Zał. Nr 1 do ZW 78/2023

PROGRAM OF STUDIES

FACULTY: **GEOENGINEERING, MINING AND GEOLOGY**
MAIN FIELD OF STUDY: **GEODESY AND CARTOGRAPHY (GIK)**
BRANCH OF SCIENCE: **engineering and technical sciences**
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 (for specialization: Inżynieria geodanych)

Content:

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

In effect since **summer semester 2024/2025**

*delete as applicable

Zał. Nr 2 do ZW 78/2023
Attachment no. 1. to the Program of Studies

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 technical sciences**

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:
P6U – universal first degree characteristics corresponding to education at the first-level studies - 6 PRK level *
P7U – universal first degree characteristics corresponding to education at the second-level studies - 7 PRK level *

P6S – second degree characteristics corresponding to education at the first-level studies - 6 PRK level *
P7S – second degree characteristics corresponding to education at the second-level studies - 7 PRK level *

W - category "knowledge"
U - category "skills"
K - category "social competences"
K (*faculty symbol*) _W1, K (*faculty symbol*) _W2, K (*faculty symbol*) _W3, … - main-field-of study learning outcomes related to the category "knowledge"
K (*faculty symbol*) _U1, K (*faculty symbol*) _U2, K (*faculty symbol*) _U3, … - main-field-of study learning outcomes related to the category "skills"
K (*faculty symbol*) _K1, K (*faculty symbol*) _K2, K (*faculty symbol*) _K3, … - main-field-of study learning outcomes related to the category "social competences"
S (*faculty symbol*) _W.., S (*faculty symbol*) _W.., S (*faculty symbol*) _W.., … - specialization learning outcomes related to the category "knowledge"
S (*faculty symbol*) _U.., S (*faculty symbol*) _U.., S (*faculty symbol*) _U.., … - specialization learning outcomes related to the category "skills"
S (*faculty symbol*) _K.., S (*faculty symbol*) _K.., S (*faculty symbol*) _K.., … - specialization 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 6 / 7* levels of PRK	Characteristics for qualifications on 6 and 7 levels of PRK, enabling acquiring engineering competences
KNOWLEDGE (W)				
K2_GIK_W01	Possess comprehensive knowledge of contemporary geodata acquisition methods.	P7U_W	P7S_WG	P7S_WG_inż
K2_GIK_W02	Possess knowledge of assessing the quality and usefulness of geodata and the principles of geodata processing.	P7U_W	P7S_WG	P7S_WG_inż
K2_GIK_W03	Knows the operational use of remote sensing data.	P7U_W	P7S_WG	P7S_WG_inż
K2_GIK_W04	Knows how to use computer programming languages for geodata processing, including artificial intelligence and machine learning methods.	P7U_W	P7S_WG	P7S_WG_inż
K2_GIK_W05	Possess knowledge of the development, construction and use of geodata databases. Knows the principles of verification, harmonisation, generalisation, visualisation and sharing of cartographic digital models.	P7U_W	P7S_WG	P7S_WG_inż
K2_GIK_W06	Knows the rules of use of geodata for environmental research and monitoring of anthropogenic objects.	P7U_W	P7S_WG P7S_WK	P7S_WG_inż P7S_WK_inż
K2_GIK_W07	Understands the technical and non-technical aspects of engineering activity.	P7U_W	P7S_WG P7S_WK	
K2_GIK_W08	Is aware of trends and latest developments in the field of geodesy and cartography.	P7U_W	P7S_WK	
K2_GIK_W09	Possess knowledge of selected topics in physics, including quantum mechanics, electromagnetic waves, relativity theory, optics.	P7U_W	P7S_WK	

SKILLS (U)				
K2_GIK_U01	Can acquire geodata from publicly available sources and by using selected surveying techniques.	P7U_U	P7S_UW P7S_UO	P7S_UW_inż
K2_GIK_U02	Possess skills to assess the quality and usefulness of geodata and can process it.	P7U_U	P7S_UW	P7S_UW_inż
K2_GIK_U03	Can process remote sensing images.	P7U_U	P7S_UW	P7S_UW_inż
K2_GIK_U04	Can program in selected languages for the automation of geodata processing, and can use simple artificial intelligence and machine learning algorithms.	P7U_U	P7S_UW P7S_UK	P7S_UW_inż
K2_GIK_U05	Possess skills in developing, creating and using geodata databases. Can verify, harmonise, generalise, visualise and share cartographic digital models, especially in the form of topographic, thematic maps and geoportals.	P7U_U	P7S_UW P7S_UK	P7S_UW_inż
K2_GIK_U06	Possess skills to use geodata for environmental research and monitoring of anthropogenic objects.	P7U_U	P7S_UW P7S_UK P7S_UO	P7S_UW_inż
K2_GIK_U07	Possess skills to use literature, databases and other available sources. Can plan and perform experiments and computer simulations, interpret the obtained results and draw conclusions.	P7U_U	P7S_UW P7S_UK P7S_UU	
K2_GIK_U08	Understands the content and intent of oral expression or written text in a foreign language on a familiar topic from everyday and professional life at the B2+ or C1+ language proficiency level. Can write a short text on a familiar topic, including an applied text. Can participate in conversations on known topics and to a limited extent speak about studies and professional work, using social and cultural knowledge.	P7U_U	P7S_UW P7S_UK P7S_UU	
SOCIAL COMPETENCES (K)				
K2_GIK_K01	Is ready to work as a team member and cooperate in a group, communicate effectively in interdisciplinary	P7U_K	P7S_KK	

K2_GIK_K02	Is ready to understand non-technical aspects of activities of surveyors and cartographers.	P7U_K	P7S_KO	
K2_GIK_K03	Is ready to understand the impact of the engineer's work results on the environment and the associated responsibility for decisions.	P7U_K	P7S_KR	
K2_GIK_K04	Is ready to obey the principles of intellectual property law, legal issues and the principles of operation and interaction of supervisory and control bodies over health and safety conditions pertaining to the profession of surveyors and cartographers.	P7U_K	P7S_KO P7S_KR	

*delete as applicable

Zał. nr 3 do ZW 78/2023

Attachment no. 2. to the Program of Studies

DESCRIPTION OF THE PROGRAM OF STUDIES

Main field of study GEODESY AND CARTOGRAPHY (GIK)
Level of studies second-level studies

Profile general academic
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: **930***	*1.4 Prerequisites (particularly for second-level studies):* *first degree engineering studies diploma*
1.5 Upon completion of studies graduate obtains *professional degree of: magister inżynier*	*1.6 Graduate profile, employability:* *Geodata engineering is an interdisciplinary field that combines the knowledge of geodesy, cartography and geoinformatics. Graduates of Geodesy and Cartography (specialization Geodata Engineering) have a wide range of skills and knowledge that can be used in various fields of activity, involving the collection, analysis, processing, interpretation and sharing of geospatial data. They acquire advanced skills in the use of geoinformatics tools and software, including geographic information systems (GIS), remote sensing, spatial databases, machine learning and programming. They know how to use various modern survey technologies, such as satellite measurements, LiDAR and drones. They can apply spatial databases for analysis and development of topographic and thematic maps. They also have knowledge of geomorphology, environmental protection and other disciplines*

	related to the structure and processes of the Earth's surface. They have the ability to integrate data from different thematic areas to solve complex geospatial problems, as well as effectively communicate and present the results of spatial analysis to clients or stakeholders. Graduates can work both in the public sector, such as in local government administration, as well as in the private sector in companies from various thematic areas: surveying, geoinformatics, environmental protection, spatial planning and data analysis.
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 classes – after the letter E or Z - enter in brackets the final subject form (lec, cl, lab, pr, sem)
[4]University-wide subject /group of classes – 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 subject / group of classes – enter P. For the group of classes – 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) = 9, U (skills) = 8, K (competences) = 4, W + U + K = 21

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) 12 (this number must be greater than half the total number of learning outcomes)

D2 9

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 52.2% ECTS points (47 ECTS points)

D2 47.8% ECTS points (43 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 76 ECTS points, or 84.4% of the total ECTS points.

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

Graduates of the Master's degree program in Geodesy and Cartography with a specialization in Geodata Engineering will develop extensive theoretical knowledge and practical skills needed in the implementation of specialized tasks commonly posed by the innovative economy in relation to geoinformation systems. They will be prepared for professional work in handling geoinformation projects, acquiring, evaluating, analyzing and interpreting geodata, and designing and implementing geographic information systems (GIS). They will gain the knowledge necessary to function in a business environment, including leading project teams, or performing effective roles within task groups. Graduates can work for companies or offices involved in e.g. inventory, monitoring and documentation of building and architectural structures, protection, management and shaping of the environment, urban planning, interior and landscape architecture, documentation and analysis of the location of anthropogenic and natural events.

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 subjects / groups of classes marked with the BU[1] code) - **is 45.06 ECTS points, or 50.07% of the total 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 classes – after the letter E or Z - enter in brackets the final subject form (lec, cl, lab, pr, sem)

[4]University-wide subject /group of classes – 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 subject / group of classes – enter P. For the group of classes – 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

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

Number of ECTS points for obligatory subjects	4
Number of ECTS points for optional subjects	0
Total number of ECTS points	4

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 subjects/group of classes denoted with code P)

Number of ECTS points for obligatory subjects	41
Number of ECTS points for optional subjects	31
Total number of ECTS points	72

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 subjects/group of classes denoted with code O) **6 ECTS points**
2.10. Total number of ECTS points, which student may obtain doing optional blocks (min. 30% of total number of ECTS points) – is 31 ECTS points, or 34.44% of total ECTS points.

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,

[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 classes – after the letter E or Z - enter in brackets the final subject form (lec, cl, lab, pr, sem)
[4]University-wide subject /group of classes – 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 subject / group of classes – enter P. For the group of classes – 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

- 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.

[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 classes – after the letter E or Z - enter in brackets the final subject form (lec, cl, lab, pr, sem)
[4]University-wide subject /group of classes – 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 subject / group of classes – enter P. For the group of classes – 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. 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.	Subject group of classes code	Name of Subjectgroup of classes (denote group of courses with symbol **GK**)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form[2] of Subjectgroup of courses	Way[3] of crediting	Subjectgroup of classes			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN[5] classes	BU[1] classes			University-wide[4]	Concerning scientific activities[5]	Practical[6]	Type[7]
1	W08GIK-SM0040C	Humanistic-managerial course		1				K2_GIK_W07, K2_GIK_K01, K2_GIK_K02, K2_GIK_K04	15	50	2		0.76	T/Z	Z	O		P(1)	KO
2	W06GIK-SM1048L	Geoinformation Project Management			2			K2_GIK_W07, K2_GIK_K01, K2_GIK_U07,	30	50	2		1.36	T/Z	Z			P(2)	KO
3	W06GIK-SM1047P	Work Culture Shaping				2		K2_GIK_W07, K2_GIK_K01, K2_GIK_K02	30	50	2		1.52	T/Z	Z				KO
		Total	**0**	**1**	**2**	**2**	**0**		**75**	**150**	**6**	**0**	**3.64**					**3**	

[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 classes – after the letter E or Z - enter in brackets the final subject form (lec, cl, lab, pr, sem)
[4]University-wide subject /group of classes – 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 subject / group of classes – enter P. For the group of classes – 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

Altogether for general education blocks

Total number of hours					Total number of ZZU hours	Total number of CNPS hours	Total number of ECTS points	Total number of ECTS points for DN classes[5]	Number of ECTS points for BU classes[1]
lec	cl	lab	pr	sem					
0	**1**	**2**	**2**	**0**	**75**	**150**	**6**	**0**	**3.64**

4.1.2 List of basic sciences blocks

4.1.2.1 *Mathematics* block

No.	Subject group of classescode	Name of Subjectgroup of classes (denote group of courses with symbol **GK**)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form[2] of Subjectgroup of courses	Way[3] of crediting	Subjectgroup of classes			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN[5] classes	BU[1] classes			University-wide[4]	Concerning scientific activities[5]	Practical[6]	Type[7]
1	W06GIK-SM1032W	Assessment of Geospatial Data Quality	1					K2_GIK_W02	15	25	1	1	0.92	T/Z	E		DN		PD
2	W06GIK-SM1032L	Assessment of Geospatial Data Quality			2			K2_GIK_U02, K2_GIK_U07	30	50	2	2	1.36	T/Z	Z		DN	P(2)	PD
		Total	**1**	**0**	**2**	**0**	**0**		**45**	**75**	**3**	**3**	**2.28**					**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 classes – after the letter E or Z - enter in brackets the final subject form (lec, cl, lab, pr, sem)
[4]University-wide subject /group of classes – 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 subject / group of classes – enter P. For the group of classes – 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

4.1.2.2 *Physics* block

No.	Subject group of classes code	Name of Subjectgroup of classes (denote group of courses with symbol **GK**)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form[2] of Subjectgroup of courses	Way[3] of crediting	Subjectgroup of classes			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN[5] classes	BU[1] classes			University-wide[4]	Concerning scientific activities[5]	Practical[6]	Type[7]
1	W11GIK-SM1600W	Elements of modern physics	1					K2_GIK_W09	15	25	1		0.76	T/Z	Z	O			PD
		Total	**1**	**0**	**0**	**0**	**0**		**15**	**25**	**1**		**0.76**						

Altogether for basic sciences blocks:

Total number of hours					Total number of ZZU hours	Total number of CNPS hours	Total number of ECTS points	Total number of ECTS points for DN classes[5]	Number of ECTS points for BU classes[1]
lec	cl	lab	pr	sem					
2	**0**	**2**	**0**	**0**	**60**	**100**	**4**	**3**	**3.04**

[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 classes – after the letter E or Z - enter in brackets the final subject form (lec, cl, lab, pr, sem)
[4]University-wide subject /group of classes – 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 subject / group of classes – enter P. For the group of classes – 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.	Subject group of classes code	Name of Subjectgroup of classes (denote group of courses with symbol **GK**)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form[2] of Subjectgroup of courses	Way[3] of crediting	Subjectgroup of classes			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN[5] classes	BU[1] classes			University-wide[4]	Concerning scientific activities[5]	Practical[6]	Type[7]
1	W06GIK-SM1030W	Geodata Acquisition Methods	2					K2_GIK_W01, K2_GIK_U01, K2_GIK_K02, K2_GIK_K03	30	75	3	3	1.36	T/Z	Z		DN		K
2	W06GIK-SM1031W	Experiment Design	1					K2_GIK_W01, K2_GIK_W02, K2_GIK_U01, K2_GIK_U02, K2_GIK_K02, K2_GIK_K03	15	25	1	1	0.76	T/Z	Z		DN		K
3	W06GIK-SM1038L	Research methodology			1			K2_GIK_W07, K2_GIK_U07, K2_GIK_K01, K2_GIK_K02, K2_GIK_K03	15	25	1	1	0.76	T/Z	Z		DN	P(1)	K
4	W06GIK-SM1033L	Geodata Processing in Open Source Environment			2			K2_GIK_U01, K2_GIK_U02, K2_GIK_U04, K2_GIK_K02, K2_GIK_K03	30	75	3	3	1.36	T	Z		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 classes – after the letter E or Z - enter in brackets the final subject form (lec, cl, lab, pr, sem)
[4]University-wide subject /group of classes – 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 subject / group of classes – enter P. For the group of classes – 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

