirements, literature. Systematization of basic concepts in the field of geographic information systems	2
Lec 2	Data models in GIS. Current state and development trends	2
Lec 3	Network analysis	2
Lec 4	Spatial statistics	2
Lec 5	Uncertainty in spatial data processing operations	2
Lec 6	Advanced Map Algebra concepts	2
Lec 7	Examples of the use of geoinformation systems in organizations (administration, industry, science)	2
Lec 8	Test of knowledge	1
	Total hours	**15**

	Laboratory	**Number of hours**
Lab 1	Overview of modules and analytical tools of common GIS packages (ArcGIS, QGIS)	2
Lab 2	Solving network analysis problems. Creation of network datasets	2
Lab 3	Solving network analysis problems. Determining the optimal route	2
Lab 4	Solving network analysis problems. The traveling salesman problem /vehicle routing problem	2
Lab 5	Solving network analysis problems. Location – allocation problem	2
Lab 6	Solving network analysis problems. Service area determination	2

Lab 7	Spatial statistics. Analysis of statistically significant clusters of a phenomenon	2
Lab 8	Spatial statistics. Hot Spot analysis.	2
Lab 9	Spatial statistics. Spatial Multiple Regression. Ordinary least squares analysis	2
Lab 10	Spatial statistics. Spatial Multiple Regression. Spatially weighted regression	2
Lab 11	Spatial statistics. Spatial Multiple Regression. Model testing, analysis and interpretation of results	2
Lab 12	Map algebra. Identification of the optimal investment location. Weighted sum of maps.	2
Lab 13	Map algebra. Determination of the total cost surface	2
Lab 14	Map algebra. Calculation of the path of the least cost	2
Lab 15	Repetition of the material	2
	Total hours	**30**

TEACHING TOOLS USED

N1. Lecture with elements of a problem lecture
N2. Multimedia presentations
N3. Preparation of individual written semester work on a given topic
N4. Laboratory assignments and reports
N5. Consultations
N6. Final written test
N7. Written test (quiz)

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-PEU_W02	F1 Written test grade, F2 Written semester assignment grade, P1 Final grade from the lecture (weighted average from F1 - 80% and F2 - 20%)
F, P	PEU_U01-PEU_U03, PEU_K01	F3 Written assignment report grades, F4 Test grades, P2 Final laboratory grade (weighted average from 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] Berry J., 2007-2013. Beyond Mapping IV — GIS Modelling
[3] Heywood I., Cornelius S., Carver S., 2006: An Introduction to Geographical Information Systems. 3rd Edition, Pearson Prentice Hall

SECONDARY LITERATURE:

[1] Maguire D., Batty M., Goodchild M., 2005. GIS Spatial Analysis and Modelling. ESRI Press
[2] Zandbergen P., 2013. Python Scripting for ArcGIS. ESRI Press
[3] Lutz M., 2011. Python Introduction. 4th Edition
[4] 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). Official Journal of the European Union 25.4.2007, L 108/1

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

dr hab. inż. Jan Blachowski, jan.blachowski@pwr.edu.pl

Zał. nr 5 do ZW 16/2020

FACULTY OF GEOENGINEERING, MINING AND GEOLOGY

SUBJECT CARD

Name of subject in Polish	Geostatystyka
Name of subject in English	Geostatistics
Main field of study (if applicable):	Geodesy and Cartography
Specialization (if applicable):	Geomatics
Profile:	academic / ~~practical~~*
Level and form of studies:	~~1st~~/ 2nd level, ~~uniform magister studies~~*, full-time / ~~part-time~~*
Kind of subject:	obligatory / ~~optional~~ / ~~university-wide~~*
Subject code	**W06GIK-SM0102**
Group of courses	~~YES~~ / 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)	**60**		**90**		
Form of crediting	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)	**1**		**1**		

*delete as not necessary

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge and understanding of the basic concepts of the probability theory (popular probability distributions and their parameters, random variable with real values and its distribution, independence of random variables, covariance, correlation) and methods of statistical inference (population, attribute, sample, point and confidence estimators of the mean value and variance, statistical tests - significance tests for mean value or variance, goodness of fit tests).
2. Ability to perform a statistical analysis of a sample from a random variable with real values (descriptive statistics, estimation of the basic parameters of the population attribute distribution, verification of parametric and non-parametric hypotheses, assessment of the correlation of the attribute two population, linear regression).
3. Basic knowledge of geoinformation systems.

SUBJECT OBJECTIVES

C1. Acquiring knowledge of the basic methods of analysis and construction of a geostatistical model of the parameters of surface layers and learning selected applications of geostatistics.

C2. Acquisition of skills in building a structural model of strata of the Earth surface, estimation and processing of the spatial model of the variability of strata parameters.

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge:

PEU_W01 Student knows the methods of describing the parameters of surface layers in terms of a regionalized variable, methods of analysis and construction of a geostatistical model of selected parameters, and estimation methods of layer parameters.

PEU_W02 Student knows techniques of building a digital model of the spatial variability of surface layer parameters (structural triangulation models of surfaces or solids and block models), methods of processing a layer model (quantitative methods, graphical presentations) and typical applications of geostatistical methods (parameter forecasting, optimization of the sampling pattern).

relating to skills:

PEU_U01 Student is able to develop a geostatistical model of the surface layer parameter, to forecast the average value of the parameter in a given area, using selected estimators (including kriging) and to assess the quality of the estimation.

PEU_U02 Student can build a structural model of layers and a model of spatial variability of their parameters, make selected elements of graphic documentation (sections, projections, maps) and obtain volumetric results.

relating to social competences:

PEU_K01 Student can communicate with representatives of various industries and cooperate in a team.

PROGRAMME CONTENT

	Lecture	**Number of hours**
Lec 1	Introduction to geostatistics. The stricture of geological data.	2
Lec 2	Forecasting methods of the value of surface layers parameters. Initial statistical analysis of the sample from a real-valued random variable (descriptive statistics, mean and variance estimation, probability distribution matching, parametric and non-parametric tests).	2
Lec 3	Characteristics of the spatial distribution of layer parameters. Descriptive statistics of the scatterplot (covariance, correlation, and semivariance). Empirical semivariogram. Ergodicity and stationarity of the stochastic proces. Regionalized variable.	2
Lec 4	Geostatistical model of a regionalized variable. Kriging - the Best Linear Unbiased Estimator of the mean value.	2
Lec 5	Affine anisotropy (geometric and zonal). Anisotropy analysis. Modelling of the variogram. Variogram model verification using the cross-validation method.	2
Lec 6	Trend and analysis of the trend. Domain analysis. Selected variants of Kriging..	2
Lec 7	Structural and qualitative model of surface layers and processing of these models.	2

Lec 8	Application of geostatistical methods (volumetric estimation, optimization of the sampling pattern).	1
	Total hours	**15**

Laboratory		**Number of hours**
Lab 1	Establishing rules of attending and working in laboratory classes. Introduction to Datamine Studio environment. Getting to know the structure of source data and assigning data sets for analysis to students. Preparation of data for spatial modelling.	3
Lab 2	Locating the modelled area on the map of Poland. Identification of the sampling pattern and sampling interval. Identification of layers.	3
Lab 3	Creation of wireframe models of the top and bottom surfaces of layers.	3
Lab 4	Creation of a structural model of surface layers - continuation.	3
Lab 5	Creation of a block model of surface layers. Identification of the thickness distribution of the layers.	3
Lab 6	Identification of estimation domains.	3
Lab 7	Identification of anisotropy directions of the analysed parameter. Determination of empirical variograms of the analysed parameter in individual domains.	3
Lab 8	Determination of variogram models of the analysed parameter in domains.	3
Lab 9	Kriging Neighbourhood Analysis (KNA).	3
Lab 10	Creation and estimation of a block model of individual layers - the spatial model of the distribution of the values of the analysed parameter.	3
Lab 11	Creation and estimation of a block model of individual layers - continuation. Estimation quality verification.	3
Lab 12	Classification of layer areas based on geometric and quantitative criteria. Volumetric processing of the spatial parameter model (volume, weight, mean values of parameters, related to classification).	3
Lab 13	Visualization of the spatial model. Creating maps and sections.	3
Lab 14	Completing the missing elements of laboratory exercises.	3
Lab 15	Final assessment.	3
	Total hours	**45**

TEACHING TOOLS USED

N1. Informative lecture, content illustrated with multimedia presentations
N2. Interactive lecture (moderated discussion)
N3. Laboratory classes - teacher presents an exemplary use of IT tools
N4. Laboratory classes – discussion on the choice of the method of analysis
N5. Laboratory classes –individual implementation of the task based on the handout
N6. Laboratory classes – practical test of knowledge of laboratory research methods
N7. Tests, including e-tests on the e-learning platform
N8. Student hours
N9. Student's own work – preparation to laboratory classes
N10. Written report on the implemented laboratory exercises
N11. Student's own work – individual studies and preparation for assessments
N12. Final written test

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	PEU_W01 - PEU_W02 PEU_U01 - PEU_U02 PEU_K01	F1: Assessment of the written or oral test of preparation for the laboratory classes, assessment of the progress of the laboratory exercises
F	PEU_W01 - PEU_W02 PEU_U01 - PEU_U02	F2: Assessment of written laboratory exercise report
F	PEU_U01 - PEU_U02 PEU_K01	F3: Practical test evaluation of the analysis and modelling methods used in the laboratory classes
P	PEU_W01 - PEU_W02 PEU_U01 - PEU_U02	P1: Final laboratory classes grade (weighted average: F1 x 0,3 + F2 x 0,7) subject to a positive evaluation F3
P	PEU_W01 - PEU_W02	P2: Lecture grade on the basis of the written exam

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] Armstrong, M., Basic Linear Geostatistics, Springer-Verlag, Berlin Heidelberg New York, 1998.
[2] Hołodnik K., Materiały do wykładów, Politechnika Wrocławska, 1994-2019.
[3] Hołodnik K., Materiały do ćwiczeń, Politechnika Wrocławska, 1994-2019.
[4] Mucha J., Metody matematyczne w dokumentowaniu złóż, AGH Kraków, 1994.
[5] Zawadzki J., Metody geostatystyczne dla kierunków przyrodniczych i technicznych, Oficyna Wyd. Politechniki Warszawskiej, 2011.
[6] Isaaks E.H., Srivastawa R.M., An introduction to Applied Geostatistics, Oxford University Press, 1989.
[7] Rossi M.W., Deutsch C.V., Mineral Resources Estimation, Springer 2014.

SECONDARY LITERATURE:

[1] Datamine Studio Users Guides and Tutorials, CAE Mining 1983-2014.
[2] Clark I. and Harper B., Practical Geostatistics 2000, Clark I., Practical geostatistics. Elsevier Applied Science, London and New York 2000.
[3] Chiles Jean-Paul, Delfiner Pierre, Geostatistics. Modeling Spatial Uncertainty, John Wiley & Sons, Wiley Series in Probability and Statistics, 1999, ISBN 978-0-471-08315-3.
[4] David M., Handbook of Applied Advanced Geostatistical Ore Reserve Estimation, Elsevier Applied Science, 1988.
[5] Davis J.C., Statistics and Data Analysis in Geology. J. Wiley and Sons, New York 1973 (rok pierwszego wydania, potem min. 1981, 1994, 2002).
[6] Dowd P.A., Lognormal kriging – The General Case, Mathematical Geology, 1982.

[7] Goovaerts, P., Geostatistics for Natural Resources Evaluation. Oxford University Press 1997.
[8] Journel A.G., Huijbregts Ch.J., Mining Geostatistics,The Blackburn Press, 2003 (1978 rok pierwszego wydania).
[9] Lantuejoul Christian, Geostatistical Simulation. Models and Algoritms. Springer 2002.
[10] Namysłowska-Wilczyńska B., Geostatystyka. Teoria i zastosowania, Oficyna PWR, 2006. (studia przypadków).
[11] Smogur Z., Excel w zastosowaniach inżynieryjnych, Helion, 2008.
[12] Webster, R., Oliver, M.A., Geostatistics for Environmental Scientists. John Wiley & Sons, 2000.

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

dr inż. Krzysztof Hołodnik, krzysztof.holodnik@pwr.edu.pl

Zał. nr 5 do ZW 16/2020

FACULTY OF GEOENGINEERING, MINING AND GEOLOGY

SUBJECT CARD

Name of subject in Polish	Pomiary specjalne
Name of subject in English	Special Measurements
Main field of study (if applicable):	Geodesy and Cartography
Specialization (if applicable):	Geomatics
Profile:	academic / ~~practical~~*
Level and form of studies:	~~1st~~/ 2nd level, ~~uniform magister studies~~*, full-time / ~~part-time~~*
Kind of subject:	obligatory / ~~optional~~ / ~~university-wide~~*
Subject code	**W06GIK-SM0103**
Group of courses	~~YES~~ / 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)	**60**		**60**		
Form of crediting	~~Examination~~ / crediting with grade*		~~Examination~~ / crediting with grade*		
For group of courses mark (X) final course					
Number of ECTS points	**2**		**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)	**0.5**		**1**		

*delete as not necessary

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Has basic knowledge of precise geodetic measurements.
2. Has basic knowledge of displacement and deformation measurements.
3. Can use computer programs for processing, calculations and visualization of measurement results of environmental elements.

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SUBJECT OBJECTIVES

C1 Presentation of physical methods in geodetic measurements

C2 Getting to know GPR measurements, their processing and analysis

C3 Getting to know the measurements with feeler gauges and processing the results

C4 Application of geodetic methods in the measurement of environmental elements (e.g. light measurements, wind measurements)

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge:

PEU_W01	Knows the principles of the correct use of the deterministic model for determining the displacement field in order to optimize the measurement of displacements and deformations
PEU_W02	Has the necessary knowledge of the methods and measurement techniques used with the use of: GNSS receiver, total station, GPR, luxometer and anemometer
PEU_W03	Has knowledge to solve advanced engineering tasks in the field of specialized geodetic measurements
PEU_W04	Knows the principles of developing engineering documentation and three-dimensional CAD models
relating to skills:	
PEU_U01	Is able to plan a field survey using: GNSS receiver, total station, GPR, luxometer and anemometer
PEU_U02	Is able to develop and process data obtained from field measurements into engineering documentation and 3D models
PEU_U03	Is able to analyze deviations, deformations, displacements and deformations of a given object covered by the field measurement
relating to social competences:	
PEU_K01	Is able to communicate with representatives of various industries and cooperate in a group

PROGRAMME CONTENT		
Lecture		**Number of hours**
Lec 1	Discussion of the subject card, course completion requirements, literature. Systematization of basic concepts in the field of monitoring of environmental elements	2
Lec 2	Physical measurement methods and their development	2
Lec 3	The principle of GPR operation	2
Lec 4	GPR measurements and preparation of results	2
Lec 5	Integration of physical and geodetic measurements	2
Lec 6	Analyzes of measurement results	2
Lec 7	Visualization and processing of measurement results	2
Lec 8	Final test	1
	Total hours	**15**
Laboratory		**Number of hours**
Lab 1	Introduction to classes, discussion of projects	1
Lab 2	Determination of horizontal and form deformations on the basis of geodetic measurements - calculation of the deformation tensor and deformation distribution	1
Lab 3	Determination of vertical and horizontal displacements of bridge structures using the constant straight line	5
Lab 4	Determining the wind speed distribution in a regular measurement grid	2

Lab 5	Determining the distribution of lighting intensity inside and outside the building, based on one measuring warp	2
Lab 6	Assessment of the geometric condition of tram / railway tracks	5
Lab 7	Measurement of vibrating elements on the example of the cablecar Polinka	4
Lab 8	Getting acquainted with the construction and principle of operation of the GPR	3
Lab 9	GPR measurements of underground infrastructure	3
Lab 10	Development of GPR imaging	3
Lab 11	Discussion of projects, summary and completion of classes	1
	Total hours	**30**

TEACHING TOOLS USED

N1. Traditional lecture with multimedia presentations.
N2. Written final test.
N3. Laboratory exercises - work with measuring equipment and specialized software.
N4. Preparation of reports.
N5. Own work - continuation of chamber work and independent study.
N6. 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
P	PEU_W01 PEU_W02 PEU_W03 PEU_W04	P1. Written final test (N2)
F, P	PEU_U01 PEU_U02 PEU_U03 PEU_K01	F1. Ratings from the reports (N3, N4, N5) P2. The final grade for laboratory exercises is issued as an arithmetic mean converted to an academic scale.

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] Karczewski J.: Zarys metody georadarowej. Wydawnictwo Akademii Górniczo-Hutniczej. Kraków 2007

[2] Czaja J.: Wybrane zagadnienia z geodezji inżynieryjnej. Wydawnictwa AGH. Kraków 1996

[3] T. Lazzarini i inni: Geodezyjne pomiary przemieszczeń budowli i ich otoczenia. Wydawnictwo PPWK. Warszawa 1977

[4] Walczak J.: Wytrzymałość materiałów oraz podstawy teorii sprężystości i plastyczności. PWN Tom II, Warszawa 1973

[5] Kadaj R.: Modele, metody i algorytmy obliczeniowe sieci kinematycznych w geodezyjnych pomiarach przemieszczeń i odkształceń. Wydawnictwa Akademii Rolniczej. Kraków 1998

[6] Prószyński W., Kwaśniak M.: Podstawy geodezyjnego wyznaczania przemieszczeń. Oficyna Wydawnicza Politechniki Warszawskiej. Warszawa 2006

[7] Gocał J.: Metody i instrumenty geodezyjne w precyzyjnych pomiarach maszyn i urządzeń mechanicznych. Wydawnictwa AGH. Kraków 1993

[8] Gocał J.: Geodezja inżynieryjno-przemysłowa część 1, Kraków 2000

[9] Gocał J.: Geodezja inżynieryjno-przemysłowa część 2, Kraków 2005

[10] Gocał J.: Geodezja inżynieryjno-przemysłowa część 1, Kraków 2010

SECONDARY LITERATURE:

[1] Geodetic survey

[2] Geological survey

[3] Scientific articles on GPR measurements

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

dr inż. Robert Gradka, robert.gradka@pwr.edu.pl

FACULTY OF GEOENGINEERING, MINING AND GEOLOGY

SUBJECT CARD

Name of subject in Polish	Zaawansowane metody nawigacji i pozycjonowania satelitarnego - GNSS
Name of subject in English	Selected Topics in GNSS
Main field of study (if applicable):	Geodesy and Cartography
Specialization (if applicable):	Geomatics
Profile:	academic / ~~practical~~*
Level and form of studies:	~~1st~~/ 2nd level, ~~uniform magister studies~~*, full-time / ~~part-time~~*
Kind of subject:	obligatory / ~~optional~~ / ~~university-wide~~*
Subject code	**W06GIK-SM0104**
Group of courses	~~YES~~ / NO*

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	**15**		**15**	**15**	
Number of hours of total student workload (CNPS)	**60**		**30**	**30**	
Form of crediting	Examination / ~~crediting with grade*~~		~~Examination~~ / crediting with grade*	~~Examination~~ / crediting with grade*	
For group of courses mark (X) final course					
Number of ECTS points	**2**		**1**	**1**	
including number of ECTS points for practical classes (P)			**1**	**1**	
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	**0.5**		**0.5**	**0.5**	

*delete as not necessary

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Has basic knowledge about orbital mechanics. Is familiar with observation methods of satellites used for studying Earth's gravitational field.
2. Knows satellite navigational systems and also basic satellite surveying techniques, especially kinematic, including real time (DGPS and RTK) and static.
3. Can perform static and RTK surveys in GPS system, and later process the data on basic level. Has ability to create technical documentation as well as interpret it. Can adequately choose survey techniques for field jobs.

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SUBJECT OBJECTIVES

C1 Presentation of knowledge about relations between global, regional and national coordinate frames.

C2 Presentation of advanced knowledge about GNSS survey techniques and methods of postprocessing.

C3 Gain practical skills in advanced static and kinematic GNSS surveys.

C4 Gain practical skills in advanced GNSS data processing.

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge:

PEU_W01 Has knowledge about global navigational satellite systems and satellite missions used for Earth's gravity field determination.

PEU_W02 Has knowledge about use of GNSS and gravity field models.

PEU_W03 Has general, systematic and theoretical knowledge about Earth's gravitational field, methods of geoid determination and definition of height systems.

relating to skills:

PEU_U01 Can plan and execute measurements in reference to available GNSS.

PEU_U02 Can use global, regional and local coordinate systems for horizontal and vertical ties.

PEU_U03 Can design and measure with GNSS a geodetic networks and specialized networks.

PEU_U04 Can perform field jobs with use of GBAS and SBAS techniques.

PEU_U05 Can process the data with considering advanced corrections.

relating to social competences:

PEU_K01 Has ability of efficient communication with representatives of different branches (professions) and communities, can cooperate and work with team. Is competent in making duties and assigning them, teams managing which are working in different projects.