5	W06GIK-SM1034W	Satellite Differential Radar Interferometry	1					K2_GIK_W01, K2_GIK_W03, K2_GIK_W06	15	25	1	1	0.92	T/Z	E		DN		S
6	W06GIK-SM1034L	Satellite Differential Radar Interferometry			2			K2_GIK_U01, K2_GIK_U03, K2_GIK_U06, K2_GIK_K02, K2_GIK_K03	30	75	3	3	1.36	T	Z		DN	P(3)	S
7	W06GIK-SM1035W	Spatial databases	1					K2_GIK_W04, K2_GIK_W05	15	25	1	1	0.76	T/Z	Z		DN		S
8	W06GIK-SM1035L	Spatial databases			1			K2_GIK_U04, K2_GIK_U05, K2_GIK_K02, K2_GIK_K03	15	25	1	1	0.76	T/Z	Z		DN	P(1)	S
9	W06GIK-SM1036W	Digital Cartographic Models	1					K2_GIK_W05	15	25	1	1	0.92	T/Z	E		DN		S
10	W06GIK-SM1036L	Digital Cartographic Models			3			K2_GIK_U05, K2_GIK_K02, K2_GIK_K03	45	75	3	3	1.96	T	Z		DN	P(3)	S
11	W06GIK-SM1037W	Selected Aspects of Spatial Statistics	1					K2_GIK_W02	15	25	1	1	0.92	T/Z	E		DN		S
12	W06GIK-SM1037L	Selected Aspects of Spatial Statistics			2			K2_GIK_U02, K2_GIK_K02, K2_GIK_K03	30	75	3	3	1.36	T	Z		DN	P(3)	S
13	W06GIK-SM1039W	GNSS Positioning Techniques	1					K2_GIK_W01	15	25	1	1	0.92	T/Z	E		DN		S
14	W06GIK-SM1039L	GNSS Positioning Techniques			2			K2_GIK_U01, K2_GIK_K02, K2_GIK_K03	30	75	3	3	1.40	T	Z		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 classes – after the letter E or Z - enter in brackets the final subject form (lec, cl, lab, pr, sem)
[4]University-wide subject /group of classes – 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 subject / group of classes – enter P. For the group of classes – 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

15	W06GIK-SM1040W	Application of Remote Sensing in Environmental Protection	1					K2_GIK_W01, K2_GIK_W03, K2_GIK_W06, K2_GIK_K03	15	25	1	1	0.92	T/Z	E		DN		S
16	W06GIK-SM1040L	Application of Remote Sensing in Environmental Protection			2			K2_GIK_U01, K2_GIK_U03, K2_GIK_U06, K2_GIK_K02, K2_GIK_K03	30	75	3	3	1.36	T	Z		DN	P(3)	S
17	W06GIK-SM1041L	InSAR Time Series Analysis			3			K2_GIK_U01, K2_GIK_U03, K2_GIK_U06, K2_GIK_K02, K2_GIK_K03	45	75	3	3	1.96	T	Z		DN	P(3)	S
18	W06GIK-SM1042W	Machine Learning in Remote Sensing	1					K2_GIK_W01, K2_GIK_W03, K2_GIK_W04	15	25	1	1	0.92	T/Z	E		DN		S
19	W06GIK-SM1042L	Machine Learning in Remote Sensing			2			K2_GIK_U01, K2_GIK_U03, K2_GIK_U04, K2_GIK_K03	30	75	3	3	1.36	T	Z		DN	P(3)	S
20	W06GIK-SM1043W	IoT Systems	2					K2_GIK_W02, K2_GIK_W04, K2_GIK_K02, K2_GIK_K03	30	50	2	2	1.36	T/Z	Z		DN		S
21	W06GIK-SM1044L	Selected Applications of Laser Scanning			3			K2_GIK_U01, K2_GIK_U02, K2_GIK_K02, K2_GIK_K03	45	75	3	3	2.00	T	Z		DN	P(3)	S
22	W06GIK-SM1045L	Analysis and Harmonization of Spatial Data			2			K2_GIK_U02, K2_GIK_U04, K2_GIK_U05, K2_GIK_K02, K2_GIK_K03	30	75	3	3	1.36	T	Z		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 classes – after the letter E or Z - enter in brackets the final subject form (lec, cl, lab, pr, sem)
[4]University-wide subject /group of classes – 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 subject / group of classes – enter P. For the group of classes – 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

23	W06GIK-SM1049L	Models and Languages for Geodata Exchange			2			K2_GIK_W04, K2_GIK_W05, K2_GIK_U04, K2_GIK_U05, K2_GIK_K02, K2_GIK_K03	30	50	2	2	1.36	T/Z	Z		DN	P(2)	S
24	W06GIK-SM1050L	WebGIS			2			K2_GIK_W04, K2_GIK_W05, K2_GIK_U04, K2_GIK_U05, K2_GIK_K02, K2_GIK_K03	30	50	2	2	1.36	T/Z	Z		DN	P(2)	S
		Total	**12**	**0**	**29**	**0**	**0**		**615**	**1225**	**49**	**49**	**29.48**					**36**	

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					
12	**0**	**29**	**0**	**0**	**615**	**1225**	**49**	**49**	**29.48**

[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 classes – after the letter E or Z - enter in brackets the final subject form (lec, cl, lab, pr, sem)
[4]University-wide subject /group of classes – 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 subject / group of classes – enter P. For the group of classes – 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.	Subject group of classes code	Name of Subjectgroup of classes (denote group of courses with symbol **GK**)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form[2] of Subjectgroup of courses	Way[3] of crediting	Subjectgroup of classes			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN[5] classes	BU[1] classes			University-wide[4]	Concerning scientific activities[5]	Practical[6]	Type[7]
1	SJO-SM0003	Foreign Language I		3				K2_GIK_U08	45	60	2		1.63	T/Z	Z	O		P(2)	KO
2	SJO-SM0004	Foreign Language II		1				K2_GIK_U08	15	30	1		0.63	T/Z	Z	O		P(1)	KO
		Total	**0**	**4**	**0**	**0**	**0**		**60**	**90**	**3**		**2.26**					**3**	

Altogether for general education blocks:

Total number of hours					Total number of ZZU hours	Total number of CNPS hours	Total number of ECTS points	Total number of ECTS points for DN classes[5]	Number of ECTS points for BU classes[1]
lec	cl	lab	pr	sem					
0	**4**	**0**	**0**	**0**	**60**	**90**	**3**	**0**	**2.26**

[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 classes – after the letter E or Z - enter in brackets the final subject form (lec, cl, lab, pr, sem)
[4]University-wide subject /group of classes – 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 subject / group of classes – enter P. For the group of classes – 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. 4 ECTS points):*

No.	Subject group of classes code	Name of Subjectgroup of classes (denote group of courses with symbol **GK**)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form[2] of Subjectgroup of courses	Way[3] of crediting	Subjectgroup of classes			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN[5] classes	BU[1] classes			University-wide[4]	Concerning scientific activities[5]	Practical[6]	Type[7]
1	GIK-SM0400ANG	Elective Course I			2			K2_GIK_W08, K2_GIK_U07, K2_GIK_K03	30	50	2	2	1.36	T/Z	Z		DN	P(2)	S
2	GIK-SM0400ANG	Elective Course II			2			K2_GIK_W08, K2_GIK_U07, K2_GIK_K03	30	50	2	2	1.36	T/Z	Z		DN	P(2)	S
		Total	**0**	**0**	**4**	**0**	**0**		**60**	**100**	**4**	**4**	**2.72**					**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					
0	**0**	**4**	**0**	**0**	**60**	**100**	**4**	**4**	**2.72**

[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 classes – after the letter E or Z - enter in brackets the final subject form (lec, cl, lab, pr, sem)
[4]University-wide subject /group of classes – 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 subject / group of classes – enter P. For the group of classes – 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

4.2.4.1 *Geodata Engineering* block *(min. 24 ECTS points):*

No.	Subject group of classes code	Name of Subjectgroup 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 Subjectgroup of courses	Way[3] of crediting	Subjectgroup of classes			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN[5] classes	BU[1] classes			University-wide[4]	Concerning scientific activities[5]	Practical[6]	Type[7]
1	W06GIK-SM1046S	Graduate Seminar I					1	K2_GIK_U07, K2_GIK_K02, K2_GIK_K04	15	50	2		0.76	T/Z	Z			P(2)	S
2	W06GIK-SM1051S	Graduate Seminar II					2	K2_GIK_U01, K2_GIK_U02, K2_GIK_U07, K2_GIK_K02, K2_GIK_K04	30	50	2		1.36	T/Z	Z			P(2)	S
3	W06GIK-SM1052D	Master Thesis				1		K2_GIK_U01, K2_GIK_U02, K2_GIK_U07, K2_GIK_K03, K2_GIK_K04	15	500	20	20	1.80	T/Z	Z		DN	P(20)	S
		Total	**0**	**0**	**0**	**1**	**3**		**60**	**600**	**24**	**20**	**3.92**					**24**	

[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 classes – after the letter E or Z - enter in brackets the final subject form (lec, cl, lab, pr, sem)
[4]University-wide subject /group of classes – 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 subject / group of classes – enter P. For the group of classes – 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

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**	**1**	**3**	**60**	**600**	**24**	**20**	**3.92**

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

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

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

[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 classes – after the letter E or Z - enter in brackets the final subject form (lec, cl, lab, pr, sem)
[4]University-wide subject /group of classes – 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 subject / group of classes – enter P. For the group of classes – 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

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

Type of diploma dissertation	magister inżynier	
Number of diploma dissertation semesters	**Number of ECTS points**	**Code**
1	**20**	**W06GIK-SM1052D**
Character of diploma dissertation		
Literature survey, project, computer program, etc.		
Number of BU[1] ECTS points	**1.8**	
Number of DN[5] ECTS points	**20**	

5. Ways of verifying assumed learning outcomes

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

[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 classes – after the letter E or Z - enter in brackets the final subject form (lec, cl, lab, pr, sem)
[4]University-wide subject /group of classes – 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 subject / group of classes – enter P. For the group of classes – 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

6. Range of diploma examination

Experiment design, assessment and processing of geodata:

1. Explain aim, objectives and scope of experiment design.
2. Discuss the discretization and quantization of a spatiotemporal phenomenon.
3. On a suitable example explain how the Fourier transform works.
4. Discuss the differences between interpolation, approximation and extrapolation of geodata.
5. How to derive a Kalman filter for a large geodata set.
6. Explain how are the quantitative and qualitative assessments of remote sensing data conducted.
7. Discuss the statistical assessment of the data quality.
8. Briefly discuss the process of transforming coordinate systems and changing data formats using the GDAL library.
9. Indicate the sequence of actions (tools, functions, variables) required to visualize data in the selected format using the GMT library.
10. Discuss what is spatial statistics and provide example applications in spatial data analysis?
11. Explain what is spatial autocorrelation? Give and discuss examples of spatial autocorrelation metrics?
12. Explain how to perform spatial regression analysis and discuss how does it differ from classical linear regression?
13. Discuss basic statistical measures used to analyze spatial patterns?

Remote sensing and radar interferometry:

14. Briefly discuss the principle of a convolutional neural network using a selected example of working with remote sensing imagery.
15. Give some selected methods for evaluating the accuracy of a machine learning model used for classification and regression. Discuss one of the selected methods.
16. Discuss the main categories of machine learning algorithms: supervised and unsupervised. For each, give examples used in working with remote sensing data.
17. Discuss the challenges of working with multidimensional remote sensing datasets. Give examples of techniques to facilitate working with such data.
18. Provide a workflow for solving a selected practical problem using remote sensing data and machine learning.
19. Briefly discuss the process of importing and visualising remote sensing imagery on the Google Earth Engine platform, for the selected remote sensing dataset.
20. Discuss the advantages and disadvantages of processing remote sensing data in the cloud versus using a local machine (computer with GIS software).
21. Give an example of the use of a cloud computing platform to monitor the environment using remote sensing imagery.
22. Describe Synthetic Aperture Radar (SAR) imaging.

[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 classes – after the letter E or Z - enter in brackets the final subject form (lec, cl, lab, pr, sem)
[4]University-wide subject /group of classes – 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 subject / group of classes – enter P. For the group of classes – 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

23. Outline the fundamental principles of differential SAR interferometry.
24. Describe the InSAR time series processing methods you are familiar with.
25. Discuss the capabilities and limitations of using SAR data in detecting ground surface displacement.
26. Discuss the issue of atmospheric delay in measurements by InSAR techniques, indicate methods for its reduction.

Geodesy, GNSS and laser scanning:

27. Characterize horizontal coordinate systems used in Poland in the past and present.
28. Characterize height reference systems used in Poland in the past and present.
29. Discuss the principles of measurement using geometric leveling when establishing a height reference network.
30. Discuss situational-height (3D) measurements using tachymetry (total station).
31. Discuss situational-height measurements using kinematic GNSS (RTK, RTN).
32. Present key parameters for processing static GNSS data.
33. Discuss differences between GBAS and SBAS, including potential correction surface areas and accuracies achievable through them.
34. Discuss the POZGEO and POZGEO-D services in the ASG-EUPOS network.
35. Discuss the essence of mobile laser scanning.
36. Characterize the airborne laser scanning system.
37. List methods for registering data obtained using terrestrial laser scanning (TLS) and discuss one of them.

Digital Cartographic Models:

38. What is the harmonization of hydrographic geodata obtained from various georeferencing registers?
39. How is a cartographic image of a landform created?
40. What is qualitative and quantitative generalization? Discuss using the example of a road network.
41. What role does the database of the state register of geographical names play in data integration?