PROGRAMME CONTENT

	Lecture	**Number of hours**
Lec 1	International reference frame ITRF and its structure. Regional reference frame ETRF and its realizations in Poland.	2
Lec 2	Global positioning systems. Positioning augmentation systems GBAS and SBAS.	2
Lec 3	Regulations in development of geodetic networks measured by GNSS. ASG-EUPOS system – structure, real time services.	2
Lec 4	ASG-EUPOS system – postprocessing services.	2
Lec 5	Methods of point determination in geodetic networks in postprocessing. Phenomena that influence accuracy of point determination and methods of their reduction.	2
Lec 6	GNSS levelling	2
Lec 7	Applications of GNSS established networks; geodynamic and control. Future GNSS development.	2
Lec 8	Revision of the material	1
	Total hours	**15**

	Laboratory	**Number of hours**
Lab 1	Transformations between ITRF, ETRF, WGS and national systems.	2
Lab 2	Situational horizontal and vertical RTK survey tied to GBAS in global and national as well as local systems.	2
Lab 3	Static survey of measurement control network.	3

Lab 4	Postprocessing of GNSS static survey tied to national, regional and global networks.	4
Lab 5	Postprocessing with use of POSGEO and POSGEO-D services.	4
	Total hours	**15**

Project		**Number of hours**
Proj 1	Static and RTK survey planning.	2
Proj 2	Measurement control network project – choosing a reference frame.	2
Proj 3	Measurement control network project – locating points.	4
Proj 4	RTK survey processing – office works.	2
Proj 5	Measurement control network project – survey strategies.	2
Proj 6	Measurement control network project – processing strategies.	3
	Total hours	**15**

TEACHING TOOLS USED

N1. Traditional lecture with multimedia presentations
N2. Written test
N3. Laboratorial practice - work with survey equipment and specialized software
N4. Field surveys
N5. Consults

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
P	PEU_W01 PEU_W02 PEU_W03	P1 Crediting written test (N2)
F, P	PEU_U01, PEU_U02, PEU_U03, PEU_U04, PEU_U05, PEU_K01	F1 Grades for tasks done and written task reports (N3 and N4) F2 Written test (N2) P2 Credit grade (arithmetic mean of F1 and F2)

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] Czarnecki K., „Geodezja współczesna w zarysie". Wyd. Gall, Warszawa, 2010;
[2] Lamparski J., „Navstar GPS od teorii do praktyki". Wydawnictwo Uniwersytetu Warmińsko-Mazurskiego, Olsztyn, 2001;
[3] Januszewski J., Systemy satelitarne GPS, Galileo i inne, PWN, Warszawa, 2006
[4] Rogowski J., Klęk M., Geodezja satelitarna, Wydawnictwo UWMSC, Warszawa 2009

SECONDARY LITERATURE:

[1] Materials from conferences, home and international, since 5 years back.
[2] Publications in home and foreign periodic and non-periodic journals.

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

dr inż. Marcin Zając, marcin.zajac@pwr.edu.pl

Zał. nr 5 do ZW 16/2020

FACULTY OF GEOENGINEERING, MINING AND GEOLOGY

SUBJECT CARD

Name of subject in Polish	Programowanie w GIS I
Name of subject in English	GIS Programming I
Main field of study (if applicable):	Geodesy and Cartography
Specialization (if applicable):	Geomatics
Profile:	academic / ~~practical~~*
Level and form of studies:	~~1st~~/ 2nd level, ~~uniform magister studies~~*, full-time / ~~part-time~~*
Kind of subject:	obligatory / ~~optional~~ / ~~university-wide~~*
Subject code	**W06GIK-SM0105**
Group of courses	~~YES~~ / 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)	**60**		**60**		
Form of crediting	~~Examination /~~ crediting with grade*		~~Examination /~~ crediting with grade*		
For group of courses mark (X) final course					
Number of ECTS points	**2**		**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)	**1**		**0.5**		

*delete as not necessary

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Skill to use GIS software and knowledge of creating and analysing spatial data sets
2. Basic programming skills.

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SUBJECT OBJECTIVES

C1 Acquisition of theoretical knowledge in the field of programming in geographic information systems in tasks related to the acquisition and collection of vector spatial data.

C2 Acquisition of theoretical knowledge in the field of programming in geographic information systems in tasks related to the processing of vector spatial data.

C3 Acquisition of practical skills in the field of programming in geographical information systems in tasks related to the acquisition and collection of vector spatial data.

C4 Acquisition of practical skills in the field of programming in geographic information systems in tasks related to the processing of vector spatial data.

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge:

PEU_W01 It has knowledge of programming in geographic information systems.

PEU_W02 It knows the principles of creating IT tools supporting work in geographic information systems on the vector data.

relating to skills:

PEU_U01 It has the ability to create IT tools supporting work in geographic information systems on the vector data.

PEU_U02 It can evaluate and select appropriate methods and algorithms for building spatial relations between objects and create an application for solving tasks on vector data.

relating to social competences:

PEU_K01 It can communicate with representatives of various industries and cooperate in a group.

PROGRAMME CONTENT

	Lecture	**Number of hours**
Lec 1	Basics of database programming.	2
Lec 2	Basics of programming spatial databases.	4
Lec 3	Structures of vector and raster data in spatial databases.	2
Lec 4	Vector objects.	2
Lec 5	Functions that perform spatial analyzes on vector objects.	3
Lec 6	Final test.	2
	Total hours	**15**

	Laboratory	**Number of hours**
Lab 1	Introduction to programming in geographic information systems.	2
Lab 2	Configuring the development environment and database.	4
Lab 3	Building simple applications to operate on files with spatial data.	4
Lab 4	Building simple applications to operate on databases.	4
Lab 5	Building simple applications to operate on databases	4
Lab 6	Building simple applications to operate on spatial databases.	4
Lab 7	Objects and classes that represent vector data.	2
Lab 8	Functions for vector data analysis.	2
Lab 9	Functions for spatial analysis on vector data.	2
Lab 10	Vector data export functions.	2
	Total hours	**30**

TEACHING TOOLS USED

N1. Traditional lecture with multimedia presentations.
N2. Final test.
N3. Laboratory exercises.
N4. Preparation of reports.

N5. Own work - continuation of work and independent study.
N6. Short tests (quizzes).
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
P	PEU_W01, PEU_W02	P1. Assessment of the final test (N2)
F, P	PEU_U01, PEU_U02, PEU_K01	F1. Assessment of the final test (N2) F2. Test grade (N6) F3. Project grade (N3, N4, N5) P2 = F1 * 0.5 + F2 * 0.2 + F3 * 0.3

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] Zdzisław Dybikowski, PostgreSQL, Wydanie II, Helion 2012,
[2] Dominik Mikiewicz, Michal Mackiewicz, Tomasz Nycz. Mastering PostGIS, Helion 2017.
[3] Michael Dawson, Python dla każdego. Podstawy programowania. Wydanie III, Helion 2014.
[4] Perdita Stevens, UML inżynieria oprogramowania, wydanie II, Helion 2007.
[5] Piotr Wróblewski, Algorytmy, struktury danych i techniki programowania. Wydanie V. Helion.
[6] Przemysław Kiciak, Podstawy modelowania krzywych i powierzchni – zastosowania w grafice komputerowej, Wydawnictwa Naukowo – Techniczne, Warszawa 2005, wydanie II, zmienione i rozszerzone.

SECONDARY LITERATURE:

[1] PostgreSQL manual, https://www.postgresql.org/docs/manuals/
[2] PostGIS 3.0.3dev Manual, https://postgis.net/docs/
[3] Gręboszz Jerzy, Symfonia C++ Standard. Programowanie w języku C++ orientowane obiektowo. Tom I i II. Helion.
[4] Bjarne Stroustrup, Programowanie. Teoria i praktyka z wykorzystaniem C++, Helion 2010.
[5] QGIS API Documentation: https://qgis.org/api/2.18/modules.html.

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

dr inż. Piotr Grzempowski, piotr.grzempowski@pwr.edu.pl

SEMESTER 2

Zał. nr 5 do ZW 16/2020

FACULTY OF GEOENGINEERING, MINING AND GEOLOGY

SUBJECT CARD

Name of subject in Polish	Modelowanie przestrzenne
Name of subject in English	Selected Topics in Geospatial Modelling
Main field of study (if applicable):	Geodesy and Cartography
Specialization (if applicable):	Geomatics
Profile:	academic / ~~practical~~*
Level and form of studies:	~~1st~~/ 2nd level, ~~uniform magister studies~~*, full-time / ~~part-time~~*
Kind of subject:	obligatory / ~~optional~~ / ~~university-wide~~*
Subject code	**W06GIK-SM0106**
Group of courses	~~YES~~ / 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	~~Examination~~ / crediting with grade*		~~Examination~~ / 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)	**0.5**		**1**		

*delete as not necessary

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knows the principles of descriptive geometry and technical drawing for reading and writing architectural and construction drawings, as well as the principles of their preparation with the use of CAD systems.
2. Knows the basic techniques of geodetic measurements and the rules of elaborating the measurement results.
3. Has knowledge of general computer science and programming basics.

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SUBJECT OBJECTIVES

C1. Introduction to the different methods of spatial modeling and data exchange.

C2. Acquiring the ability to process point clouds and create 2D CAD documentation and simple 3D models (CAD, MESH, BIM) on the basis of point clouds.

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge:

PEU_W01	Student knows the principles of planning and carrying out measurements with a terrestrial laser scanner
PEU_W02	Student knows the rules of processing point clouds obtained from laser scanners (registration, filtration, segmentation, decimation)
PEU_W03	Student knows the rules of developing 2D CAD documentation as well as 3D CAD, MESH and BIM models at various levels of detail

relating to skills:

PEU_U01	Student can plan a field measurement with a terrestrial laser scanner
PEU_U02	Student can develop a point cloud from a laser scanner (perform registration, filtration, segmentation, decimation)
PEU_U03	Student can process point clouds into CAD documentation and 3D models at various levels of detail

relating to social competences:

PEU_K01	Student can communicate with representatives of various industries and cooperate in a group

PROGRAMME CONTENT

	Lecture	**Number of hours**
Lec 1	Introduction to terrestrial laser scanning	1
Lec 2	Techniques for acquiring point clouds	2
Lec 3	Methods of processing point clouds	2
Lec 4	Creating 2D and 3D CAD documentation	2
Lec 5	Introduction to SLAM technology	4
Lec 6	Introduction to BIM	2
Lec 7	Final test	2
	Total hours	**15**

	Laboratory	**Number of hours**
Lab 1	Measurement with a terrestrial laser scanner - obtaining a point cloud	4
Lab 2	Registration of point clouds by various methods and preliminary cleaning	4
Lab 3	Development of 2D CAD documentation in the form of floor plan and cross-sections based on a point cloud	2
Lab 4	Development of the MESH model of an architectural detail based on a point cloud	4
Lab 5	Measurement of an industrial installation element with development of results	6
Lab 6	SLAM - real-time 3D data acquisition using a sensor in motion	4
Lab 7	Building a BIM model based on architectural and construction documentation	6
	Total hours	**30**

TEACHING TOOLS USED

N1. Traditional lecture with multimedia presentations.

N2. Written final test.
N3. Laboratory exercises - work with measuring equipment and specialized software.
N4. Preparation of reports.
N5. Own work - continuation of work and self-study.
N6. Short tests (quizzes)
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
P	PEU_W01 PEU_W02 PEU_W03	P1. Written final test (N2)
F, P	PEU_U01 PEU_U02 PEU_U03 PEU_K01	F1. Grades from reports (N3, N4, N5) F2. Test grades (N6) P2. Final grade for laboratory exercises based on the result of the formula: (arithmetic mean from F1 + arithmetic mean from F2) / 2 converted to an academic grade scale.

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] Eastman C., Teicholz P., Sacks R., Liston K., *BIM Handbook: A Guide to Building Information Modeling for Owners, Managers, Designers, Engineers and Contractors*, Wiley 2011
[2] Heritage G. L., Large A. R., *Laser scanning for the environmental sciences*, Wiley 2009.
[3] Kasznia D., Magiera J., Wierzowiecki P., *BIM w praktyce. Standardy. Wdrożenie. Case Study*, PWN, 2018
[4] Reshetyuk Y., *Terrestrial laser scanning: error sources, self-calibration and direct georeferencing*, VDM Verlag, 2009
[5] Szajrych K., Fijka J., Kozłowski W., *Revit Architecture. Podręcznik użytkownika*, Helion SA, 2010
[6] Vosselman G., Maas H.-G., *Airborne and Terrestrial Laser Scanning*, Whittles Publishing, 2010
[7] Worboys M. F., Duckham M., *GIS: A Computing Perspective*, CRC Press 2004.

SECONDARY LITERATURE:

[1] Miśniakiewicz E., Skowroński W., *Rysunek techniczny budowlany*, Arkady, Warszawa, 2011
[2] Sujecki K., Burkiewicz J.: *Zapis konstrukcji i grafika inżynierska*, Wyd. AGH, Kraków, 2014
[3] Ślęk R., *ArchiCAD. Wprowadzenie do projektowania BIM,* Helion, 2013

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

dr inż. Zbigniew Muszyński, zbigniew.muszynski@pwr.edu.pl

Zał. nr 5 do ZW 16/2020

FACULTY OF GEOENGINEERING, MINING AND GEOLOGY

SUBJECT CARD

Name of subject in Polish	Analiza finansowa
Name of subject in English	Financial Analysis
Main field of study (if applicable):	Geodesy and Cartography
Specialization (if applicable):	Geomatics
Profile:	academic / ~~practical~~*
Level and form of studies:	~~1st~~/ 2nd level, ~~uniform magister studies~~*, full-time / ~~part-time~~*
Kind of subject:	obligatory / ~~optional~~ / ~~university-wide~~*
Subject code	**W06GIK-SM0107**
Group of courses	~~YES~~ / 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	~~Examination~~ / crediting with grade*		~~Examination~~ / 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)	**0.5**		**0.5**		

*delete as not necessary

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

C1 Acquiring basic knowledge and skills concerning the role and main concepts of financial analysis in a mining or geoinformation/geodetic company

C2 Gaining skills to interpret data presented in financial statements, to perform ratio analysis, to create simple financial models of investment project cash flows and to assess the financial viability of geoinformation projects.

C3 Fixing the attitude of including economic aspects in decision making and the competences of thinking and acting in an entrepreneurial and creative way

SUBJECT LEARNING OUTCOMES

relating to knowledge:

PEU_W01 Has basic knowledge about the contents and mutual interdependence of Balance Sheet, Income Statement and Cash Flow Statement

PEU_W02 Knows the concepts of costs in economics and accounting, understands differences

PEU_W03 Has basic knowledge concerning the ratio analysis of financial statements

PEU_W04 Knows the main cost classifications in companies, knows the main concepts of cost accounting

PEU_W05 Understands the concepts of Future Value and Present Value of cash flows, Knows the main methods of capital budgeting and project evaluation

PEU_W06 Knows the main methods of investment project risk assessment

relating to skills:

PEU_U01 Can read information presented in financial statements and analyse them using financial ratios

PEU_U02 Can interpret cost data presented in different cost classification systems. Is able to make short term decisions basing on cost data

PEU_U03 Is able to calculate Present Value of cash flows, PEU_U04

PEU_U05 Can perform capital budgeting procedure, assess the investment project

PEU_U06 Is able to perform risk analysis of an investment project by means of sensitivity and scenario analyses.

relating to social competences:

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

PROGRAMME CONTENT

	Lecture	**Number of hours**
Lec 1	Basics of financial accounting. Income statement and cash flow statement. Balance sheet. Working capital. Examples of financial statements of mining companies.	3
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	Financial ratio analysis. Liquidity, profitability, activity and debt ratios. Financial and operating leverage	2
Lec 6	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 7	The concept of risk and return. Quantification of risk. Risk analysis in project evaluation: sensitivity analysis, scenario analysis, other methods.	2
Lec 8	Written test	1
	Total hours	**15**

Laboratory		Number of hours
Lab 1	Basic financial accounting. Creation of simple Balance Sheet, Profit and Loss Statement and Cash Flow Statement.	4
Lab 2	Ratio analysis based on financial statements of companies	2
Lab 3	Managerial cost accounting. Decision making cases.	2
Lab 4	Time value of money– calculation by means of Excel functions.	2
Lab 5	Capital budgeting. Financial model of an investment.	3
Lab 6	Sensitivity and Scenario analysis.	2
	Total hours	**15**

TEACHING TOOLS USED

N1. Interactive lecture, slideshow and discussion
N2. Laboratory assignments with the use of Excel spreadsheet
N3. Laboratory – presentation of homework with discussion
N4. Individual consultancy within duty hours
N5. Individual work – preparing of projects
N6. Individual work – literature studies
N7. Written examination

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
P	PEU_W01-W08 PEU_K01	P1. Written examination (N1, N6, N7)
F, P	PEU_U01-U08 PEU_K01	F1. Discussion, active participation in laboratory and project classes (N2, N5). F2. Assessment of laboratory assignments solutions and project reports (N3. N4, N5). P2. Arithmetic mean (F1, F2)

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] Erhardt M., Brigham E.: Financial Management Theory and Practice. South-Western Cengage Learning, USA
[2] Johnson H.: Making Capital Budgeting Decisions – Maximising the Value of the Firm. Financial Times/Prentice Hall (April 15, 1999)
[3] Lock D.: Project Management. Routledge; 10th Edition (April 11, 2013)

SECONDARY LITERATURE:

[1] A Guide to Project Management Body of Knowledge (PMBOK®Guide Fourth Edition), Project Management Institute, 2008 (2004). wyd. pol., MT&DC Warszawa, 2009 (2006)
[2] Handouts, articles

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

dr inż. Gabriela Paszkowska, gabriela.paszkowska@pwr.edu.pl

Zał. nr 5 do ZW 16/2020

FACULTY OF GEOENGINEERING, MINING AND GEOLOGY

SUBJECT CARD

Name of subject in Polish	Geodezja fizyczna
Name of subject in English	Physical Geodesy
Main field of study (if applicable):	Geodesy and Cartography
Specialization (if applicable):	Geomatics
Profile:	academic / ~~practical~~*
Level and form of studies:	~~1st~~/ 2nd level, ~~uniform magister studies~~*, full-time / ~~part-time~~*
Kind of subject:	obligatory / ~~optional~~ / ~~university-wide~~*
Subject code	**W06GIK-SM0108**
Group of courses	~~YES~~ / 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	~~Examination~~ / crediting with grade*		~~Examination~~ / 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)			**1**		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Has a basic knowledge of the Earth's gravitational field, potential and acceleration of the speed force.
2. Has basic knowledge in the field of measuring the acceleration of gravity.
3. Has basic knowledge and skills in determining gravimetric anomalies.

SUBJECT OBJECTIVES

C1 Presentation of theoretical knowledge in the field of the Earth's gravitational potential

C2 Presentation of theoretical knowledge in the field of determining gravimetric anomalies, plumb line deviation and geoid course

C3 Presentation of theoretical basic knowledge of the Earth's rotation

C4 Presentation of theoretical basic knowledge in the field of terrestrial tides

C5 Presentation of theoretical basic knowledge in the field of tectonic plate motion models

C6 Acquisition of skills in the field of determining gravimetric anomalies, plumb line deviation and geoid course

C7 Acquisition of skills in numerical analysis of time series

C8	Acquiring the ability to analyze GNSS measurements and model the velocity and deformation of the earth's crust.

SUBJECT LEARNING OUTCOMES

relating to knowledge:

PEU_W01	Characterizes the issues related to the Earth's gravitational potential
PEU_W02	Characterizes the issues related to the calculation of gravimetric anomalies, plumb line deviation and geoid course
PEU_W03	Characterizes the issues related to the Earth's rotation
PEU_W04	Characterizes the issues related to the tides
PEU_W05	Characterizes issues related to models of tectonic plate motion

relating to skills:

PEU_U01	Is able to calculate gravimetric anomalies, plumb line deviations and geoid course
PEU_U02	Is able to perform numerical analysis of time series in geophysical and geodynamic applications
PEU_U03	Is able to analyze GNSS measurements and model the velocity and deformation of the earth's crust.

PROGRAMME CONTENT

	Lecture	**Number of hours**
Lec 1	Earth's gravitational potential. Expansion of the potential into a number of spherical functions. Geopotential models	2
Lec 2	Determination of gravimetric anomalies, plumb line deviation and geoid course on the basis of geopotential models	2
Lec 3	Determination of gravimetric anomalies, plumb line deviation and geoid course based on gravimetric data	2
Lec 4	Earth rotation (pole motion, astronomical precession / nutation, geophysical perturbations of the Earth's rotation)	2
Lec 5	Earth tides (crust tides and ocean tides, tidal effects in the atmosphere)	2
Lec 6	Methods of numerical analysis of time series	2
Lec 7	Plate tectonics. Geodetic and plate movement determination methods Models of tectonic plate movement. Modeling of velocity and deformation	2
Lec 8	Final test	1
	Total hours	**15**

	Laboratory	**Number of hours**
Lab 1	Statistical description of the gravity field. Covariance function. Least squares collocation	2
Lab 2	Calculation of gravimetric anomalies, plumb line deviation and geoid course from gravimetric data	4
Lab 3	Calculation of gravimetric anomalies and plumb line deviation from geopotential models and geoid course from geopotential models	4
Lab 4	Numerical analysis of time series	2

Lab 5	Approximation of tectonic plate motion parameters based on GNSS measurements. Modeling of in-plate velocities based on GNSS measurements. Modeling of deformation of the surface of the Earth's crust on the basis of GNSS measurements	3
	Total hours	**15**

TEACHING TOOLS USED

N1 Multimedia presentations.
N2 Procedures and computational functions.
N3 Carrying out and preparing reports on laboratory tasks.
N4 Final test
N5 Short test (quiz)

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
P	PEU_W01 – PEU_W05	P1 Assessment of the final test
F, P	PEU_U01 – PEU_U03	F1 Assessment of the final test F2 Score from a quiz F3 Assessment of the project P2=F1*0.5+F2*0.2+F3*0.3

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] Barlik M., Pachuta A., Geodezja fizyczna i grawimetria geodezyjna, teoria i praktyka, Oficyna Wydawnicza PW, Warszawa, 2007.
[2] Łyszkowicz A., Geodezja fizyczna, Wydawnictwo Uniwersytetu Warmińsko – Mazurskiego w Olsztynie, Olsztyn 2012.
[3] Reik V. Donner, Susana M. Barbosa, Nonlinear Time Series Analysis in the Geosciences, Applications in Climatology, Geodynamics and Solar-Terrestrial Physics, Springer, 2008.

SECONDARY LITERATURE:

[1] Czarnecki K., Geodezja współczesna w zarysie, Wyd. Gall, Warszawa 2010.
[2] Geodezja wyższa i astronomia geodezyjna, praca zbiorowa. PWN, Warszawa–Wrocław 1981.
[3] Niwelacja precyzyjna, praca zbiorowa, PPWK, Warszawa – Wrocław, 1993.