Databases, Models and Languages for Geodata Exchange, WebGIS:

42. Describe the data storage formats for vector data compliant with OGC.
43. Describe spatial data types compliant with OGC.
44. Characterize selected methods of spatial data indexing.
45. Describe the GML (Geography Markup Language) standard. What are its main features and applications in geodata exchange?
46. Describe what is XML language and how can it be used to exchange spatial data? Give examples of XML applications in the context of geoinformatics?

[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 classes – after the letter E or Z - enter in brackets the final subject form (lec, cl, lab, pr, sem)
[4]University-wide subject /group of classes – 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 subject / group of classes – enter P. For the group of classes – 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

47. Explain the basic elements of a class diagram in UML? Describe how classes, attributes, methods, and relationships between classes are represented in this diagram?
48. Describe the development process of an application designed to deliver data via a spatial data server.

Project Management:

49. Indicate the differences between the traditional and agile approaches in project management.
50. Discuss the issues of project risk management.
51. Discuss the processes of project initiation and project objectives definition.

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

No.	*Subject / group of classes code*	*Name of subject / group of classes*	*Crediting by deadline of... (number of semester)*
1	W06GIK-SM1030W	Geodata Acquisition Methods	1
2	W06GIK-SM1031W	Experiment Design	1
3	W06GIK-SM1038L	Research Methodology	1
4	W06GIK-SM1032	Assessment of Geodata Quality	1
5	W06GIK-SM1033L	Geodata Processing in Open Source Environment	1
6	W06GIK-SM1034	Satellite Differential Radar Interferometry	1
7	W06GIK-SM1035	Spatial Databases	1
8	W06GIK-SM1036	Digital Cartographic Model	1
9	W06GIK-SM1037	Selected Aspects of Spatial Statistics	1
10	W11GIK-SM1600W	Elements of modern physics	1

[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 classes – after the letter E or Z - enter in brackets the final subject form (lec, cl, lab, pr, sem)
[4]University-wide subject /group of classes – 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 subject / group of classes – enter P. For the group of classes – 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	W08GIK-SM0040C	Humanistic-managerial course	1
12	SJO-SM0003	Foreign Language I	1
13	W06GIK-SM1039	GNSS Positioning Techniques	2
14	W06GIK-SM1040	Application of Remote Sensing in Environmental Protection	2
15	W06GIK-SM1041L	InSAR Time Series Analysis	2
16	W06GIK-SM1042	Machine Learning in Remote Sensing	2
17	W06GIK-SM1043W	IoT Systems	2
18	W06GIK-SM1044L	Selected Applications of Laser Scanning	2
19	W06GIK-SM1045L	Analysis and Harmonization of Spatial Data	2
20	SJO-SM0004	Foreign Language II	2
21	W06GIK-SM1046S	Graduate Seminar I	2
22	GIK-SM0400ANG	Elective Course I	2
23	W06GIK-SM1047P	Work Culture Shaping	2
24	W06GIK-SM1048L	Geoinformation Project Management	3
25	W06GIK-SM1049L	Models and Languages for Geodata Exchange	3
26	W06GIK-SM1050L	WebGIS	3
27	GIK-SM0400ANG	Elective Course II	3
28	W06GIK-SM1051S	Graduate Seminar II	3
29	W06GIK-SM1052D	Master Thesis	3

[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 classes – after the letter E or Z - enter in brackets the final subject form (lec, cl, lab, pr, sem)
[4]University-wide subject /group of classes – 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 subject / group of classes – enter P. For the group of classes – 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

8. Plan of studies (attachment no. 3)

Approved by faculty student government legislative body:

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

23.02.24r.
Date

Jakub Dobrzański
Jakub Dobrzański
Head of Student Government
Faculty of Geoengineering, Mining and Geology
name and surname, signature of student representative

DZIEKAN
prof. dr hab. inż. Radosław Zimroz

23.02.2024
Date

Dean's signature

*delete as appropriate

[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 classes – after the letter E or Z - enter in brackets the final subject form (lec, cl, lab, pr, sem)
[4]University-wide subject /group of classes – 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 subject / group of classes – enter P. For the group of classes – 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

Zał. nr 4 do ZW 78/2023
Attachment no. 3 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: Geodata Engineering

LANGUAGE OF STUDY: english / polish (for specialization: Inżynieria geodanych)

In effect since **summer semester 2024/2025**

*delete as applicable

Plan of studies structure (optionally)

1) in ECTS point layout

sem/h	1	ECTS	2	ECTS	3	ECTS
1	Geodata Acquisition Methods 20000Z W06GIK-SM1030W	3	GNSS Positioning Techniques 10200E W06GIK-SM1039	4	Geoinformation Project Management 00200Z W06GIK-SM1048L	2
2						
3	Experiment Design 10000Z W06GIK-SM1031W	1			Models and Languages for Geodata Exchange 00200Z W06GIK-SM1049L	2
4	Assessment of Geodata Quality 10200E W06GIK-SM1032	3	Application of Remote Sensing in Environmental Protection 10200E W06GIK-SM1040	4		
5					WebGIS 00200Z W06GIK-SM1050L	2
6						
7	Geodata Processing in Open Source Environment 00200Z W06GIK-SM1033L	3	InSAR Time Series Analysis 00300Z W06GIK-SM1041L	3	Elective Course II 00200Z GIK-SM0400ANG	2
8						
9	Satellite Differential Radar Interferometry 10200E W06GIK-SM1034	4			Graduate Seminar II 00002Z W06GIK-SM1051S	2
10			Machine Learning in Remote Sensing 100200E W06GIK-SM1042	4		
11					Master Thesis W06GIK-SM1052D	20
12	Spatial Databases 10100Z W06GIK-SM1035	2				
13			IoT Systems 20000Z W06GIK-SM1043W	3		
14	Digital Cartographic Model 10300E W06GIK-SM1036	4				
15						
16			Selected Applications of Laser Scanning 00300Z W06GIK-SM1044L	3		
17						
18	Selected Aspects of Spatial Statistics 10200E W06GIK-SM1037	4	Analysis and Harmonization of Spatial Data 00200Z W06GIK-SM1045L	3		
19						
20			Foreign Language II 01000Z SJO-SM0004	1		
21	Research Methodology 00100Z W06GIK-SM1038L	1	Graduate Seminar I 00001Z W06GIK-SM1046S	1		
22	Elements of Modern Physics 10000Z W11GIK-SM1600W	1	Elective Course I 00200Z GIK-SM0400ANG	2		
23	Foreign Language I 03000Z SJO-SM0003	2				
24			Work Culture Shaping 00020Z W06GIK-SM1047P	2		
25						
26	Conflict Resolution and Negotiations 01000Z W08GIK-SM0040C	2				
sum		30		30		30

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

Semester 1

Obligatory subjects / groups of classes Number of ECTS points 28

No.	Subject / groups of classescode	Name of subject / groups of classes (denote group of courses with symbol **GK**)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form[2] of subject / groups of classes	Way[3] of crediting	Subject / groups of classes			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN[5] classes	BU[1] classes			University-wide[4]	Concerning scientific activities[5]	Practical[6]	Type[7]
1	W06GIK-SM1032W	Assessment of Geospatial Data Quality	1					K2_GIK_W02	15	25	1	1	0.92	T/Z	E		DN		PD
2	W06GIK-SM1032L	Assessment of Geospatial Data Quality			2			K2_GIK_U02, K2_GIK_U07	30	50	2	2	1.36	T/Z	Z		DN	P(2)	PD
3	W11GIK-SM1600W	Elements of modern physics	1					K2_GIK_W09	15	25	1		0.76	T/Z	Z	O			PD
4	W06GIK-SM1030W	Geodata Acquisition Methods	2					K2_GIK_W01, K2_GIK_U01, K2_GIK_K02, K2_GIK_K03	30	75	3	3	1.36	T/Z	Z		DN		K
5	W06GIK-SM1031W	Experiment Design	1					K2_GIK_W01, K2_GIK_W02, K2_GIK_U01, K2_GIK_U02, K2_GIK_K02, K2_GIK_K03	15	25	1	1	0.76	T/Z	Z		DN		K
6	W06GIK-SM1038L	Research methodology			1			K2_GIK_W07, K2_GIK_U07, K2_GIK_K01, K2_GIK_K02, K2_GIK_K03	15	25	1	1	0.76	T/Z	Z		DN	P(1)	K

[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 classes – after the letter E or Z - enter in brackets the final subject form (lec, cl, lab, pr, sem)
[4]University-wide subject /group of classes – 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 subject / group of classes – enter P. For the group of classes – 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

7	W06GIK-SM1033L	Geodata Processing in Open Source Environment			2			K2_GIK_U01, K2_GIK_U02, K2_GIK_U04, K2_GIK_K02, K2_GIK_K03	30	75	3	3	1.36	T	Z		DN	P(3)	S
8	W06GIK-SM1034W	Satellite Differential Radar Interferometry	1					K2_GIK_W01, K2_GIK_W03, K2_GIK_W06	15	25	1	1	0.92	T/Z	E		DN		S
9	W06GIK-SM1034L	Satellite Differential Radar Interferometry			2			K2_GIK_U01, K2_GIK_U03, K2_GIK_U06, K2_GIK_K02, K2_GIK_K03	30	75	3	3	1.36	T	Z		DN	P(3)	S
10	W06GIK-SM1035W	Spatial databases	1					K2_GIK_W04, K2_GIK_W05	15	25	1	1	0.7	T/Z	Z		DN		S
11	W06GIK-SM1035L	Spatial databases			1			K2_GIK_U04, K2_GIK_U05, K2_GIK_K02, K2_GIK_K03	15	25	1	1	0.7	T/Z	Z		DN	P(1)	S
12	W06GIK-SM1036	Digital Cartographic Models	1					K2_GIK_W05	15	25	1	1	0.9	T/Z	E		DN		S
13	W06GIK-SM1036L	Digital Cartographic Models			3			K2_GIK_U05, K2_GIK_K02, K2_GIK_K03	45	75	3	3	1.9	T	Z		DN	P(3)	S
14	W06GIK-SM1037W	Selected Aspects of Spatial Statistics	1					K2_GIK_W02	15	25	1	1	0.92	T/Z	E		DN		S
15	W06GIK-SM1037L	Selected Aspects of Spatial Statistics			2			K2_GIK_U02, K2_GIK_K02, K2_GIK_K03	30	75	3	3	1.36	T	Z		DN	P(3)	S
16	W08GIK-SM0040	Humanistic-managerial course		1				K2_GIK_W07, K2_GIK_K01, K2_GIK_K02, K2_GIK_K04	15	50	2		0.76	T/Z	Z	O		P(1)	KO
		Total	**9**	**1**	**13**	**0**	**0**		**345**	**700**	**28**	**25**	**17.00**					**17**	

[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 classes – after the letter E or Z - enter in brackets the final subject form (lec, cl, lab, pr, sem)
[4]University-wide subject /group of classes – 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 subject / group of classes – enter P. For the group of classes – 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 subjects / groups of classes (Geodata Engineering) (minimum 45 hours in semester, 2 ECTS points)

No.	Subject / groups of classescode	Name of subject / groups of classes (denote group of courses with symbol **GK**)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form[2] of subject / groups of classes	Way[3] of crediting	Subject / groups of classes			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN[5] classes	BU[1] classes			University -wide[4]	Concerning scientific activities[5]	Practical[6]	Type[7]
1	SJO-SM0003	Foreign Language I		3				K2_GIK_U08	45	60	2		1.63	T/Z	Z	O		P(2)	KO
		Total	**0**	**3**	**0**	**0**	**0**		**45**	**60**	**2**	**0**	**1.63**					**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					
9	**4**	**13**	**0**	**0**	**390**	**760**	**30**	**25**	**18.63**

[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 classes – after the letter E or Z - enter in brackets the final subject form (lec, cl, lab, pr, sem)
[4]University-wide subject /group of classes – 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 subject / group of classes – enter P. For the group of classes – 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

Semester 2

Obligatory subjects / groups of classes Number of ECTS points 25

No.	Subject / groups of classescode	Name of subject / groups of classes (denote group of courses with symbol **GK**)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form[2] of subject / groups of classes	Way[3] of crediting	Subject / groups of classes			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN[5] classes	BU[1] classes			University-wide[4]	Concerning scientific activities[5]	Practical[6]	Type[7]
1	W06GIK-SM1039W	GNSS Positioning Techniques	1					K2_GIK_W01	15	25	1	1	0.92	T/Z	E		DN		S
2	W06GIK-SM1039L	GNSS Positioning Techniques			2			K2_GIK_U01, K2_GIK_K02, K2_GIK_K03	30	75	3	3	1.40	T	Z		DN	P(3)	S
3	W06GIK-SM1040W	Application of Remote Sensing in Environmental Protection	1					K2_GIK_W01, K2_GIK_W03, K2_GIK_W06, K2_GIK_K03	15	25	1	1	0.92	T/Z	E		DN		S
4	W06GIK-SM1040L	Application of Remote Sensing in Environmental Protection			2			K2_GIK_U01, K2_GIK_U03, K2_GIK_U06, K2_GIK_K02, K2_GIK_K03	30	75	3	3	1.36	T	Z		DN	P(3)	S
5	W06GIK-SM1041L	InSAR Time Series Analysis			3			K2_GIK_U01, K2_GIK_U03, K2_GIK_U06, K2_GIK_K02, K2_GIK_K03	45	75	3	3	1.96	T	Z		DN	P(3)	S
6	W06GIK-SM1042W	Machine Learning in Remote Sensing	1					K2_GIK_W01, K2_GIK_W03, K2_GIK_W04	15	25	1	1	0.92	T/Z	E		DN		S
7	W06GIK-SM1042L	Machine Learning in Remote Sensing			2			K2_GIK_U01, K2_GIK_U03, K2_GIK_U04, K2_GIK_K03	30	75	3	3	1.36	T	Z		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 classes – after the letter E or Z - enter in brackets the final subject form (lec, cl, lab, pr, sem)
[4]University-wide subject /group of classes – 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 subject / group of classes – enter P. For the group of classes – 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