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

dr inż. Marcin Zając, marcin.zajac@pwr.edu.pl

Zał. nr 5 do ZW 16/2020

FACULTY OF GEOENGINEERING, MINING AND GEOLOGY

SUBJECT CARD

Name of subject in Polish	Kartograficzne modele cyfrowe
Name of subject in English	Digital Cartographic Models
Main field of study (if applicable):	Geodesy and Cartography
Specialization (if applicable):	Geomatics
Profile:	academic / ~~practical~~*
Level and form of studies:	~~1st~~/ 2nd level, ~~uniform magister studies~~*, full-time / ~~part-time~~*
Kind of subject:	obligatory / ~~optional~~ / ~~university-wide~~*
Subject code	**W06GIK-SM0109**
Group of courses	~~YES~~ / 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	Examination / ~~crediting with grade~~*		~~Examination~~ / 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)	**1**		**0.5**		

*delete as not necessary

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Has basic knowledge of digital cartography, knows the structure and content of the topographic database
2. Can practically use a GIS software package in a wide range of its functions

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SUBJECT OBJECTIVES

C1 Theoretical knowledge of feeding standard cartographic studies (digital cartographic models): topographic and thematic

C2 Knowledge of basic materials and methods for building and updating cartographic models of single- and multi-resolution models

C3 Ability to integrate different geo-referential registers: cartographic models (maps) of official and industry models

C4 Ability to harmonize the various public georeferenced registers: cartographic models (maps) of official and professional models

C5 Evaluation of the quality of georeferenced data and model information

C6 Understanding of the responsibility of the author of cartographic models

SUBJECT LEARNING OUTCOMES

relating to knowledge:

PEU_W01 Has a general, structured and theoretically underpinned knowledge of feeding and updating standard cartographic studies (digital cartographic models): topographic and thematic

PEU_W02 Has knowledge of the harmonization and integration of data in a multi-resolution database obtained from various georeferenced registers

relating to skills:

PEU_U01 Can assess and select appropriate methods for building cartographic digital models in GIS systems using various databases and data imaging modules

PEU_U02 It is prepared to supply, update and harmonize cartographic models from different georeferenced registers

relating to social competences:

PEU_K01 Is aware of the importance of quality in official digital cartographic models and maps: topographical and thematic

PEU_K02 Understands the responsibility of the contractor for digital cartographic models: thematic and topographic, for the completeness and timeliness of data and metadata entered into the model and made available, as well as copyright protection of information from georeferenced registers used for harmonization

PROGRAMME CONTENT

	Lecture	**Number of hours**
Lec 1	The scope of information collected in the database of topographic objects and used in digital cartographic models (DCM)	2
Lec 2	Organization, mode and technical standards of creating cartographic models from the database of topographic objects (BDOT10k) and general geographic objects (BDOO)	1
Lec 3	Processing of topographic data and their integration with data of spatial information infrastructure in Poland	1
Lec 4	Processing of topographic data and their integration with data of spatial information infrastructure in Poland	2
Lec 5	Multi-resolution topographical database (MRTD)	2
Lec 6	Power supply of MRTD from thematic databases based on the example of the sozological and hydrographic map - data harmonisation	2
Lec 7	Possibilities of supplying the KARTO component of a multi-resolution topographic database from selected public georeferenced registers	1
Lec 8	Forest Numerical Map, Electronic Sea Map, Numerical Map of Railroads etc. - data integration	1
Lec 9	Analysis of georeferenced data quality and evaluation of data quality obtained from cartographic models	1
Lec 10	Quality of data obtained from cartographic models and the responsibility of the contractor for the information obtained from the DCM	1

Lec 11	Colloquium credit	1
	Total hours	**15**

Laboratory		**Number of hours**
Lab 1	Digital cartographic models of topographic data. Development of a selected group of objects in a scale series from 10k to 250k	6
Lab 2	Updating the cartographic model on the basis of data from the Central Centre for Surveying and Cartographic Documentation	6
Lab 3	Integration of the cartographic model of topographic data with the land and building registry map	6
Lab 4	Harmonisation of selected groups of objects in the cartographic model of thematic data with a sozological and hydrographic map	6
Lab 5	Evaluation of the quality of the data available from the digital cartographic model	6
	Total hours	**30**

TEACHING TOOLS USED

N1. Informational lecture with elements of problematic lecture
N2. Multimedia presentations
N3. Performing individual written semester work on a given topic
N4. Conducting and preparing reports on laboratory tasks
N5. Testing
N6. Consultation

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT

Evaluation (F – forming during semester), P – concluding (at semester end)	Learning outcomes code	Way of evaluating learning outcomes achievement
P	PEU_W01, PEU_W02	P1 Final evaluation from the credit colloquium from the lecture
F, P	PEU_U01, PEU_U02, PEU_K01, PEU_K02	F1 Evaluation of the digital report on laboratory exercises F2 Assessment from the test P2 Final evaluation from the laboratory (mean weighted with F1 - 70% and F2 - 30%)

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] Bielecka E. 2005. Systemy Informacji geograficznej. Teoria i zastosowania. Wydawnictwo PJWSTK. Warszawa.
[2] Gotlib D., Olszewski R. (red.). 2013. Rola bazy danych obiektów topograficznych w tworzeniu infrastruktury informacji przestrzennej w Polsce. Główny Urząd Geodezji i Kartografii.
[3] Longley P.A., Goodchild M.F., Maguire D.J., Rhind D.W. 2006. GIS. Teoria i praktyka, Wydawnictwo Naukowe PWN;
[4] Pasławski J. i współautorzy. 2006. Wprowadzenie do kartografii i topografii.

[5] Urbański J. 2008. GIS w badaniach przyrodniczych. Wydawnictwo Uniwersytetu Gdańskiego.
[6] Żyszkowska W., Spallek W., Borowicz D. 2012. *Kartografia tematyczna*. Wydawnictwo Naukowe PWN

SECONDARY LITERATURE:

[1] ICA News www.icaci.org
[2] Geodezja i Kartografia, kwartalnik naukowy PAN Komitetu Geodezji
[3] Kwartalnik Geomatics and Environmental Enginneering. Uczelniane Wydawnictwa Naukowo-Dydaktyczne AGH
[4] Polski Przegląd Kartograficzny, kwartalnik Polskiego Towarzystwa Geograficznego;
[5] Seria „Studia Geograficzne" publikacje Wydawnictwa Uniwersytetu Wrocławskiego
[6] www.polishcartography.pl

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

dr hab. inż. Joanna Bac-Bronowicz, joanna.bac-bronowicz@pwr.edu.pl
dr Adam Górecki, adam.gorecki@pwr.edu.pl

Zał. nr 5 do ZW 16/2020

FACULTY OF GEOENGINEERING, MINING AND GEOLOGY

SUBJECT CARD

Name of subject in Polish	Programowanie w GIS II
Name of subject in English	GIS Programming II
Main field of study (if applicable):	Geodesy and Cartography
Specialization (if applicable):	Geomatics
Profile:	academic / ~~practical~~*
Level and form of studies:	~~1st~~/ 2nd level, ~~uniform magister studies~~*, full-time / ~~part-time~~*
Kind of subject:	obligatory / ~~optional~~ / ~~university-wide~~*
Subject code	**W06GIK-SM0110**
Group of courses	~~YES~~ / 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**		**90**		
Form of crediting	~~Examination /~~ crediting with grade*		~~Examination /~~ crediting with grade*		
For group of courses mark (X) final course					
Number of ECTS points	**1**		**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)	**1**		**1**		

*delete as not necessary

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. It has knowledge and skills in object-oriented programming in GIS systems to operate on vector data.
2. It has knowledge and skills in creation and operation databases.

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SUBJECT OBJECTIVES

C1 Acquisition of theoretical knowledge in the field of programming in geographic information systems in tasks related to the acquisition and collection of raster spatial data.

C2 Acquisition of theoretical knowledge in the field of programming in geographic information systems in tasks related to the processing of raster spatial data.

C3 Acquisition of practical skills in the field of programming in geographical information systems in tasks related to the acquisition and collection of raster spatial data.

C4 Acquisition of practical skills in the field of programming in geographic information systems in tasks related to the processing of raster spatial data.

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge:

PEU_W01 It has knowledge of programming in geographic information systems.

PEU_W02 It has the basics knowledge of big data processing and cloud computing.

relating to skills:

PEU_U01 It has the ability to create IT tools supporting work in geographic information systems on the raster data.

PEU_U02 It can evaluate and select appropriate methods and algorithms for building spatial relations between objects and create an application for solving tasks on vector and raster data.

relating to social competences:

PEU_K01 It can communicate with representatives of various industries and cooperate in a group.

PROGRAMME CONTENT

	Lecture	**Number of hours**
Lec 1	Raster objects.	2
Lec 2	Functions that perform operations on raster objects.	4
Lec 3	Introduction to big, variable and diverse data sets (big data).	4
Lec 4	Introduction to cloud computing.	3
Lec 5	Final test.	2
	Total hours	**15**

	Laboratory	**Number of hours**
Lab 1	Classes and objects representing raster data.	4
Lab 2	Objects and functions for raster data.	4
Lab 3	Spatial analysis functions for raster data.	4
Lab 4	Raster data export functions.	2
Lab 5	Conversion functions vector-raster and raster-vector.	2
Lab 6	The basic of NoSQL databases.	4
Lab 7	The basics of data processing in NoSQL databases.	4
Lab 8	The basics of creating simple applications to support NoSQL databases.	4
Lab 9	Final test.	2
	Total hours	**30**

TEACHING TOOLS USED

N1. Traditional lecture with multimedia presentations.
N2. Final test.
N3. Laboratory exercises.
N4. Preparation of reports.
N5. Own work - continuation of work and independent study.
N6. Short tests (quizzes).
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
P	PEU_W01, PEU_W02	P1. Assessment of the final test (N2)
F, P	PEU_U01, PEU_U02, PEU_K01	F1. Assessment of the final test (N2) F2. Test grade (N6) F3. Project grade (N3, N4, N5) P2 = F1 * 0.5 + F2 * 0.2 + F3 * 0.3

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] Zdzisław Dybikowski, PostgreSQL, Wydanie II, Helion 2012,
[2] Dominik Mikiewicz, Michal Mackiewicz, Tomasz Nycz. Mastering PostGIS, Helion 2017.
[3] Michael Dawson, Python dla każdego. Podstawy programowania. Wydanie III, Helion 2014.
[4] Perdita Stevens, UML inżynieria oprogramowania, wydanie II, Helion 2007.
[5] Piotr Wróblewski, Algorytmy, struktury danych i techniki programowania. Wydanie V. Helion.
[6] Przemysław Kiciak, Podstawy modelowania krzywych i powierzchni – zastosowania w grafice komputerowej, Wydawnictwa Naukowo – Techniczne, Warszawa 2005, wydanie II, zmienione i rozszerzone.

SECONDARY LITERATURE:

[1] PostgreSQL manual, https://www.postgresql.org/docs/manuals/
[2] PostGIS 3.0.3dev Manual, https://postgis.net/docs/
[3] Gręboszl Jerzy, Symfonia C++ Standard. Programowanie w języku C++ orientowane obiektowo. Tom I i II. Helion.
[4] Bjarne Stroustrup, Programowanie. Teoria i praktyka z wykorzystaniem C++, Helion 2010.
[5] QGIS API Documentation: https://qgis.org/api/2.18/modules.html.