8	W06GIK-SM1043W	IoT Systems	2					K2_GIK_W02, K2_GIK_W04, K2_GIK_K02, K2_GIK_K03	30	50	2	2	1.36	T/Z	Z		DN		S
9	W06GIK-SM1044L	Selected Applications of Laser Scanning			3			K2_GIK_U01, K2_GIK_U02, K2_GIK_K02, K2_GIK_K03	45	75	3	3	2.00	T	Z		DN	P(3)	S
10	W06GIK-SM1045L	Analysis and Harmonization of Spatial Data			2			K2_GIK_U02, K2_GIK_U04, K2_GIK_U05, K2_GIK_K02, K2_GIK_K03	30	75	3	3	1.36	T	Z		DN	P(3)	S
11	W06GIK-SM1047P	Work Culture Shaping				2		K2_GIK_W07, K2_GIK_K01, K2_GIK_K02	30	50	2		1.52	T/Z	Z				KO
		Total	**5**	**0**	**14**	**2**	**0**		**315**	**625**	**25**	**23**	**15.08**					**18**	

Optional subjects / groups of classes (Geodata Engineering) (minimum 60 hours in semester, 5 ECTS points)

No.	Subject / groups of classescode	Name of subject / groups of classes (denote group of courses with symbol **GK**)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form[2] of subject / groups of classes	Way[3] of crediting	Subject / groups of classes			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN[5] classes	BU[1] classes			University -wide[4]	Concerning scientific activities[5]	Practical[6]	Type[7]
1	SJO-SM0004	Foreign Language II		1				K2_GIK_U08	15	30	1		0.63	T/Z	Z	O		P(1)	KO
2	GIK-SM0400ANG	Elective Course I			2			K2_GIK_W08, K2_GIK_U07, K2_GIK_K03	30	50	2	2	1.36	T/Z	Z		DN	P(2)	S
3	W06GIK-SM1046S	Graduate Seminar I					1	K2_GIK_U07, K2_GIK_K02, K2_GIK_K04	15	50	2		0.76	T/Z	Z			P(2)	S
		Total	**0**	**1**	**2**	**0**	**1**		**60**	**130**	**5**	**2**	**2.75**					**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 classes – after the letter E or Z - enter in brackets the final subject form (lec, cl, lab, pr, sem)
[4]University-wide subject /group of classes – 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 subject / group of classes – enter P. For the group of classes – 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

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					
5	**1**	**16**	**2**	**1**	**375**	**755**	**30**	**25**	**17.83**

Semester 3

Obligatory subjects / groups of classes Number of ECTS points 6

No.	Subject / groups of classescode	Name of subject / groups of classes (denote group of courses with symbol **GK**)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form[2] of subject / groups of classes	Way[3] of crediting	Subject / groups of classes			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN[5] classes	BU[1] classes			University -wide[4]	Concerning scientific activities[5]	Practical[6]	Type[7]
1	W06GIK-SM1048L	Geoinformation Project Management			2			K2_GIK_W07, K2_GIK_K01, K2_GIK_U07	30	50	2		1.36	T/Z	Z			P(2)	KO
2	W06GIK-SM1049L	Models and Languages for Geodata Exchange			2			K2_GIK_W04, K2_GIK_W05, K2_GIK_U04, K2_GIK_U05, K2_GIK_K02, K2_GIK_K03	30	50	2	2	1.36	T/Z	Z		DN	P(2)	S
3	W06GIK-SM1050L	WebGIS			2			K2_GIK_W04, K2_GIK_W05, K2_GIK_U04, K2_GIK_U05, K2_GIK_K02, K2_GIK_K03	30	50	2	2	1.36	T/Z	Z		DN	P(2)	S
		Total	**0**	**0**	**6**	**0**	**0**		**90**	**150**	**6**	**4**	**4.08**					**6**	

[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 classes – after the letter E or Z - enter in brackets the final subject form (lec, cl, lab, pr, sem)
[4]University-wide subject /group of classes – 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 subject / group of classes – enter P. For the group of classes – 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 subjects / groups of classes (Geodata Engineering) (minimum 75 hours in semester, 24 ECTS points)

No.	Subject / groups of classescode	Name of subject / groups of classes (denote group of courses with symbol **GK**)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form[2] of subject / groups of classes	Way[3] of crediting	Subject / groups of classes			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN[5] classes	BU[1] classes			University -wide[4]	Concerning scientific activities[5]	Practical[6]	Type[7]
1	GIK-SM0400ANG	Elective Course II			2			K2_GIK_W08, K2_GIK_U07, K2_GIK_K03	30	50	2	2	1.36	T/Z	Z		DN	P(2)	S
2	W06GIK-SM1051S	Graduate Seminar II					2	K2_GIK_U01, K2_GIK_U02, K2_GIK_U07, K2_GIK_K02, K2_GIK_K04	30	50	2		1.36	T/Z	Z			P(2)	S
3	W06GIK-SM1052D	Master Thesis				1		K2_GIK_U01, K2_GIK_U02, K2_GIK_U07, K2_GIK_K03, K2_GIK_K04	15	500	20	20	1.80	T/Z	Z		DN	P(20)	S
		Total	**0**	**0**	**2**	**1**	**2**		**75**	**600**	**24**	**22**	**4.52**					**24**	

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					
0	**0**	**8**	**1**	**2**	**165**	**750**	**30**	**26**	**8.60**

[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 classes – after the letter E or Z - enter in brackets the final subject form (lec, cl, lab, pr, sem)
[4]University-wide subject /group of classes – 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 subject / group of classes – enter P. For the group of classes – 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

Subject / groups of classes code	Names of subjects / groups of classesending with examination	Semester
W06GIK-SM1032W W06GIK-SM1034W W06GIK-SM1036W W06GIK-SM1037W	1. Assessment of Geospatial Data Quality 2. Satellite Differential Radar Interferometry 3. Digital Cartographic Models 4. Selected Aspects of Spatial Statistics	1
W06GIK-SM1039W W06GIK-SM1040W W06GIK-SM1042W	1. GNSS Positioning Techniques 2. Application of Remote Sensing in Environmental Protection 3. Machine Learning in Remote Sensing	2

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 classes – after the letter E or Z - enter in brackets the final subject form (lec, cl, lab, pr, sem)
[4]University-wide subject /group of classes – 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 subject / group of classes – enter P. For the group of classes – 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

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

23.02.24r.
Date

Jakub Dobrzański
Jakub Dobrzański
Head of Student Government
Faculty of Geoengineering, Mining and Geology
name and surname, signature of student representative

23.02.2024
Date

DZIEKAN
prof. dr hab. inż. Bogdan Zimroz
(1)
Dean's signature

[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 classes – after the letter E or Z - enter in brackets the final subject form (lec, cl, lab, pr, sem)
[4]University-wide subject /group of classes – 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 subject / group of classes – enter P. For the group of classes – 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

SUBJECT CARDS

FACULTY: **GEOENGINEERING, MINING AND GEOLOGY**

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

Assigned to the disciplines:

D1 ENVIROMENTAL ENGINEERING, MINING AND ENERGY (major discipline)

D2 CIVIL ENGINEERING, GEODESY AND TRANSPORT

EDUCATION LEVEL: **second-level**

FORM OF STUDIES: **full-time**

PROFILE: **general academic**

SPECIALIZATION: **Geodata Engineering**

LANGUAGE OF STUDY: **English / Polish (for specialization: Inżynieria geodanych)**

IN EFFECT SINCE: **summer semester 2024/2025**

SEMESTER 1

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

FACULTY OF GEOENGINEERING, MINING AND GEOLOGY

SUBJECT CARD

Name of subject in Polish	**Metody pozyskiwania geodanych**
Name of subject in English	**Geodata Acquisition Methods**
Main field of study (if applicable):	**Geodesy and Cartography**
Specialization (if applicable):	**Geodata Engineering**
Profile:	**academic**
Level and form of studies:	**2nd, full-time**
Kind of subject:	**obligatory**
Subject code	**W06GIK-SM1030W**
Group of courses	**NO**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	**30**				
Number of hours of total student workload (CNPS)	**75**				
Form of crediting (Examination / crediting with grade)	(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)					
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	**1.36**				

*delete as not necessary

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Has basic knowledge of mathematics and physics
2. Is able to use office software

SUBJECT OBJECTIVES

C1. Presentation/reminder of key information about the national spatial reference system
C2. Presentation/reminder of key information about modern geodata acquisition techniques: leveling, total station measurements, satellite techniques (GNSS), photogrammetry, remote sensing and laser scanning
C3. Presentation/reminder of key information about available geodata databases

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge:

PEU_W01	Knows key information about the national spatial reference system, with particular emphasis on the Cartesian rectangular coordinate systems applicable in Poland
PEU_W02	Knows key information about leveling, total station and satellite surveys (GNSS) and measurement instruments used in these techniques
PEU_W03	Knows key information about photogrammetry and remote sensing
PEU_W04	Knows key information about laser scanning
PEU_W05	Knows available geodata databases

relating to social competences:

PEU_K01	Is ready to behave in a professional manner and comply with the principles of professional ethics, and understands his responsibility for decisions taken. Has an awareness of the role of the surveyor in the tasks of the national economy
PEU_K02	Is ready to understand the importance of reliable performance of assigned tasks and the significance of the documentation produced, and has an awareness of the need for systematic self-education
PEU_K03	Is ready to work individually, cooperate in a group and manage the work of a team of people, as well as establish correct relations with outsiders in the performance of assigned tasks

PROGRAMME CONTENT

Lecture		Number of hours
Lec 1	National spatial reference system	4
Lec 2	Height measurements using the geometric leveling method	4
Lec 3	Situational and altitude measurements using the tachymetric method	6
Lec 4	Situational and altitude measurements using the GNSS method	2
Lec 5	Partial test	2
Lec 6	Photogrammetry as a method of obtaining geodata	4
Lec 7	Laser scanning as a method of obtaining geodata	2
Lec 8	Remote sensing as a method of obtaining geodata	2
Lec 9	Publicly available geodata databases	2
Lec 10	Final test	2
	Total hours	**30**

TEACHING TOOLS USED

N1. Lecture with multimedia presentations and elements of problem lecture
N2. Geodata development (computational, graphical and descriptive)
N3. Quizzes/tests
N4. Own work (self-study)
N5. 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

F1	PEU_W01 - PEU_W05, PEU_K01 – PEU_K02	Quizzes scores – must obtain at least 85% points on each quiz
F2	PEU_W01 - PEU_W02, PEU_K01 – PEU_K03	Grade from partial test
F3	PEU_W03 - PEU_W05, PEU_K01 – PEU_K03	Grade from final test
The condition for obtaining a pass in the lecture is to obtain at least 85% of the points in each quiz (F1). The final grade is calculated from the formula: P1 = 0.6*F2 + 0.4*F3 (converted to academic scale)		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] Uren J., Price B., 2000. Surveying for Engineers, 5th Edition, Palgrave Macmillan, Macmillan Education

[2] Vosselman G., Mass H-G., 2010. Airborne and Terrestrial Laser Scanning, Whittles Publishing, UK

[3] Schofield W., Breach M., 2000. Engineering Surveying, 6th Edition, Taylor&Francis Ltd.

[4] Lavender S. Lavender A., 2016. Practical Handbook of Remote Sensing, Taylor&Francis Group

SECONDARY LITERATURE:

[1] Jagielski A., Surveying I in the theory and practice part 1, Wydawnictwo Geodpis, Kraków 2019 (in Polish)

[2] Jagielski A., Surveying I in the theory and practice part 2, Wydawnictwo Geodpis, Kraków 2019 (in Polish)

[3] Hejmanowska B., Wężyk P., 2020. Satellite data for public administration, 1st Edition, Polish Space Agency (in Polish)

[4] Dworak T.Z., Hejmanowska B., Pyka K., 2011. The problems of remote sensing monitoring of the environment, Volume II, Publishing House of AGH University (in Polish)

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

dr inż. Zbigniew Muszyński, zbigniew.muszynski@pwr.edu.pl
dr inż. Jarosław Wajs, jaroslaw.wajs@pwr.edu.pl
dr inż. Anna Buczyńska, anna.buczynska@pwr.edu.pl

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

FACULTY OF GEOENGINEERING, MINING AND GEOLOGY

SUBJECT CARD

Name of subject in Polish	**Planowanie eksperymentu**
Name of subject in English	**Experiment Design**
Main field of study (if applicable):	**Geodesy and Cartography**
Specialisation (if applicable):	**Geodata Engineering**
Profile:	**academic**
Level and form of studies:	**2nd, full-time**
Kind of subject:	**obligatory**
Subject code	**W06GIK-SM1031W**
Group of courses	**NO**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organised classes in University (ZZU)	**15**				
Number of hours of total student workload (CNPS)	**25**				
Form of crediting (Examination / crediting with grade)	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)	**0.76**				

*delete as not necessary

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge and skills acquired during the first level of engineering studies

SUBJECT OBJECTIVES

C1. Gaining knowledge of experiment planning in geosciences
C2. Gaining knowledge of the selection of instruments, data sources and methods for experiments in geosciences

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge:

PEU_W01	Understands the need for experiment design
PEU_W02	Knows experiment design methods
PEU_W03	Knows procedures for discretisation and quantisation of experimental data
PEU_W04	Knows the Nyquista-Shannon theorem
PEU_W05	Knows the Fourier transform

relating to social competences:

PEU_K01	Is ready to behave in a professional manner and comply with the principles of professional ethics, and understands his responsibility for decisions taken. Has an awareness of the role of the surveyor in the tasks of the national economy
PEU_K02	Is ready to understand the importance of reliable performance of assigned tasks and the significance of the documentation produced, and has an awareness of the need for systematic self-education
PEU_K03	Is ready to work individually, cooperate in a group and manage the work of a team of people, as well as establish correct relations with outsiders in the performance of assigned tasks

PROGRAMME CONTENT

	Lecture	Number of hours
Lec 1	On the need for experiment design: Purpose, objectives, scope of experiment design in geosciences	1
Lec 2	Four methods of experiment design	2
Lec 3	Bayesian experiment design approach	2
Lec 4	Fisher experiment design approach	2
Lec 5	Characteristics of geodata	2
Lec 6	The Nyquist-Shannon sampling theorem in geosciences	2
Lec 7	Fourier transform in geosciences	2
Lec 8	Final test	2
	Total hours	**15**

TEACHING TOOLS USED

N1. Lecture or online lecture, including multimedia presentation
N2. Self study
N3. Consultations
N4. Activity in class

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT

Evaluation (F – forming during semester), P – concluding (at semester end)	Learning outcomes code	Way of evaluating learning outcomes achievement
F1	PEU_W01 – PEU_W05	Test
F2	PEU_W03, PEU_W04, PEU_K01 - PEU_K03	Final test

F3	PEU_W01 – PEU_W05, PEU_K01 – PEU_K03	Activity in class
P1 = 0.2*F1 + 0.5*F2 + 0.3*F3		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] Hicks, C.R., and K.V. Turner, Jr. (1999). Fundamental Concepts in the Design of Experiments. 5th ed. New York, NY: Oxford University Press.