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

dr inż. Piotr Grzempowski, piotr.grzempowski@pwr.edu.pl

Zał. nr 5 do ZW 16/2020

FACULTY OF GEOENGINEERING, MINING AND GEOLOGY

SUBJECT CARD

Name of subject in Polish	Teledetekcja i przetwarzanie obrazów cyfrowych
Name of subject in English	Remote Sensing and Processing of Digital Image
Main field of study (if applicable):	Geodesy and Cartography
Specialization (if applicable):	Geomatics
Profile:	academic / ~~practical~~*
Level and form of studies:	~~1st~~/ 2nd level, ~~uniform magister studies~~*, full-time / ~~part-time~~*
Kind of subject:	obligatory / ~~optional~~ / ~~university-wide~~*
Subject code	**W06GIK-SM0111**
Group of courses	~~YES~~ / 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)	**60**		**90**		
Form of crediting	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)	**1**		**1.5**		

*delete as not necessary

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCIES

1. Possesses knowledge and skills in land surveying and cartography
2. Possesses knowledge and skills in a selected GIS software package

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SUBJECT OBJECTIVES

C1 To deliver knowledge and skills in the Remote Sensing-based methods of identifying and monitoring Earth's surface.

C2 To deliver knowledge and skills on the Remote Sensing image characteristics, acquisition, processing, and classification.

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge:

PEU_W01: Possess a basic knowledge about remote sensing of the environment

PEU_W02: Possess a basic knowledge about LiDAR and SAR for remote sensing of the environment

relating to skills:

PEU_U01: Possess the necessary skills in identifying LULC using remote sensing and LiDAR data.
PEU_U02: Possess the necessary skills to used SAR data.
PEU_U03: Possess skills to use technical literature to construct computer programs performing remote sensing tasks.

relating to social competences:
PEU_K01: Respects moral and legal regulations and requirements on the Intelectual Properties Law and Copyrights act.
PEU_K02: Possess skills in a teamwork environment.

PROGRAMME CONTENT

	Lecture	**Number of hours**
Lec 1	The role of Remote Sensing in Geomatics and other Geosciences	2
Lec 2	Remote Sensing data acquisition. Pushbrum scanner. Type of data and formats.	2
Lec 3	Fundamentals of electromagnetic waves and their propagation through the atmosphere	2
Lec 4	Orbits of Remote Sensing spacecraft	2
Lec 5	Radiometric and geometric errors of Remote Sensing imagery and their corrections	2
Lec 6	Accuracy assessment of the Remote Sensing products	2
Lec 7	Data fusion of Remote Sensing data with other types of geodata	2
Lec 8	Remote Sensing space programs: focus on Copernicus Sentinel project	1
	Total hours	**15**

	Laboratory	**Number of hours**
Lab 1	Standard procedures for processing of digital images	2
Lab 2	Unsupervised classification of multispectral images	4
Lab 3	Supervised classification of multispectral images	4
Lab 4	Ground truthing	2
Lab 5	Accuracy assessment of image classification	4
Lab 6	Spectral indices for multispectral image classification	2
Lab 7	Data fusion of multispectral images with digital elevation models	4
Lab 8	SAR for land use and land cover classification	2
Lab 9	Data fusion of SAR with multispectral data	2
Lab 10	Monitoring land deformation using the InSAR and PsInSAR methods	4
	Total hours	**30**

TEACHING TOOLS USED

N1. Lecture with multimedia support.
N2. Oral or written exam
N3. Report on a Lab assignment
N4. Homework
N5. Self-preparation for tests and exams.

N6.	Oral presentation
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
P	PEU_W01, PEU_W02	P1. Oral or written exam (N2)
F, P	PEU_U01, PEU_U02, PEU_U03, PEU_K01, PEU_K02	F1. Reports' mark (N3, N4, N5, N7) F2. Oral presentation (N6) P2. Mean of F1 and F2.

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] Adamczyk J., Będkowski K. 2005 Metody cyfrowe w teledetekcji, Wydawnictwo SGGW, Warszawa

[2] Larose D. T. 2008 Metody i modele eksploracji danych, Wydawnictwo Naukowe PWN, Warszawa

[3] Tadeusiewicz R., Kohorda P. 1997 Komputerowa analiza i przetwarzanie obrazów, Wydawnictwo Fundacji Postępu Telekomunikacji, Kraków

SECONDARY LITERATURE:

[1] Kurczyński Z., Preuss R. 2010 Podstawy fotogrametrii. Wyd. 3, Oficyna Wydawnicza Politechniki Warszawskiej.

[2] Habib A.F. Analytical Photogrammety. Podręcznik PDF, www.geomatics.ucalgary.ca/Ehabib/courses.html.

[3] Habib A.F. Remote sensing. Podręcznik PDF, www.geomatics.ucalgary.ca/Ehabib/courses.html.

[4] Magazyn Geoinformacyjny; Geodeta.

[5] Materiały konferencyjne z Kongresów ISPRS.

[6] Materiały konferencyjne z Kongresów Polskiego Towarzystwa Fotogrametrii i Teledetekcji.

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

dr hab. inż. Kazimierz Bęcek, kazimierz.becek@pwr.wroc.pl

FACULTY OF GEOENGINEERING, MINING AND GEOLOGY

SUBJECT CARD

Name of subject in Polish	Zaawansowane metody wyznaczania przemieszczeń powierzchni terenu
Name of subject in English	Selected Topics in Displacement Monitoring
Main field of study (if applicable):	Geodesy and Cartography
Specialization (if applicable):	Geomatics
Profile:	academic / ~~practical~~*
Level and form of studies:	~~1st~~/ 2nd level, ~~uniform magister studies~~*, full-time / ~~part-time~~*
Kind of subject:	obligatory / ~~optional~~ / ~~university-wide~~*
Subject code	**W06GIK-SM0112L**
Group of courses	~~YES~~ / NO*

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)			**45**		
Number of hours of total student workload (CNPS)			**90**		
Form of crediting			~~Examination~~ / crediting with grade*		
For group of courses mark (X) final course					
Number of ECTS points			**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)			**2.5**		

*delete as not necessary

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Has basic knowledge of image processing.
2. Knows the basics of programming in C ++ and Python.
3. Has basic knowledge of satellite remote sensing.

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SUBJECT OBJECTIVES

C1 Acquiring the ability to determine land surface displacements based on satellite radar data.

C2 Acquiring the ability to integration of InSAR and GNSS data.

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge:

PEU_W01 Has broadened knowledge of satellite radar interferometry and has extended knowledge in the field of SAR data processing.

PEU_W02	Has knowledge of the influence of the atmosphere on the results of SAR data calculations.

relating to skills:

PEU_U01	Has the ability to configure the environment for advanced SAR data calculations.
PEU_U02	Has the ability to acquire radar data and perform calculations using the following methods: DInSAR, SBAS and / or PsInSAR.
PEU_U03	Has the ability to integrate and adequately present the InSAR and GNSS results.

relating to social competences:

PEU_K01	Has the ability to formulate and pass knowledge on the use of SAR data in the aspect of detecting ground surface displacements (natural and anthropogenic factors).

PROGRAMME CONTENT

	Laboratory	**Number of hours**
Lab 1	Configuration of the environment (including software installation) for SAR calculations	3
Lab 2	Introduction to radar data calculations - calculation tasks	3
Lab 3	Acquiring radar data and calculating the interferogram - DInSAR method	3
Lab 4	Acquiring radar data and calculating the interferogram - DInSAR method	3
Lab 5	Unwrapping of the interferometric phase - calculations	3
Lab 6	Unwrapping of the interferometric phase - calculations	3
Lab 7	Acquisition and preparation of radar data for calculations in time series methods	3
Lab 8	Time series calculations: PsInSAR, SBAS	3
Lab 9	Time series calculations: PsInSAR, SBAS	3
Lab 10	Influence of ground surface humidity and phase unwrapping	3
Lab 11	Influence of the ionosphere and troposphere on SAR data calculations	3
Lab 12	Influence of the ionosphere and troposphere on SAR data calculations	3
Lab 13	InSAR and GNSS data integration	3
Lab 14	InSAR and GNSS data integration	3
Lab 15	Presentation of results in the GMT environment (DInSAR, PsInSAR i/lub SBAS)	3
	Total hours	**45**

TEACHING TOOLS USED

N1. Multimedia presentations
N2. Laboratory instructions
N3. Laboratory assignments and reports
N4. Consultations

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT

Evaluation (F – forming during semester), P – concluding (at semester	Learning outcomes code	Way of evaluating learning outcomes achievement

end)		
F, P	PEU_W01- PEU_W02 PEU_U01-PEU_U03 PEU_K01	F1. Correct execution of exercises - 100% (N1, N2, N3, N4). P1. Arithmetic mean of F1

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] Satellite InSAR Data: Reservoir Monitoring from Space, A. Ferretti, EAGE; 1st edition, 2014

[2] GMTSAR: An InSAR Processing System Based on Generic Mapping Tools (Second Edition), D. Sandwell et al., Scripps Institution of Oceanography, University of California, San Diego, La Jolla, CA, USA, 2016

[3] InSAR Principles - Guidelines for SAR Interferometry Processing and Interpretation, ESA Publications, 2008

SECONDARY LITERATURE:

[1] GMT (Generic Mapping Tools) Online Documentation - http://gmt.soest.hawaii.edu/projects/gmt/wiki/Documentation

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

dr hab. inż. Wojciech Milczarek, wojciech.milczarek@pwr.edu.pl

Zał. nr 5 do ZW 16/2020

FACULTY OF GEOENGINEERING, MINING AND GEOLOGY

SUBJECT CARD

Name of subject in Polish	Hydrologia II
Name of subject in English	Hydrology II
Main field of study (if applicable):	Geodesy and Cartography
Specialization (if applicable):	Geomatics
Profile:	academic / ~~practical~~*
Level and form of studies:	~~1st~~/ 2nd level, ~~uniform magister studies~~*, full-time / ~~part-time~~*
Kind of subject:	obligatory / ~~optional~~ / ~~university-wide~~*
Subject code	**W06GIK-SM0114W**
Group of courses	~~YES~~ / NO*

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	**15**				
Number of hours of total student workload (CNPS)	**30**				
Form of crediting	~~Examination~~ / crediting with grade*				
For group of courses mark (X) final course					
Number of ECTS points	**1**				
including number of ECTS points for practical classes (P)					
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	**0.5**				

*delete as not necessary

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Has basic knowledge of mathematical analysis necessary to understand mathematical issues in engineering sciences
2. Has mastered the basic concepts of general geology, mineralogy, petrology, hydrology and chemistry.
3. Can use the Microsoft Office environment in the preparation of documents in Word and work with an Excel spreadsheet.

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SUBJECT OBJECTIVES

C1 Understanding the genesis of groundwater.

C2 Understanding groundwater structures

C3 Getting to know the various types of groundwater (ordinary, healing, thermal, mine).

C4 Understanding the laws of groundwater flow.

C5 Understanding the influence of hydrogeological activities on deformation of the terrain surface.

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge:

PEU_W01	Has a general knowledge of the genesis, groundwater resources, their protection and pollution
PEU_W02	Has knowledge of various groundwater intakes and types of groundwater (normal, curative, thermal, mine).
PEU_W03	Has knowledge of the basic documents in force in water management.

relating to skills:

PEU_U01	Can assess the impact of hydrogeology activities on land surface deformation.
PEU_U02	Can use literature, databases and other sources.
PEU_U03	Can interpret the obtained results and draw conclusions.

relating to social competences:

PEU_K01	He understands the impact of his work on the environment.
PEU_K02	He knows the legal issues and the principles of operation and cooperation of supervisory and control bodies regarding the profession of surveyor, cartographer and miner.