SECONDARY LITERATURE:

[1] Montgomery, D.C. (2019). Design and Analysis of Experiments. Wiley, ISBN: 978-1-119-63542-0.

[2] Giri, Narayan C.; Das, M. N. (1979). Design and Analysis of Experiments. New York, N.Y: Wiley. pp. 350–359. ISBN 9780852269145.

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

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

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

FACULTY OF GEOENGINEERING, MINING AND GEOLOGY

SUBJECT CARD

Name of subject in Polish	**Ocena jakości geodanych**
Name of subject in English	**Assessment of Geospatial Data Quality**
Main field of study (if applicable):	**Geodesy and Cartography**
Specialization (if applicable):	**Geodata Engineering**
Profile:	**academic**
Level and form of studies:	**2nd, full-time**
Kind of subject:	**obligatory**
Subject code	**W06GIK-SM1032**
Group of courses	**NO**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	**15**		**30**		
Number of hours of total student workload (CNPS)	**25**		**50**		
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)					
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	**0.92**		**1.36**		

*delete as not necessary

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Has knowledge and skills in the field of mathematical statistics.
2. Has knowledge and skills in the field of detailed cadastral surveys.
3. Has knowledge in the field of settlement accounting.

SUBJECT OBJECTIVES

C1. Skill in assessing the accuracy of data obtained from direct and indirect measurements.
C2. Skill in analyzing the quality and correctness of data obtained from open sources.
C3. Skill in performing filtration on large datasets.

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge:

PEU_W01	Knows the principles of statistical assessment of measurement results.
PEU_W02	Knows methods for evaluating data obtained through photogrammetric and remote sensing methods.
PEU_W03	Knows the principles of filtering large sets of information, filtering methods.
PEU_W04	The student is acquainted with methods of optimization, approximation, and interpolation of data.

relating to skills:

PEU_U01	The student is able to conduct an analysis of the accuracy of measurement results.
PEU_U02	The student is capable of developing an assessment of utility along with the verification of the quality of obtained information.
PEU_U03	The student can use filtration for verification and assessment of data quality.
PEU_U04	The student is capable of utilizing approximation and interpolation of data for optimizing values obtained from measurements or open sources.

relating to social competences:

PEU_K01	Is ready to behave in a professional manner and comply with the principles of professional ethics, and understands his responsibility for decisions taken. Has an awareness of the role of the surveyor in the tasks of the national economy
PEU_K02	Is ready to understand the importance of reliable performance of assigned tasks and the significance of the documentation produced, and has an awareness of the need for systematic self-education
PEU_K03	Is ready to work individually, cooperate in a group and manage the work of a team of people, as well as establish correct relations with outsiders in the performance of assigned tasks

PROGRAMME CONTENT

Lecture		Number of hours
Lec 1	Statistical analysis of a set of measurement data. Mean, median, standard deviation, errors of expected values. Weights of direct and indirect observations.	1
Lec 2	Statistical verification of the correctness of obtained measurement data. Verification of outliers. Robust methods in data quality analysis. Estimation of data.	**2**
Lec 3	Qualitative analysis of photogrammetric and remote sensing data using various statistical methods.	**2**
Lec 4	Quantitative analysis of photogrammetric and remote sensing data using statistical models.	**2**
Lec 5	Evaluation of the utility of data obtained from open sources. Statistical methods for information verification. Geodata quality model.	**2**
Lec 6	Data filtration – principles, methods, applications. Kalman filter, low-pass, and high-pass filters.	**2**
Lec 7	Data optimization, approximation, interpolation – principles, methods, applications.	**2**
Lec 8	Forecasting – principles and methods of developing statistical forecasts.	**2**
	Total hours	**15**

Laboratory		Number of hours
Lab1	Direct measurement, acquisition of source data for analysis. Equally and unequally accurate measurement.	**2**
Lab2	Statistical analysis, accuracy assessment, verification of data quality from direct measurement. Histogram.	**4**
Lab3	Classification, aggregation, grouping of geodata along with utility assessment and distribution values.	**4**
Lab4	Verification of outliers, robust estimation.	**4**
Lab5	Approximation, interpolation, and forecasting of geodata using various statistical methods.	**4**
Lab6	Assessment of the quality of data from photogrammetric measurement, statistical verification of parameters obtained from the image.	**2**
Lab7	Quantitative verification of information contained in photogrammetric and satellite images.	**2**
Lab8	Data filtration, linear filters, Kalman filter.	**2**
Lab9	Accuracy analysis and verification of point cloud quality using statistical methods.	**2**
Lab10	Verification of publicly available data using qualitative and quantitative methods. Assessment of data suitability for processing and sharing.	**2**
Lab11	Development of a geodata quality model based on European Standards	**2**
	Total hours	**30**

TEACHING TOOLS USED	
N1.	Lecture with multimedia presentations.
N2.	Field measurements using surveying instruments.
N3.	Processing geodetic data (computational, graphical, and descriptive).
N4.	Report or documentation of performed work in digital or paper form.
N5.	Individual work (self-education).
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
F1	PEU_W01 - PEU_W04, PEU_K01 - PEU_K03	Exam in the written assignment form.
P1 = F1		
F2	PEU_U01 – PEU_U04	Grades for reports submitted electronically on eportal.pwr.edu.pl.
P2 – arithmetic mean of F2		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] Ghilani Ch. D. and Wolf P. R.: Adjustment Computations: Spatial Data Analysis 5th Edition, Publisher: Wiley, 2022

[2] Wolf P. R.: Least Squares Adjustment of Surveying Measurements 3rd Edition, Publisher: American Society of Civil Engineers (ASCE), 2001

[3] Bonin Ch. E.: Adjustment of Observations: The Least Squares Method, Publisher: Springer, 1971

[4] Vining G., Kowalski S.: Statistical Methods for Engineers, Publisher: Cengage Learning, 4th Edition, 2019

SECONDARY LITERATURE:

[1] Wolf P. R., Ghilani Ch. D.: Adjustment Computations: Statistics and Least Squares in Surveying and GIS, Publisher: Wiley, 2020

[2] Nielsen A.: Practical Time Series Analysis, Publisher: O'Reilly Media, 2017

[3] .Proakis J., Dimitris G., Manolakis G.: Digital Signal Processing: Principles, Algorithms, and Applications, Publisher: Pearson, 4th Edition, 2006

[4] Chen W.F.: European Standards in Civil Engineering, Publisher: CRC Press, 2004

[5] DeMers M.: Geospatial Data and Analysis: A Comprehensive Guide, Publisher: New York: The Guilford Press, 4th Edition, 2015

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

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

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

FACULTY OF GEOENGINEERING, MINING AND GEOLOGY

SUBJECT CARD

Name of subject in Polish	**Przetwarzanie geodanych w środowisku open source**
Name of subject in English	**Geodata Processing in Open Source Environment**
Main field of study (if applicable):	**Geodesy and Cartography**
Specialization (if applicable):	**Geodata Engineering**
Profile:	**academic**
Level and form of studies:	**2nd, full-time**
Kind of subject:	**obligatory**
Subject code	**W06GIK-SM1033L**
Group of courses	**NO**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)			**30**		
Number of hours of total student workload (CNPS)			**75**		
Form of crediting (Examination / crediting with grade)			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)			**1.36**		

*delete as not necessary

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knows the basics of programming.
2. Has the ability to use practically GIS software.

SUBJECT OBJECTIVES

C1. Acquiring practical skills related to geodata processing based on command line tools.
C2. Acquiring of practical skills related to geodata visualization based on command line tools.

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge:

PEU_W01	Knows a variety spatial data formats.
PEU_W02	Knows the basic tools of the GDAL library and can specify their use.
PEU_W03	Knows the basic GMT modules and can specify their use.

relating to skills:

PEU_U01	Can retrieve spatial data information from the command line level.
PEU_U02	Has the ability to define a coordinate system and perform operations on geodata from the command line level.
PEU_U03	Can perform mathematical operations on rasters from the command line.
PEU_U04	Has the ability to develop geodata visualizations using command line tools.
PEU_U05	Has the ability of using technical documentation.

relating to social competences:

PEU_K01	Is ready to behave in a professional manner and comply with the principles of professional ethics, and understands his responsibility for decisions taken. Has an awareness of the role of the surveyor in the tasks of the national economy
PEU_K02	Is ready to understand the importance of reliable performance of assigned tasks and the significance of the documentation produced, and has an awareness of the need for systematic self-education
PEU_K03	Is ready to work individually, cooperate in a group and manage the work of a team of people, as well as establish correct relations with outsiders in the performance of assigned tasks

Laboratory		**Number of hours**
Lab1	Introduction to the GDAL library, supported raster and vector data formats, data information extraction.	2
Lab2	GDAL library - universal raster tool options, create new files, define coordinate system, transform coordinate systems, convert between raster data formats.	4
Lab3	GDAL library - editing and processing of raster data (including mosaicking, VRT creation, polygonization).	2
Lab4	GDAL library - command line raster calculator with *numpy* syntax.	2
Lab5	GDAL library - editing and conversion of vector data.	2
Lab6	Introduction to GMT tools - basic modules and universal variables.	2
Lab7	GMT - Geodata visualization: creation of a map frame and its basic elements, extraction and visualization of data from the GSHHG database.	2
Lab8	GMT - Raster data visualization, color palette creation, shading, color scale bar. Raster data processing (including calculation, resampling, filtering).	4
Lab9	GMT - Visualize vector data, add text, create charts, complex compositions.	4
Lab10	Preparation of a complex thematic composition using command line tools: data collection, processing and visualization.	6
	Total hours	**30**

TEACHING TOOLS USED

N1. Acquisition of geodata (spatial databases).
N2. Developing geodata (computational, graphical and descriptive).
N3. A report of the work performed in digital or paper form.
N4. Own work (self-study).

N5. 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
F1	PEU_W01, PEU_W02, PEU_W03, PEU_K01	Grades from tests
F2	PEU_U01, PEU_U02, PEU_U03, PEU_U04, PEU_U05, PEU_K02, PEU_K03	Grades from reports
P1 = (arithmetic mean of F1 + arithmetic mean of F2)/2 converted to academic scale		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] GDAL Environment Documentation: https://gdal.org/index.html
[2] GMT Environment Documentation (Generic Mapping Tools) - https://docs.generic-mapping-tools.org/latest/

SECONDARY LITERATURE:

[1] Documentation of the PROJ tool: https://proj.org/en/9.2/
[2] Documentation of the GSHHG database: https://www.soest.hawaii.edu/pwessel/gshhg/
[3] Wessel, P., Luis, J. F., Uieda, L., Scharroo, R., Wobbe, F., Smith, W. H. F., & Tian, D. (2019). The Generic Mapping Tools version 6. Geochemistry, Geophysics, Geosystems, 20, 5556–5564. https://doi.org/10.1029/2019GC008515

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

dr inż. Anna Kopeć, anna.kopeć@pwr.edu.pl
dr hab. inż. Wojciech Milczarek, wojciech.milczarek@pwr.edu.pl

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

FACULTY OF GEOENGINEERING, MINING AND GEOLOGY

SUBJECT CARD

Name of subject in Polish	**Satelitarna różnicowa interferometria radarowa**
Name of subject in English	**Satellite Differential Radar Interferometry**
Main field of study (if applicable):	**Geodesy and Cartography**
Specialization (if applicable):	**Geodata Engineering**
Profile:	**academic**
Level and form of studies:	**2nd, full-time**
Kind of subject:	**obligatory**
Subject code	**W06GIK-SM1034**
Group of courses	**NO**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	**15**		**30**		
Number of hours of total student workload (CNPS)	**25**		**75**		
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)	**0.92**		**1.36**		

*delete as not necessary

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knows the basics of programming .
2. Has basic knowledge of the role of geoinformation tools (GIS) and spatial data acquisition techniques.
3. Has basic knowledge of databases.
4. Has basic knowledge of remote sensing.

SUBJECT OBJECTIVES

C1. Presenting the knowledge of satellite radar interferometry, and the possibility of its application in ground deformation measurements.

C2. To gain the skills of determining ground surface displacements based on satellite radar data.

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge:

PEU_W01 Has a general knowledge of the theoretical basis of satellite radar interferometry.

PEU_W02 Has knowledge of satellite radar data acquisition and processing.

PEU_W03 Knows the possibilities and limitations of using SAR data in ground surface displacement detection.

relating to skills:

PEU_U01 Can acquire SAR data from current and historical space missions.

PEU_U02 Has ability to perform calculations using the DInSAR differential method including atmospheric corrections.

PEU_U03 Can visualize the results of DInSAR calculations in GDAL and GMT environments.

PEU_U04 Has ability to interpret the measurement results determined by the DInSAR method.

relating to social competences:

PEU_K01 Is ready to behave in a professional manner and comply with the principles of professional ethics, and understands his responsibility for decisions taken. Has an awareness of the role of the surveyor in the tasks of the national economy

PEU_K02 Is ready to understand the importance of reliable performance of assigned tasks and the significance of the documentation produced, and has an awareness of the need for systematic self-education

PEU_K03 Is ready to work individually, cooperate in a group and manage the work of a team of people, as well as establish correct relations with outsiders in the performance of assigned tasks

PROGRAMME CONTENT

Lecture		**Number of hours**
Lec 1	Introduction to microwave signal theory for Earth observation	1
Lec 2	Application of passive and active satellite remote sensing to determine ground surface displacement	2
Lec 3	SAR data acquisition and processing	2
Lec 4	Theory of SAR imaging	2
Lec 5	Basics of SAR data calculations, differential SAR interferometry method	2
Lec 6	Interferometric phase unwrapping, delays: ionospheric and tropospheric	2
Lec 7	Introduction to time series SAR data calculations	2
Lec 8	Use of SAR data in monitoring ground surface activity	2
	Total hours	**15**

Laboratory		**Number of hours**
Lab1	Introduction to GMT/GMTSAR environment	4
Lab2	Acquisition of SAR data, preparation of API for simple search and retrieval of data	4
Lab3	Introduction to radar data calculations	4
Lab4	Interferometric phase unwrapping	4
Lab5	Determination of ionospheric and tropospheric correction	4

Lab6	Differential InSAR calculations	6
Lab7	Presentation of the results of SAR data calculations in the GMT environment	4
	Total hours	**30**

TEACHING TOOLS USED
N1. Traditional or remote lecture with multimedia presentations.
N2. Acquisition of geodata (spatial databases).
N3. Developing geodata (computational, graphical and descriptive).
N4. A report of the work performed in digital or paper form.
N5. Own work (self-study).
N6. Consultation.