PROGRAMME CONTENT

	Lecture	**Number of hours**
Lec 1	Program of the course, course completion requirements, literature on the subject. Hydrogeological profile.	2
Lec 2	The genesis of groundwater. Groundwater structures.	2
Lec 3	Groundwater intakes.	2
Lec 4	Different types of groundwater (ordinary, healing, thermal, mine waters).	2
Lec 5	Determining groundwater resources. Water quality and threats.	2
Lec 6	Influence of activities related to hydrogeology on land surface deformation.	2
Lec 7	Water law permits, hydrogeological reports.	2
Lec 8	Final test	1
	Total hours	**15**

TEACHING TOOLS USED

N1. Traditional lecture illustrated with multimedia presentations
N2. Written final test

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
P	PEU_W01 – PEU_W03, PEU_U01 – PEU_U03, PEU_K01 – PEU_K02	P1. Written final test (N2)

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] Macioszczyk A. (red.) – Podstawy hydrogeologii stosowanej. Wydawnictwo Naukowe PWN., 2006.
[2] Pazdro Z., Kozerski B. - Hydrogeologia ogólna. Wydawnictwa Geologiczne. 1990.
[3] Deming D. – Introduction to hydrogeology. McGraw-Hill, 2002.

SECONDARY LITERATURE:

[1] Chełmicki W. – Wody – zasoby, degradacja, ochrona. Wydawnictwo Naukowe PWN. 2001.
[2] Rogoż M. – Hydrogeologia kopalniana z podstawami hydrogeologii ogólnej. Główny Instytut Górnictwa. 2004

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

prof. dr hab. inż. Wojciech Ciężkowski, wojciech.ciezkowski@pwr.edu.pl
dr Barbara Kiełczawa, barbara.kielczawa@pwr.edu.pl

SEMESTER 3

Zał. nr 5 do ZW 16/2020

FACULTY OF GEOENGINEERING, MINING AND GEOLOGY

SUBJECT CARD

Name of subject in Polish	Zarządzanie projektami geoinformacyjnymi
Name of subject in English	Geoinformation Project Management
Main field of study (if applicable):	Geodesy and Cartography
Specialization (if applicable):	Geomatics
Profile:	academic / ~~practical~~*
Level and form of studies:	~~1st~~/ 2nd level, ~~uniform magister studies~~*, full-time / ~~part-time~~*
Kind of subject:	obligatory / ~~optional~~ / ~~university-wide~~*
Subject code	**W06GIK-SM0115**
Group of courses	~~YES~~ / 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	~~Examination~~ / crediting with grade*		~~Examination~~ / 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)	**0.5**		**0.5**		

*delete as not necessary

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge of geoinformation systems and economics.

SUBJECT OBJECTIVES

C1. Acquisition of basic knowledge, taking into account its application aspects, in the field of project management: project approach, project preparation and initiation, project planning, project monitoring.

C2. Acquiring basic skills of the development initial project definition (Project Charter).

C3. Acquiring the competence to think and act in accordance with the project approach.

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge:

PEU_W01 Student has a basic knowledge of the genesis and basic features of the project approach as well as leading classic project management methodologies, the main project management processes, techniques and tools for project planning, profitability analysis and quantification of project risk and project monitoring.

relating to skills:

PEU_U01 Student is able to analyse the environment of a simple project, define its objectives, organization, life cycle, scope, conduct a preliminary risk analysis, develop a business case, as well as develop and present a Project Charter of the non-complex project.

relating to social competences:

PEU_K01 Student can think and act in a systemic, creative and entrepreneurial way, work in a team.

PROGRAMME CONTENT

	Lecture	**Number of hours**
Lec 1	Introduction to project management. The specificity of geoinformation projects.	2
Lec 2	Project preparation and initiation. Project analysis.	2
Lec 3	Project planning. Project organization.	2
Lec 4	Project life cycle. Project scope.	2
Lec 5	Planning activities, resources and project costs.	2
Lec 6	Project risk. Project monitoring.	2
Lec 7	Communication in the project. Project management methodologies.	2
Lec 8	Final assessment.	1
	Total hours	**15**

	Laboratory	**Number of hours**
Lab 1	Establishing rules of attending and working in laboratory classes and principles of teamwork. Group exercise: Project - Process - Task. Case study introduction.	2
Lab 2	Presentation of project proposals by students. Establishing teams and preliminary selection of team projects. Group exercises: Project environment analysis, Stakeholder analysis.	2
Lab 3	Presentation of required Project Charter items by teams Approval of projects to be defined by teams. Group exercises: Project objectives, Project Approach.	2
Lab 4	Presentation of required Project Charter items by teams Group exercises: Project Organisation Structure, Project life cycle.	2
Lab 5	Presentation of required Project Charter items by teams Group exercise: Project scope.	2
Lab 6	Presentation of required Project Charter items by teams Group exercise: Preliminary Risk Assessment.	2
Lab 7	Presentation of drafts of the Project Charter by teams. Providing comments and recommendations.	2
Lab 8	Final assessment, presentation by teams their Project Charters.	1
	Total hours	**15**

TEACHING TOOLS USED

N1. Informative lecture, content illustrated with multimedia presentations
N2. Interactive lecture (moderated discussion)
N3. Laboratory classes - team work on elements of the sample project definition
N4. Laboratory classes – presentations of Project Charter items developed by the team as part of their own work
N5. Student hours
N6. Student's own work – development of the project charter by the team
N7. Student's own work – individual studies and preparation for assessments
N8. Tests, including e-tests on the e-learning platform

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	PEK_U01, PEK_K01	F1: Evaluation of the results of group exercises and presentations of the Project Charter items
F	PEU_W01	F2: Knowledge tests (e-tests) during laboratory exercises
F	PEK_U01, PEK_K01	F3: Presentation of the project definition (Project Charter) by the team
P	PEU_W01 PEK_U01, PEK_K01	P1: Final laboratory classes grade (weighted average: F1 x 0,4 + F2 x 0,1+ F3 x 0,5)
P	PEU_W01	P2: Lecture grade on the basis of the test of knowledge (e-test)

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] Wysocki Robert K., McGary R., Efektywne zarządzanie projektami, OnePress, 2005.
[2] Zarządzanie projektem europejskim, PWE, 2007.
[3] Trocki M., Nowoczesne zarządzanie projektami, PWE, 2012.

SECONDARY LITERATURE:

[1] Polskie Wytyczne Kompetencji IPMA wersja 4.0, Stowarzyszenie Project Management Polska, 2019.
[2] A Guide to Project Management Body of Knowledge (PMBOK®Guide Sixth Edition), Project Management Institute, 2017.
[3] PRojects IN Controlled Environments PRINCE2™, Office of Government Commerce, 2011.
[4] Project Cycle Management Guidelines, 3rd Edition 2004, EC EuropeAid Cooperation Office.
[5] ISO 21500:2012, Guidance on project management.

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

dr inż. Krzysztof Hołodnik, krzysztof.holodnik@pwr.edu.pl

Zał. nr 5 do ZW 16/2020

FACULTY OF GEOENGINEERING, MINING AND GEOLOGY

SUBJECT CARD

Name of subject in Polish	Zaawansowane technologie informacyjne
Name of subject in English	Selected Topics in Information Technologies
Main field of study (if applicable):	Geodesy and Cartography
Specialization (if applicable):	Geomatics
Profile:	academic / ~~practical~~*
Level and form of studies:	~~1st~~/ 2nd level, ~~uniform magister studies~~*, full-time / ~~part-time~~*
Kind of subject:	obligatory / ~~optional~~ / ~~university-wide~~*
Subject code	**W06GIK-SM0116**
Group of courses	~~YES~~ / NO*

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	**30**		**30**		
Number of hours of total student workload (CNPS)	**30**		**60**		
Form of crediting	~~Examination~~ / crediting with grade*		~~Examination~~ / 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)	**0.5**		**1**		

*delete as not necessary

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Has knowledge of general computer science and programming basics

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SUBJECT OBJECTIVES

C1 The aim of the course is to acquire practical skills in creating applications using Internet technologies.

C2 The aim of the course is to understand selected data models, data structures and algorithms used in geoinformation.

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge:

PEU_W01 Has fundamental knowledge of building structural and object-oriented computer programs.

PEU_W02 Has knowledge of creating and applying selected data models, data structures and algorithms.

PEU_W03 Has knowledge of the programming basics in a network environment and selected Internet technologies.

relating to skills:

PEU_U01 Is able to select a computer network architecture suitable for the geodata system.

PEU_U02 Can use selected Internet techniques to design and create applications for collecting, processing and presenting data.

PEU_U03 Is able to assess the usefulness, the possibility of using and apply selected models, data structures and algorithms for the effective solution of tasks typical for engineering activities in the field of geoinformation.

relating to social competences:

PEU_K01 Student can work in teams

PROGRAMME CONTENT

	Lecture	**Number of hours**
Lec 1	Introduction to computer networks: IP addresses, communication, protocols and network services	2
Lec 2	HTML: creating HTML documents	2
Lec 3	CSS: formatting HTML documents using styles	2
Lec 4	JavaScript: basics of JavaScript programming	4
Lec 5	HTML+CSS+JavaScript: creating dynamic WWW pages	4
Lec 6	Google Maps programming interface	2
Lec 7	PHP: basics of PHP programming, database connection	2
Lec 8	Introduction to data models and data structures	2
Lec 9	Trees - basic types, representation and operations	2
Lec 10	Quadtree and octree	2
Lec 11	Graphs, graph algorithms and computational complexity	2
Lec 12	Topological data structures: half-edge and quad-edge	2
Lec 13	Delaunay Triangulation and Voronoi Diagram	1
Lec 14	Final test	1
	Total hours	**30**

	Laboratory	**Number of hours**
Lab 1	Development environment for creating websites, access to remote web server resources	2
Lab 2	HTML: website structure	2
Lab 3	CSS: basic styles and their use for formatting HTML documents	2
Lab 4	JavaScript: basic programming structures	2
Lab 5	JavaScript: access to HTML document elements in a web browser	2
Lab 6	JavaScript: processing of data entered by a user	2
Lab 7	Google Maps API: placing static maps in an HTML document	2
Lab 8	Google Maps API: placing dynamic maps in an HTML document	2
Lab 9	PHP: scripts execution on a remote web server and using database	2
Lab 10	Arrays and lists	2

Lab 11	Search and sort list items	2
Lab 12	Binary trees: structure	2
Lab 13	Binary trees: add, delete and search operations	2
Lab 14	Graphs: implementation using the half-edge topological data structure	4
	Total hours	**30**

TEACHING TOOLS USED

N1. Traditional lecture illustrated with multimedia presentations
N2. Laboratory instructions with examples
N3. Consultations
N4. Written final test
N5. Algorithm implemented by students

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
P	PEU_W01 – PEU_W03	P1. Credit based on a written test (N4).
F, P	PEU_U01 – PEU_U03, PEU_K01	F1. Credit based on computer programs developed according to the given guidelines (N5). P2. Arithmetic mean of F1

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] L. Lemay, R. Colburn, J. Kyrnin, HTML,CSS i JavaScript dla każdego, Helion, 2016
[2] M. Zandstra, PHP. Obiekty, wzorce, narzędzia, Helion, 2017
[3] A.V. Aho, J.E. Hopcroft, J.D. Ullman, Algorytmy i struktury danych, Helion, 2003.
[4] T.H. Cormer, C. E. Leiserson, R. L. Rivest, C. Stein, Wprowadzenie do algorytmów, WNT, 2017.