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT

Evaluation (F – forming during semester), P – concluding (at semester end)	Learning outcomes code	Way of evaluating learning outcomes achievement
F1	PEU_W01, PEU_W02, PEU_W03, PEU_K01 – PEU_K03	Written exam
P1 = F1		
F2	PEU_U01, PEU_U02, PEU_U03, PEU_U04	Grades from reports
P2 - arithmetic mean of F2 converted to academic scale		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

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

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

[3] GMTSAR: An InSAR Processing System Based on Generic Mapping Tools (Second Edition), Sandwell i in., Scripps Institution of Oceanography, University of California, San Diego, La Jolla, CA, USA, 2016 (https://escholarship.org/uc/item/8zq2c02m)

SECONDARY LITERATURE:

[1] Hanssen, R.F., 2001. *Radar Interferometry: Data Interpretation and Error Analysis, Remote Sensing and Digital Image Processing*. Springer Netherlands. https://doi.org/10.1007/0-306-47633-9

[2] Michele Crosetto, Lorenzo Solari, *Satellite Interferometry Data Interpretation and Exploitation*, Elsevier, 2023, https://doi.org/10.1016/B978-0-443-13397-8.00010-8

[3] GMT Environment Documentation (Generic Mapping Tools) - https://docs.generic-mapping-tools.org/latest/

[4] ESA Documentation: https://earth.esa.int/eogateway/search?category=document+library

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

dr hab. inż. Wojciech Milczarek, wojciech.milczarek@pwr.edu.pl
dr inż. Anna Kopeć, anna.kopec@pwr.edu.pl

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

FACULTY OF GEOENGINEERING, MINING AND GEOLOGY

SUBJECT CARD

Name of subject in Polish	**Bazy danych przestrzennych**
Name of subject in English	**Spatial Databases**
Main field of study (if applicable):	**Geodesy and Cartography**
Specialization (if applicable):	**Geodata Engineering**
Profile:	**academic**
Level and form of studies:	**2nd, full-time**
Kind of subject:	**obligatory**
Subject code	**W06GIK-SM1035**
Group of courses	**NO**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	**15**		**15**		
Number of hours of total student workload (CNPS)	**25**		**25**		
Form of crediting (Examination / crediting with grade)	Crediting with grade		Crediting with grade		
For group of courses mark (X) final course					
Number of ECTS points	**1**		**1**		
including number of ECTS points for practical classes (P)			**1**		
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	**0.76**		**0.76**		

*delete as not necessary

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Fundamentals of relational databases.
2. Basics of the SQL language.
3. Basics of programming.

SUBJECT OBJECTIVES

C1. Acquiring knowledge and skills in creating classes and their instances for the purpose of collecting, processing, and sharing spatial data.
C2. Acquiring knowledge and skills in spatial data indexing and optimizing processing algorithms.

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge:

PEU_W01 Has knowledge in creating classes and their instances for the purpose of collecting, processing, and sharing spatial data.

PEU_W02 Has knowledge in spatial data indexing and optimizing processing algorithms.

relating to skills:

PEU_U01 Has skills in creating classes and their instances for the purpose of collecting, processing and sharing spatial data.

PEU_U02 Has skills in indexing spatial data and optimizing processing algorithms.

relating to social competences:

PEU_K01 Is ready to behave in a professional manner and comply with the principles of professional ethics, and understands his responsibility for decisions taken. Has an awareness of the role of the surveyor in the tasks of the national economy

PEU_K02 Is ready to understand the importance of reliable performance of assigned tasks and the significance of the documentation produced, and has an awareness of the need for systematic self-education

PEU_K03 Is ready to work individually, cooperate in a group and manage the work of a team of people, as well as establish correct relations with outsiders in the performance of assigned tasks

PROGRAMME CONTENT

Lecture		Number of hours
Lec 1	Basic concepts and definitions related to spatial databases	1
Lec 2	Fundamentals of programming using spatial database objects	2
Lec 3	Vector data structures in spatial databases	2
Lec 4	Raster data structures in spatial databases	2
Lec 5	Objects performing spatial analyses on vector and raster objects	4
Lec 6	Indexing in spatial databases	2
Lec 7	Final colloquium	2
	Total hours	**15**

Laboratory		Number of hours
Lab1	Introduction to the spatial database environment	1
Lab2	Configuration of the development environment and database	2
Lab3	Introduction to programming in geographic information systems	2
Lab4	Spatial database design and creation of object classes representing vector data	2
Lab5	Spatial database design and creation of object classes representing raster data	2
Lab6	Objects and functions for spatial analysis of raster and vector data	2
Lab7	Indexing in spatial databases	2
Lab8	Final colloquium	2
	Total hours	**15**

TEACHING TOOLS USED	
N1.	Traditional or remote lecture with multimedia presentations
N2.	Acquisition of geospatial data (spatial databases)
N3.	Processing geospatial data (computational, graphical, and descriptive)
N4.	Report or documentation of completed work in digital or paper form
N5.	Independent work (self-learning)
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
F1	PEU_W01, PEU_W02, PEU_K01 – PEU_K03	Assessment from the colloquium
P1 = F1		
F4	PEU_U01, PEU_U02	Assessment from the colloquium
F5	PEU_U01, PEU_U02	Quiz grade
F6	PEU_U01, PEU_U02	Grade for the database project
P2 = F2*0.5+F3*0.3+F4*0.2		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] Yeung, Albert K. W; Hall, G. Brent , Hall, G. Brent; Yeung, Albert K. W., Spatial Database Systems: Design, Implementation and Project Management, Springer Nature, 2007

[2] Dominik Mikiewicz, Michal Mackiewicz, Tomasz Nycz. Mastering PostGIS, Packt Publishing Limited, 2017

[3] Gianni Ciolli, Boriss Mejías, Jimmy Angelakos, Vibhor Kumar, Simon Riggs, PostgreSQL 16 Administration Cookbook, Packt, 2023

SECONDARY LITERATURE:

[1] Bernhard Rumpe, Modeling with UML, Springer International Publishing AG, 2018

[2] PostgreSQL manual, https://www.postgresql.org/docs/manuals/

[3] PostGIS Manual, https://postgis.net/docs/

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

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

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

FACULTY OF GEOENGINEERING, MINING AND GEOLOGY

SUBJECT CARD

Name of subject in Polish	**Kartograficzne modele cyfrowe**
Name of subject in English	**Digital Cartographic Models**
Main field of study (if applicable):	**Geodesy and Cartography**
Specialization (if applicable):	**Geodata Engineering**
Profile:	**academic**
Level and form of studies:	**2nd, full-time**
Kind of subject:	**obligatory**
Subject code	**W06GIK-SM1036**
Group of courses	**NO**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	**15**		**45**		
Number of hours of total student workload (CNPS)	**25**		**75**		
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)	**0.92**		**1.96**		

*delete as not necessary

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

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

SUBJECT OBJECTIVES

C1. Theoretical knowledge of the supply of standard cartographic studies (digital cartographic models): topographic and thematic
C2. Knowledge of basic materials and methods for the construction and updating of cartographic single-scale and multi-representational models.
C3. Ability to integrate different georeferenced registers: official and other state services cartographic models (maps).
C4. Ability to harmonise the different public georeferenced registers: cartographic official and other state services models (maps) in the geoportal.
C5. Evaluate the quality of georeferenced data and information derived from the model.
C6. Understanding the responsibility of the author of cartographic models.

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge:

PEU_W01 Has a general, structured and theoretically grounded knowledge of the supply and updating of standard cartographic studies (digital cartographic models): topographic and thematic.

PEU_W02 Has knowledge in the field of harmonization and integration of data in a multi-resolution database (MRDB) obtained from various georeferencing register.s

relating to skills:

PEU-U01 Be able to evaluate and select appropriate methods to build cartographic digital models in GIS systems using different databases and data imaging modules.

PEU_U02 Is prepared to carry out the supply, updating and harmonisation of cartographic models from different georeferenced registers.

relating to social competences:

PEU_K01 Is ready to understand the importance of quality in official digital cartographic models and maps: topographic and thematic.

PEU_K02 Is ready to understand the responsibility of the developer of digital cartographic models: thematic and topographic, for the completeness and timeliness of the data and metadata entered into the model and made available, and the copyright protection of the georeferenced register information used for harmonisation.

PEU_K03 Is ready to work individually, cooperate in a group and manage the work of a team of people, as well as establish correct relations with outsiders in the performance of assigned tasks

PROGRAMME CONTENT

Lecture		**Number of hours**
Lec 1	Presentation of topographic and thematic data in geoservices.	1
Lec 2	Scope of spatial information collected in the database of topographic objects and thematic maps used in the multiresolution/multiscale database for creating digital cartographic models (DCM) compliant with Polish standards and the INSPIRE specification	2
Lec 3	Processing of topographic data and their integration with Spatial Information Infrastructure data in Poland. Content of thematic state registers. Assessment of quality, redundancy and risk of data inconsistency and the contractor's responsibility for information obtained from the DCM.	2
Lec 4	Organisation, mode and technical standards for the creation of cartographic models from the database of topographic objects (BDOT10k) and general geographic objects (BDOO). Qualitative and quantitative generalisation. Cartographic relief models and their consistency with topographic objects from BDOT10k and BDOT500 databases.	2
Lec 5	Multi-resolution topographic database (MRTDB). Integration of cartographic model of topographic data with database and map of land and building registry, State Register of Borders, State Register of Geographic Names and thematic collections e.g.: Map of Hydrographic Division of Poland, soil-agricultural map, soil-habitat map of forests, geological maps of PGI, database of Wody Polskie, Sozological and Hydrographic Maps	6
Lec 6	Numerical Forest Map, Electronic Maritime Map, Numerical Railway Map, etc. - data integration	2

	Total hours	**15**

Laboratory		**Number of hours**
Lab1	Update of the cartographic model based on data from geodetic and cartographic documentation centres.	9
Lab2	Digital cartographic models of topographic data. Development of a selected group of objects in a scale series from 10k to 250k. Quantitative generalisation.	9
Lab3	Harmonisation of selected groups of thematic data cartographic model objects with hydrographic data.	9
Lab4	Integration of topographic data cartographic model with terrain elevation model.	12
Lab5	Evaluation of the quality of the data possible from the created digital cartographic model. Construction of DCM to feed the geoportal on the basis of harmonised data.	6
	Total hours	**45**

TEACHING TOOLS USED
N1. Informative lecture with elements of problem lecture
N2. Multimedia presentations
N3. Completion of an individual written term paper on an assigned topic
N4. Carrying out and preparing reports on laboratory tasks
N5. Test
N6. Consultation

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT

Evaluation (F – forming during semester), P – concluding (at semester end)	Learning outcomes code	Way of evaluating learning outcomes achievement
F1	PEU_W01, PEU_W02	Examination grade for the lecture
P1 = F1		
F1	PEU_U01, PEU_U02, PEU_K01-PEU_K03	Evaluation of the digital report of the laboratory exercises
F2	PEU_U01, PEU_U02, PEU_K01-PEU_K03	Test scores
P2 = 0,7*F1 + 0,3*F2		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] Boodala J.,Dikshit O. and Balasubramanian N., 2020. Towards the derivation of Multiple Representation Database. 2020 IEEE International Conference on Electronics, Computing and Communication Technologies (CONECCT), Bangalore, India, pp. 1-6, doi: 10.1109/CONECCT50063.2020.9198528.

[2] Głażewski A., Kowalski P.J., Olszewski R., Bac-Bronowicz J. 2010. New Approach to Multi Scale Cartographic Modelling of Reference and Thematic Databases in Poland [in:] Gartner G. and Ortag F. (Eds.): Lecture Notes in Geoinformation and Cartography, Cartography in Central and Eastern Europe Selected Papers of the 1st ICA Symposium on Cartography for Central and Eastern Europe, Springer-Verlag, Berlin - Heidelberg.

[3] Głażewski, A., Kowalski, P. J., Olszewski, R., & Ostrowski, W. 2011. New approach to cartographic presentation of Georeference Database in Poland. In *Proceedings of the 25th International Cartographic Conference, Paris* (Vol. 3, No. 8).

[4] Gotlib D., Iwaniak A., Olszewski R., *SDI in Poland – concept of topographic reference system for thematic, harmonized databases,* ICA Conference, La Coruna 2005

[5] Główny Urząd Geodezji i Kartografii. Rozporządzenia, instrukcje i wytyczne techniczne wydawane od 2012 r.

[6] Hampe M, Sester M and Harrie L, 2004, Multiple representation databases to support visualisation on mobile devices. In: Altan O (eds), Proc. 20th ISPRS Congress, volume XXXV (Part B4), series International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences, Istanbul, Turkey, pages 135–140.

[7] Izdebski W., Zwirowicz-Rutkowska A., Nowak da Costa J.: Open data in spatial data infrastructure: the practices and experiences of Poland, International Journal of Digital Earth, 2021 DOI: 10.1080/17538947.2021.1952323

[8] Kilpeläinen T. 2000. Maintenance of Multiple Representation Databases for Topographic Data, The Cartographic Journal, 37:2, 101-107, DOI: 10.1179/0008704.37.2.p101

[9] Kowalski P.J., Olszewski R., Bac-Bronowicz J. 2010. A Multiresolution, Reference and Thematic Database as the NSDI Component in Poland – The Concept and Management Systems [in:] Gartner G. and Ortag F. (Eds.): Lecture Notes in Geoinformation and Cartography, Cartography in Central and Eastern Europe Selected Papers of the 1st ICA Symposium on Cartography for Central and Eastern Europe, Springer-Verlag, Berlin – Heidelberg.

[10] Lupa M., Kozioł K. 2013. The use of merging and aggregation operators for MRDB data feeding. *Geoinformatica Polonica*. 12: 17-24.

[11] Olszewski R.2009. Distribution of Topographic Data in Geoinformation Services. Geomatics and Environmental Engineering.Vol.3, No.1/1

SECONDARY LITERATURE:

[1] ICA News www.icaci.org

[2] Geomatics and Environmental Enginneering. AGH

[3] Polish Cartographical Review

[4] Izdebski W.: Infrastruktura Danych Przestrzennych w Polsce. Geo-System Sp. z o.o., Warszawa 2020 Materiały do pobrania - Geoportal Krajowy

[5] Izdebski W.: Praktyczne aspekty Infrastruktury Danych Przestrzennych w Polsce. Geo-System Sp. z o.o., Warszawa 2020 - gugik.gov.pl .Materiały do pobrania - Geoportal Krajowy

[6] Izdebski W.: Infrastruktura Danych Przestrzennych w Polsce. Geo-System Sp. z o.o., Warszawa 2020 Materiały do pobrania - Geoportal Krajowy
[7] https://geoportal.dolnyslask.pl/imap/#gpmap=gp1
[8] https://www.geoportal.gov.pl/documents/10179/26435/Strategia+Harmonizacji+Infrastruktury+Informacji+Przestrzennej

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 78/2023
Attachment no. 4. to the Program of Studies

FACULTY OF GEOENGINEERING, MINING AND GEOLOGY

SUBJECT CARD

Name of subject in Polish	**Wybrane zagadnienia statystyki przestrzennej**
Name of subject in English	**Selected Aspects of Spatial Statistics**
Main field of study (if applicable):	**Geodesy and Cartography**
Specialization (if applicable):	**Geodata Engineering**
Profile:	**academic**
Level and form of studies:	**2nd, full-time**
Kind of subject:	**obligatory**
Subject code	**W06GIK-SM1037**
Group of courses	**NO**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	**15**		**30**		
Number of hours of total student workload (CNPS)					
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)	**0.92**		**1.36**		

*delete as not necessary

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. The student has basic knowledge and skills in geographic information systems
2. The student has basic knowledge of databases
3. The student has basic knowledge and skills in statistics
4. The student has basic skills in group work and presentation of own work results

SUBJECT OBJECTIVES

C1. To provide knowledge and skills in the application of spatial statistics for advanced analysis and description of the distribution of objects, phenomena and processes in space and time

C2. To acquire the ability to formulate and solve spatial tasks using advanced GIS analytical functions and to create simple algorithms in Python language

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge:

PEU_W01	The student has an expanded knowledge of advanced spatial data processing used in the analysis and modelling of natural and human related phenomena and processes.
PEU_W02	The student understands how to present and interpret the results of spatial analysis and draw conclusions based on them.
PEU_W03	The student knows examples of the use of spatial statistics in various industries

relating to skills:

PEU_U01	The student is capable to select methods and tools of spatial analysis depending on the nature of the problem under consideration.
PEU_U02	The student can formulate and solve spatial problems using open and commercial GIS software.
PEU_U03	The student Able to formulate and communicate knowledge of the use of geo-information systems in spatial analysis and presentation of their results.

relating to social competences:

PEU_K01	Is ready to behave in a professional manner and comply with the principles of professional ethics, and understands his responsibility for decisions taken. Has an awareness of the role of the surveyor in the tasks of the national economy
PEU_K02	Is ready to understand the importance of reliable performance of assigned tasks and the significance of the documentation produced, and has an awareness of the need for systematic self-education
PEU_K03	Is ready to work individually, cooperate in a group and manage the work of a team of people, as well as establish correct relations with outsiders in the performance of assigned tasks

PROGRAMME CONTENT

	Lecture	Number of hours
Lec 1	Presentation of the lecture and laboratory syllabus, credit conditions and applicable literature. Recall of basic concepts of geographic information systems	1
Lec 2	Network analysis in GIS. Theory and applications	2
Lec 3	Fundamentals of spatial statistics. Spatial measures of distribution. Theory and application examples	2
Lec 4	Identification and analysis of patterns and/or clusters. Theory and examples of applications.	2
Lec 5	Analysis of spatial relationships. Spatial regression. Global and local methods. Theory and applications	2
Lec 6	Random forest regression in regression and classification problems	2
Lec 7	Advanced map algebra problems. Path of least cost. Space-time cube. Multivariate analysis.	2
Lec 8	Repetition of the material	2
	Total hours	**15**

Laboratory		Number of hours
Lab1	Network analysis. Solving the agent routing problem.	2
Lab2	Network analyses. Allocation of resources.	2
Lab3	Network analyses. Determination of service area.	2
Lab4	Spatial statistics. Measures of spatial distribution.	2
Lab5	Spatial statistics. Identification and analysis of spatial patterns.	2
Lab6	Spatial statistics. Identification and analysis of clusters	2
Lab7	Analysis of spatial relationships. Global spatial regression methods	2
Lab8	Analysis of spatial relationships. Weighted spatial regression methods.	2
Lab9	Analysis of spatial relationships. Random forest regression	2
Lab10	Multivariate geostatistical analysis. Supervised classification	2
Lab11	Multivariate geostatistical analysis. Principal component analysis	2
Lab12	Analysis of a process using a spatio-temporal cube	2
Lab13	Map algebra. Solving the least cost path problem	2
Lab14	Repetition of the material	2
Lab15	Presentations of student assignments	2
	Total hours	**30**

TEACHING TOOLS USED	
N1.	Lecture with multimedia presentations and elements of problem lecture
N2.	Individual semester assignment
N3.	Reports on completed laboratory exercises (in digital form)
N4.	Tests
N5.	Self-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
F1	PEU_W01, PEU_W03, PEU_K01, PEU_K02	written/oral exam
F2	PEU_W02	Semester assignment
F3		
P1 = 0.8*F1 + 0.2*F2		
F3	PEU_U01, PEU_U02,	evaluation from tests
F4	PEU_U02,	evaluation from reports
F5	PEU_U03, PEU_K03	evaluation from presentations
P2 = (F3 + F4 + F5)/3		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] Paul A. Longley, Mike Goodchild, David J. Maguire, David W. Rhind. Geographic Information Systems & Science, 4th Edition, Wiley

[2] Andy Mitchell, Lauren Scott Griffin. The Esri Guide to GIS Analysis, Volume 2: Spatial Measurements and Statistics, 2nd Edition

[3] Lecture notes and laboratory instructions

SECONDARY LITERATURE:

[1] Andy Mitchell 2009. GIS Analysis. Spatial Measurements and Statistics. ESRI Press

[2] Lauren Bennett, Flora Vale Spatial Statistics Illustrated

[3] P. Zandbergen 2013. Python Scripting for ArcGIS. ESRI Press

[4] ESRI Academy, https://www.esri.com/training/

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

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

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

FACULTY OF GEOENGINEERING, MINING AND GEOLOGY

SUBJECT CARD

Name of subject in Polish	**Metodyka prowadzenia prac badawczych**
Name of subject in English	**Research Methodology**
Main field of study (if applicable):	**Geodesy and Cartography**
Specialization (if applicable):	**Geodata Engineering**
Profile:	**academic**
Level and form of studies:	**2nd, full-time**
Kind of subject:	**obligatory**
Subject code	**W06GIK-SM1038L**
Group of courses	**NO**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)			**15**		
Number of hours of total student workload (CNPS)			**25**		
Form of crediting (Examination / crediting with grade)			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)			**1**		
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)			**0.76**		

*delete as not necessary

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. None

SUBJECT OBJECTIVES

C1. Familiarization with the stages of conducting research work.
C2. Presentation of tools that support the presentation of research results.

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge:

PEU_W01 Knows the basic stages of conducting research.

relating to skills:

PEU_U01 Is able to use advanced text editors.

PEU_U02 Is able to prepare a bibliography in according to applicable rules.

PEU_U03 Is able to present the results of research work in a clear and understandable way.

relating to social competences:

PEU_K01 Is ready to behave in a professional manner and comply with the principles of professional ethics, and understands his responsibility for decisions taken. Has an awareness of the role of the surveyor in the tasks of the national economy

PEU_K02 Is ready to understand the importance of reliable performance of assigned tasks and the significance of the documentation produced, and has an awareness of the need for systematic self-education

PEU_K03 Is ready to work individually, cooperate in a group and manage the work of a team of people, as well as establish correct relations with outsiders in the performance of assigned tasks

PROGRAMME CONTENT		
Laboratory		**Number of hours**
Lab1	Introduction: purpose and range of the course, rules of participation, completion conditions.	1
Lab2	Stages of research work - planning and implementation. Thesis as a work of art.	4
Lab3	Editing a document. Typesetting and text composition. Graphic elements. Bibliography management.	4
Lab4	Presentation of research results – theory and practice.	4
Lab5	Summary of classes, comments on completed tasks.	2
	Total hours	**15**

TEACHING TOOLS USED

N1. Multimedia presentations
N2. Independent and/or group implementation of tasks based on guidelines
N3. Report on completed work in digital form
N4. Didactic discussion
N5. Own work (self-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
F1	PEU_U01, PEU_U02, PEU_K01, PEU_K02	Grade for an essay prepared according to established rules.
F2	PEU_W01, PEU_U03, PEU_K03	Grade for a presentation.

P1 – the final grade results from the arithmetic mean of the partial grades.

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] Misra, R. P. (1989). *Research Methodology: a Hand Book*. Concept Publishing Company.

[2] DePoy, E., & Gitlin, L. N. (2019). *Introduction to research E-book: understanding and applying multiple strategies*. Elsevier Health Sciences.

[3] Evans, D., Gruba, P., & Zobel, J. (2011). *How to write a better thesis*. Melbourne Univ. Publishing.

[4] Winsor, D. A. (2013). *Writing like an engineer: A rhetorical education*. Routledge.

SECONDARY LITERATURE:

[1] Mullins, G., & Kiley, M. (2002). It's a PhD, not a Nobel Prize': how experienced examiners assess research theses. *Studies in higher education*, *27*(4), 369-386

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

dr hab. inż. Katarzyna Pactwa, katarzyna.pactwa@pwr.edu.pl

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

FACULTY OF FUNDAMENTAL PROBLEMS OF TECHNOLOGY

SUBJECT CARD

Name of subject in Polish	**Elementy fizyki współczesnej**
Name of subject in English	**Elements of Modern Physics**
Main field of study (if applicable):	**Geodesy and Cartography**
Specialization (if applicable):	**Geodata Engineering**
Profile:	**academic**
Level and form of studies:	**2nd, full-time**
Kind of subject:	**obligatory**
Subject code	**W11GIK-SM1600W**
Group of courses	**NO**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	**15**				
Number of hours of total student workload (CNPS)	**25**				
Form of crediting (Examination / crediting with grade)	(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)	**0.7**				

*delete as not necessary

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge and skills in the field of Physics 1A or Physics 1B

SUBJECT OBJECTIVES

C1. Acquiring knowledge of selected fundamental laws of modern physics necessary to understand physical phenomena within the studied scientific discipline.

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge:

PEU_W01 The student has structured and theoretically based knowledge covering key issues regarding: particle-wave duality of light and matter, quantum mechanics, quantum description of multi-atomic systems, in particular the band structure of crystals, electro-optical properties of solids and principles of operation of modern selected semiconductor devices

relating to skills:

PEU_U01 The student is able to use the acquired knowledge, i.e. solve unusual problems;

relating to social competences:

PEU_K01 The student is ready to critically evaluate the received content

PROGRAMME CONTENT

Lecture		Number of hours
Lec 1	Wave-Particle Duality. Planck radiation law. De Broglie Waves.	2
Lec 2	Fundamentals of quantum mechanics. Wave function. The Heisenberg uncertainty principle.	2
Lec 3	The Schrodinger equation. Stationary states. Particle in a box. Potential barriers and tunneling. The scanning tunneling microscope.	2
Lec 4	The hydrogen atom. Quantum numbers. Spin. Many-electron atoms. Absorption and emission spectrum.	2
Lec 5	Types of molecular bonds. Structure of solids state. Band model of solids.	2
Lec 6	Insulators, Semiconductors, and Conductors.	2
Lec 7	Selected modern semiconductor devices.	2
Lec 8	Final test.	1
	Total hours	**15**

TEACHING TOOLS USED

N1. Traditional lecture with the use of multimedia presentations and physical laws/phenomena demonstrations
N2. Own work - self-preparation for the colloquium and exam
N3. 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_U01, PEU_K01	Test

PRIMARY AND SECONDARY LITERATURE
PRIMARY LITERATURE: [1] University Physics with Modern Physics, H. Young, R. Freedman.
SUBJECT SUPERVISOR (NAME AND SURNAME, E-MAIL ADDRESS)
Teacher from Faculty of Fundamental Problems of Technology

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

SUBJECT CARD

Name of subject in Polish	**Rozwiązywanie konfliktów i negocjacje**
Name of subject in English	**Conflict Resolution and Negotiations**
Main field of study (if applicable):	**Geodesy and Cartography**
Specialization (if applicable):	**Geodata Engineering**
Profile:	**academic**
Level and form of studies:	**2nd, full-time**
Kind of subject:	**university-wide**
Subject code	**W08GIK-SM0040C**
Group of courses	**NO**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)			**15**		
Number of hours of total student workload (CNPS)			**50**		
Form of crediting (Examination / crediting with grade)			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)			**1**		
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)			**0.7**		

*delete as not necessary

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge of communication.
2. Ability to work in a group and to cooperate.

SUBJECT OBJECTIVES

C1. Gaining knowledge in the field of effective communication and effective decision making.
C2. Ability to conduct negotiations, proper argumentation.
C3. Gaining knowledge in the field of generating methods of solving conflicts.

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge:

PEU_W01 [P7S_WK] Knows and understands the conditions (including economic) of undertaking various types of professional activities the basic principles of creation and development of various forms of entrepreneurship.

relating to skills:

PEU_U01 [P7S_UO] Is able to direct the work of a team.

PEU_U02 [P7S_UO] Is able to interact with others in teamwork and take a leading role in teams.

relating to social competences:

PEU_K01 [P7S_KO] Is ready to think and act in an enterprising manner.

Classes		Number of hours
Cl 1	Negotiations and conflict. Characteristics and components of negotiation situations. Case study.	2
Cl 2	Preparation of negotiations. Stages of negotiation, defining negotiation issues. Case study.	2
Cl 3	Positional negotiations. Characteristics. Techniques, styles and negotiation strategies. Case study.	2
Cl 4	Intergaining negotiations. Properties of the negotiations. Factors hindering the achievement of an integrative solution. Case study.	2
Cl 5	Team and communication in negotiations. Case study.	2
Cl 6	Managers' mistakes during negotiations. Case study.	2
Cl 7	Ways of resolving conflicts. Case study.	2
Cl 8	Summary of the classes. Discussion of the results. Discussion.	1
	Total hours	**15**

TEACHING TOOLS USED

N1. Studies of negotiation cases.
N2. Discussion with the participants.
N3. Own and group work.