SECONDARY LITERATURE:

[1] W. Sanders, PHP. Wzorce projektowe, Helion , Październik 2013
[2] M. F. Worboys, M. Duckham, GIS: A Computing Perspective, CRC Press, 2004.
[3] M. de Berg, O. Cheong, M. van Kreveld, M. Overmars, Computational Geometry (Algorithms and Applications), Springer, 2008.

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

dr inż. Paweł Bogusławski, pawel.boguslawski@pwr.edu.pl
mgr inż. Oleksandr Yeroshkin, oleksandr.yeroshkin@pwr.edu.pl

FACULTY OF GEOENGINEERING, MINING AND GEOLOGY

SUBJECT CARD

Name of subject in Polish	Rozproszone bazy danych przestrzennych
Name of subject in English	Distributed Spatial Databases
Main field of study (if applicable):	Geodesy and Cartography
Specialization (if applicable):	Geomatics
Profile:	academic / ~~practical~~*
Level and form of studies:	~~1st~~/ 2nd level, ~~uniform magister studies~~*, full-time / ~~part-time~~*
Kind of subject:	obligatory / ~~optional~~ / ~~university-wide~~*
Subject code	**W06GIK-SM0117**
Group of courses	~~YES~~ / 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	Examination / ~~crediting with grade~~*		~~Examination~~ / 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)	**1**		**0.5**		

*delete as not necessary

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Has basic knowledge of the acquisition and processing of spatial data in the GIS environment.
2. Has the ability of using GIS software packages: ArcGIS i/lub QGIS.
3. Knows the basics of programming in Python.

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SUBJECT OBJECTIVES

C1 Presentation of the current state of knowledge in the field of spatial data presentation based on commercial and open source solutions.

C2 Presentation of the advantages and disadvantages of commercial and open source solutions.

C3 Acquiring the ability to develop spatial data services based on commercial and open source solutions.

C4 Acquiring the ability to programming skills in the development of spatial data services.

C5 Acquiring the ability to optimize the functioning of spatial data services.

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge:

PEU_W01 Has broadened knowledge of the use of GIS environments in the presentation of spatial data on the Internet.

PEU_W02 Has knowledge of advanced spatial data processing (vector and raster).

PEU_W03 Knows the current solutions in the field of developing mapping portals based on commercial and open source solutions. Knows the most important free standards in the field of geospatial data and services.

relating to skills:

PEU_U01 Has the ability to develop a project of a simple mapping portal including: the method of obtaining data, processing and selecting the optimal system architecture based on the knowledge and assumptions.

PEU_U02 Has the ability to process spatial data in order to present them on the Internet. Has the ability to optimize the work of a spatial data service based on open source solutions.

PEU_U03 Has the ability to develop tools for performing simple spatial analyzes from the level of the website. Has the ability to implement external libraries to the structure of a spatial data service, increasing its effectiveness and scope of use.

relating to social competences:

PEU_K01 Has the ability to pass knowledge on the presentation of spatial data on the Internet.

PROGRAMME CONTENT

	Lecture	**Number of hours**
Lec 1	Presentation of the scope of the course, course completion requirements and literature. Introduction to WebGIS.	2
Lec 2	OGC web services standards.	2
Lec 3	Geoportal - website design.	2
Lec 4	Geoportal - website development based on commercial solutions.	2
Lec 5	Geoportal - portal development based on open source solutions.	2
Lec 6	Optimization of the presented data on the Internet.	2
Lec 7	Cloud GIS. Spatial analyzes in WebGIS.	2
Lec 8	Spatial analyzes in WebGIS.	1
	Total hours	**15**

	Laboratory	**Number of hours**
Lab 1	Mapserver / GeoServer / QGIS - introductory exercises	2
Lab 2	GeoServer - launch and configuration of spatial data server	2
Lab 3	GeoServer - configuration and server of spatial data	2
Lab 4	MapServer - launch and configuration of the spatial data server	2
Lab 5	MapServer - *.map* file structure	2
Lab 6	Use of external libraries - increasing the functionality of the portal	4
Lab 7	Using the database in WebGIS	2

Lab 8	Mapserver / GeoServer - optimization of displaying spatial data using tiles	2
Lab 9	ArcGIS online - introduction, presentation of spatial data	2
Lab 10	ArcGIS online - presentation of spatial data	2
Lab 11	Individual project - development of a geoportal	8
	Total hours	**30**

TEACHING TOOLS USED

N1. Lecture with elements of a problem lecture
N2. Multimedia presentations
N3. Laboratory instructions
N4. Laboratory assignments and reports
N5. Consultations
N6. Written exam
N7. Written test

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
P	PEU_W01 - PEU_W03	P1. Written exam grade (N6)
F, P	PEU_U01 - PEU_U03 PEU_K01	F1. Arithmetic mean from test grades (N7) F2. Arithmetic mean from written assignment report grades (N4) P2. Final grade calculated as P2=F1*0,3+F2*0,7

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] Getting to Know Web GIS Third Edition, Pinde Fu, Publisher: Esri Press; Third edition, 2018
[2] OpenLayers 3 Beginner's Guide, Thomas Gratier, Paul Spencer, Erik Hazzard, Packt, 2014
[3] Concepts & Applications of Web GIS, Anuj Tiwari, Kamal Jain, Nova Science Publishers Inc., 2017

SECONDARY LITERATURE:

[1] Presentations from lectures and instructions from the laboratory
[2] Technical documentation of Mapserver (https://mapserver.org/documentation.html) and Geoserver (https://docs.geoserver.org/)

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

dr hab. inż. Wojciech Milczarek, wojciech.milczarek@pwr.edu.pl

FACULTY OF GEOENGINEERING, MINING AND GEOLOGY

SUBJECT CARD

Name of subject in Polish	Zarządzanie rozwojem spółek
Name of subject in English	Management of Company Development
Main field of study (if applicable):	Geodesy and Cartography
Specialization (if applicable):	Geomatics
Profile:	academic / ~~practical~~*
Level and form of studies:	~~1st~~/ 2nd level, ~~uniform magister studies~~*, full-time / ~~part-time~~*
Kind of subject:	obligatory / ~~optional~~ / ~~university-wide~~*
Subject code	**W06GIK-SM0118**
Group of courses	~~YES~~ / 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	~~Examination~~ / crediting with grade*				~~Examination~~ / 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)	**0.5**				**0.5**

*delete as not necessary

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic information on economics and economics in mining

SUBJECT OBJECTIVES

C1 Providing basic information on the environment of geological and mining companies and the impact of its variability on making key management decisions

C2 Analyzing practical examples of experience regarding the management of a geological and mining company in a changing macroeconomic environment, predicting future economic events, their consequences and the use of instruments allowing for controlled risk management

SUBJECT LEARNING OUTCOMES

relating to knowledge:

PEU_W01: has a basic knowledge of the market economy and its functioning mechanisms

PEU_W02: has knowledge of the forms and structures of functioning of global mining entities

PEU_W03: knows the basic issues related to the functioning of global commodity and capital markets

PEU_W04:	has basic knowledge of forecasting economic events and managing their consequences through the available instruments
relating to skills:	
PEU_U01:	can see economic mechanisms and explain them the observed socio-economic phenomena
PEU_U02:	understands the operation of the basic factors influencing the value of the geological and mining project
PEU_U03:	can predict the impact of selected economic phenomena on the functioning of economic entities
relating to social competences:	
PEU_K01:	understands the influence of basic economic mechanisms on the economic situation of the country and the industry
PEU_K02:	identifies the basic relationships between current economic events and their impact on the development of the sector and the region

PROGRAMME CONTENT		
Lecture		**Number of hours**
Lec 1	Review of raw material markets and geological and mining projects	1
Lec 2	Trade, money, capital, time value of money - the basis of investment analysis	2
Lec 3	Business cycles, commodity markets	2
Lec 4	Analysis of investments in the enterprise, stock exchanges and FX	2
Lec 5	Financing of geological and mining projects	2
Lec 6	Technical, geopolitical and market risk in the assessment of geological and mining projects	2
Lec 7	Hedging in mining (genesis, role and implementation methods), information obligations and standards, communication with the market. Written test.	2
Lec 8	Information obligations and standards, communication with the market.	1
Lec 9	Written test.	1
	Total hours	**15**

Seminar		**Number of hours**
Semin 1	Introduction to the seminar, distribution of the topics of speeches for individual students. The topics of the presentations concern the problems learned during the lectures, supplementing their content	1
Semin 2	Presentations by the participants of the seminar in the form of 20-25 minutes presentations and group discussion on the content and form of speeches	14
	Total hours	**15**

TEACHING TOOLS USED
N1. The form of the lecture - an information lecture with elements of a problem lecture, content illustrated with multimedia presentations N2. The presentations of the seminar participants should be illustrated with multimedia presentations with the use of possible paper documentation N3. Written test N4. Discussion about student's speech

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
P	PEU_W01 – PEU_W04	P1. Grade of the written test (N3) for the given range of lecture material
F, P	PEU_W01 – PEU_W04, PEU_U01 – PEU_U03, PEU_K01 – PEU_K02	The seminar participant's speech is discussed by the group, and the results of the discussion are summarized with the assessments given by the teacher in the field of: F1. Substantive and formal aspects of the speeches (N2) F2. Activity in discussions (N4) P2. The final rating is a weighted average P2=F1*0,7+F2*0,3

PRIMARY AND SECONDARY LITERATURE
PRIMARY LITERATURE:
[1] Magda R., Międzynarodowe rynki metali i surowców mineralnych, Nauka i technika górnicza, Uczelniane Wydawnictwo Naukowo-Dydaktyczne, Kraków 2006 [2] Szeląg T., Hedging w teorii i praktyce. Przykład światowego runku miedzi, Wyd. Przecinek, Wrocław 2003 [3] Wirth H., Metody oceny aktywów geologiczno-górniczych w „Dylematy wyceny przedsiębiorstwa" pod red. Panfil M., Szablewski A., Wyd. Poltext, Warszawa 2013 [4] Jajuga K., Jajuga T., Inwestycje, instrumenty finansowe, ryzyko finansowe, inżynieria finansowa, Wyd. Naukowe PWN, Warszawa 1998
SECONDARY LITERATURE:
[1] Wirth H., Wieloczynnikowa wycena złóż i ich zasobów na przykładzie przemysłu metali nieżelaznych. IGSMiE PAN, Kraków 2011 [2] Jajuga K., Zarządzanie ryzykiem, Wyd. Naukowe PWN, Warszawa 2007 [3] Butra J., Kicki J., Kudełko J., Wanielista K., Wirth H., Ekonomika projektów geologiczno-górniczych Centrum Badawczo-Projektowe Miedzi CUPRUM, Wrocław 2004
SUBJECT SUPERVISOR (NAME AND SURNAME, E-MAIL ADDRESS)
prof. dr hab. inż. Herbert Wirth, herbert.wirth@pwr.edu.pl