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT

Evaluation (F – forming during semester), P – concluding (at semester end)	Learning outcomes code	Way of evaluating learning outcomes achievement
F1	PEU_K01	Case study, active participation in discussions
F2	PEU_U01, PEU_U02	Case study, team activity
F3	PEU_W01	Own and group work
P=0.6*F1+0.3*F2+0.1*F3		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] Kowalczyk E. (2021), Psychologia negocjacji. Psychologia negocjacji. Między nauką a praktyką zarządzania, Wydawnictwo Naukowe PWN, Warszawa

[2] Carre C. (2008), Sztuka rozwiązywania konfliktów, Wydawnictwo VIDEOGRAF II, Katowice

[3] Nęcki Z. (2013), Negocjacje w biznesie, Wydawnictwo Antywka

[4] Dawson R. (2018), Sekrety negocjacji dla biznesmenów, MT Biznes

SECONDARY LITERATURE:

[1] Lunden, B., Rosell L. (2014), Techniki negocjacji; Wydawnictwo BL Info Polska, Warszawa

[2] Fisher, R., Ury, W., Bruce, P. (2016), Dochodząc do tak. Negocjowanie bez poddawania się, PWE, Warszawa

[3] Witkowski, T, Chełpa, S. (2015), Psychologia konfliktów, Wydawnictwo Bez Maski. Wrocław

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

Beata Bajcar; beata.bajcar@pwr.edu.pl
Anna Borkowska; anna.borkowska@pwr.edu.pl
Radosław Ryńca; radosław.rynca@pwr.edu.pl

SEMESTER 2

Załącznik nr 6 do ZW 77/2023

Attachment no. 4. to the Program of Studies

WYDZIAŁ GEOINŻYNIERII, GÓRNICTWA i GEOLOGII

SUBJECT CARD

Name of subject in Polish:	**Techniki pozycjonowania GNSS**
Name of subject in English:	**GNSS Positioning Techniques**
Main field of study (if applicable):	**Geodesy and Cartography**
Specialization (if applicable):	**Geodata Engineering**
Profile:	**academic**
Level and form of studies:	**2nd, full-time**
Kind of subject:	**obligatory**
Subject code	**W06GIK-SM1039**
Group of courses	**NO**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	**15**		**30**		
Number of hours of total student workload (CNPS)	**25**		**75**		
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)	**0.92**		**1.40**		

*niepotrzebne skreślić

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Has basic knowledge about current satellite positioning systems. Has knowledge about spatial systems; global, regional, country and local. Knows file exchange formats used in GNSS such as RINEX or sp3.
2. Can perform static GNSS measurements of small networks. Can process technical documentation and interpret it. Is able to pick adequate measurement techniques to perform field works.

SUBJECT OBJECTIVES

C1. Has knowledge about relationship between global, country and local spatial systems.
C2. Knows background theory about GNSS systems and measurement techniques.
C3. Can perform all techniques measurements (static and kinematic).
C4. Can process GNSS data acquired during field works.

SUBJECT EDUCATIONAL EFFECTS

Relating to knowledge:

PEU_W01	Knows the ITRF and ETRF structure and components.
PEU_W02	Knows global satellite navigation systems as well as augmentation systems (SBAS) and the way they work.
PEU_W03	Has knowledge about GBAS, especially ASG-EUPOS including services available by this network
PEU_W04	Has theoretical background about GNSS surveying techniques and ways to process it.

Relating to skills:

PEU_U01	Can transform between any spatial systems and daums.
PEU_U02	Can perform RK (RTN) survey in any spatial system or datum. Can perform GNSS static, fast static, kinematic survey.
PEU_U03	Can process GNSS data in commercial and free software with different parameters (atmosphere, frequency combination etc), can also determine height in datums used in Europe.
PEU_U04	Can use ASG-EUPOS services for GNSS data processing.

Relating to social competences::

PEU_K01	Is ready to behave in a professional manner and comply with the principles of professional ethics, and understands his responsibility for decisions taken. Has an awareness of the role of the surveyor in the tasks of the national economy
PEU_K02	Is ready to understand the importance of reliable performance of assigned tasks and the significance of the documentation produced, and has an awareness of the need for systematic self-education
PEU_K03	Is ready to work individually, cooperate in a group and manage the work of a team of people, as well as establish correct relations with outsiders in the performance of assigned tasks

PROGRAMME CONTENT

Lecture		**Number of hours**
Lec 1	International terrestrial reference frame ITRF and its structure. Regional terrestrial refence frame ETRF and its realisation in Poland.	1
Lec 2	Global satellite positioning systems. Ground and satellite based augmentation systems (GBAS and SBAS).	2
Lec 3	Creation of geodetic networks in the legal aspect. ASG-EUPOS – structure, real time services.	2
Lec 4	ASG-EUPOS system – postprocessing services.	2
Lec 5	Postprocessing methods for point and network coordinates development.	2
Lec 6	GNSS leveling.	2
Lec 7	GNSS network usage as geodynamic and control purposes.	2
Lec 8	GNSS future developmetnt.	2
	Total hours.	**15**

Laboratory		Number of hours
Lab 1	Transformation between ITRF, ETRF and national spatial systems.	2
Lab 2	RTK and RTN horizontal and height survey with addition of GBAS corrections in global, national and local spatial systems and datums.	4
Lab 3	Static, fast static and kinematic measurement network survey.	6

Lab 4	Postprocessing of GNSS data in reference to national, regional and global networks in commercial and free software. Precise Point Positioning.	12
Lab 5	Satellite leveling.	4
Lab 6	Use of POZGEO and POZGEO-D in postprocessing.	2
	Total hours	**30**

TEACHING TOOLS USED	
N1	Traditional lecture with multimedia presentations
N2	Laboratory instructions in text form.
N3	Own work (self-study)
N4	Practical tests
N5	Digital reports of completed work
N6	Consultations

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW UCZENIA SIĘ

Evaluation (F – forming during semester), P – concluding (at semester end)	Learning outcomes code	Way of evaluating learning outcomes achievement
F1	PEU_W01, PEU_W02, PEU_W03, PEU_W04, PEU_K01-PEU_K02	Final exam grade
P1 = F1		
F2	PEU_U01, PEU_U02, PEU_U03, PEU_U04, PEU_K01-PEU_K03	Grade from assesment of reports
F3	PEU_U01, PEU_U04	Grade of test
P2 = (F2 + F3)/2		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] B. Hofmann-Wellenhof; H. Lichtenegger; E. Wasle, Gnss - Global Navigation Satellite Systems: Gps, Glonass, Galileo, and More, ISBN-13: 9783211730126, 2007

[2] Zhang Z. Yu W. Casula G., Precise GNSS Positioning and Navigation: Methods, Challenges, and Applications, Remote Sensing, 2023

[3] Van Sicle J., GPS and GNSS for Land Surveyors, ISBN 9781032521022

[4] Hofmann-Wellenhof B., Lichtenegger H., Collins J., Global Positioning System. Theory and Practice, ISBN-10: 3211825916

[5] Huibert-Jan L. GNSS Survey & Engineering: Handbook for Surveyors and Survey Engineers, Geomares Education, 2017

SECONDARY LITERATURE:

[6] Conference materials after 2010.

[7] Research articles in scientific journals

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

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

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

FACULTY OF GEOENGINEERING, MINING AND GEOLOGY

SUBJECT CARD

Name of subject in Polish	**Zastosowanie teledetekcji w ochronie środowiska**
Name of subject in English	**Application of Remote Sensing in Environmental Protection**
Main field of study (if applicable):	**Geodesy and Cartography**
Specialization (if applicable):	**Geodata Engineering**
Profile:	**academic**
Level and form of studies:	**2nd, full-time**
Kind of subject:	**obligatory**
Subject code	**W06GIK-SM1040**
Group of courses	**NO**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	**15**		**30**		
Number of hours of total student workload (CNPS)	**25**		**75**		
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)	**0.92**		**1.36**		

*delete as not necessary

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge and skills in remote sensing and digital image processing.
2. Ability to use basic office software, use online sources and edit reports documenting completed work.

SUBJECT OBJECTIVES

C1. Learning about remote sensing applications in selected environmental protection areas.
C2. Acquire practical skills in processing remote sensing data using cloud computing.
C3. Learning about methods of developing analyses for environmental protection using remote sensing imagery.

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge:

PEU_W01	Knowledge of the application of remote sensing data in environmental research and monitoring.
PEU_W02	Knowledge of available platforms that provide tools for cloud-based remote sensing data processing.
PEU_W03	Familiarity with open remote sensing data resources available in cloud computing platforms.

relating to skills:

PEU_U01	Ability to carry out analyses using remote sensing data for environmental protection purposes.
PEU_U02	Ability to view remotely sensed datasets and acquire satellite imagery using the data resource available in the cloud.
PEU_U03	Ability to visualise remote sensing data in a cloud environment using a scripting language.
PEU_U04	Ability to create colour compositions, perform arithmetic operations and carry out classification of satellite imagery in a cloud environment.
PEU_U05	Capability to filter and reduce satellite imagery collections and map features onto imagery collections.
PEU_U06	Ability to determine time series of pixel values of remote sensing products.

relating to social competences:

PEU_K01	Is ready to understand the advantages of cloud-based solutions in the processing of large data sets and the performance of analyses on a regional and global scale.
PEU_K02	Is ready to understand the benefits of using remote sensing imagery in environmental protection.
PEU_K03	Is ready to understand the need to support the engineer's professional work using available software tools and new technologies.
PEU_K04	Is ready to work systematically and independently to acquire knowledge.

PROGRAMME CONTENT

Lecture		Number of hours
Lec 1	Discussion of elements of the environment whose condition can be studied by remote sensing methods: terrain relief, soil cover, surface water and shallow groundwater, vegetation cover, atmosphere, climate. The subject of interdependence between components of the environment.	3
Lec 2	The effects of human economic activity on the environment.	2
Lec 3	Application of remote sensing to atmospheric research and monitoring. Monitoring of air quality and pollution levels.	2
Lec 4	Application of remote sensing to study and monitor climate change. Detecting changes in surface temperature, tracking atmospheric features, detecting changes in land cover resulting from climate change.	2
Lec 5	Application of remote sensing to the study and monitoring of surface water and hydrological conditions. Trophic status of waters. Recognition of water status: flooding, drought.	2
Lec 6	Application of remote sensing to forest environment research and monitoring.	2

Lec 7	Application of remote sensing to the study and monitoring of the anthropogenic environment. Urban heat island, light pollution, land cover.	2
	Total hours	**15**

Laboratory		**Number of hours**
Lab1	Presentation of the subject matter and content of the course. Discussion of the credit requirements. Introduction to the Google Earth Engine platform (creating an account, learning about the Code Editor interface).	2
Lab2	Introduction to the Google Earth Engine (GEE) API. Learning the basics of JavaScript necessary to work with the GEE API: JavaScript syntax, variables, data structures, functions, creating and running scripts.	2
Lab3	Image loading in GEE. Selecting bands of imagery and displaying imagery as layers on a map. Creation of colour compositions. Overview of remote sensing imagery collections available on the GEE platform.	4
Lab4	Image processing in GEE. Raster operations, masking, classification. Spectral indices.	4
Lab5	Working with image series in GEE. Filtering, mapping, reducing. Processing of imaging time series.	2
Lab6	Practical test 1: basics of remote sensing data processing in the Google Earth Engine cloud environment	2
Lab7	Application of remote sensing in environmental protection using GEE. Land Use Land Cover analysis.	2
Lab8	Application of remote sensing in environmental protection using GEE. Air pollution. Measurement of pollutant concentrations by remote sensing methods.	2
Lab9	Application of remote sensing in environmental protection using GEE. Wildfires. Monitoring of active fire areas. Estimating the effects of large-scale fires. Assessment of emissions of volatile substances into the atmosphere.	2
Lab10	Application of remote sensing in environmental protection using GEE. Monitoring of the hydrosphere. Groundwater measurements using GRACE. Analysis of surface water. Identification of areas at risk of drought.	2
Lab11	Application of remote sensing in environmental protection using GEE. Monitoring of forest degradation and tree cutting. Analysis of vegetation condition.	2
Lab12	Application of remote sensing in environmental protection using GEE. Analysis of urban environments: population, buildings, urban heat island. Analysis of night lighting imagery, light pollution.	2
Lab13	Practical test 2: selected applications of remote sensing in environmental protection	2
	Total hours	**30**

TEACHING TOOLS USED	
N1.	Traditional lecture with multimedia presentations
N2.	Laboratory instructions in text and hybrid form (text with programme code)
N3.	Own work (self-study)
N4.	Practical tests
N5.	Digital reports of completed work
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
P1	PEU_W01, PEU_W02, PEU_W03, PEU_K01-PEU_K04	Written exam
P1 - lecture final evaluation		
F1	PEU_U01 – PEU_U06	Grading of tests/quizzes
F2	PEU_U01 – PEU_U06, PEU_K01-PEU_K04	Assessment of reports
F3	PEU_U01 – PEU_U06	Practical tests
P2 = 0.3*mean(F1) + 0.2*mean(F2) + 0.5*mean(F3)		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] Cardille J. A., Crowley M. A., Saah D., Clinton N. E., Cloud-Based Remote Sensing with Google Earth Engine: Fundamentals and Applications, Springer International Publishing, 2023

[2] Lavender S., Lavender A., Practical Handbook of Remote Sensing, CRC Press, 2023

[3] Wu Q., Earth Engine and Geemap: Geospatial Data Science with Python, Locate Press, 2023

SECONDARY LITERATURE:

[1] Google Earth Engine training materials available at: https://developers.google.com/earth-engine/tutorials/tutorials

[2] Research articles in scientific journals such as: International Journal of Remote Sensing, International Journal of Applied Earth Observation and Geoinformation, Remote Sensing, Remote Sensing of Environment

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

dr hab. inż. Justyna Górniak-Zimroz, justyna.gorniak-zimroz@pwr.edu.pl
dr inż. Dariusz Głąbicki, dariusz.glabicki@pwr.edu.pl

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

FACULTY OF GEOENGINEERING, MINING AND GEOLOGY

SUBJECT CARD

Name of subject in Polish	**Analiza szeregów czasowych InSAR**
Name of subject in English	**InSAR Time Series Analysis**
Main field of study (if applicable):	**Geodesy and Cartography**
Specialization (if applicable):	**Geodata Engineering**
Profile:	**academic**
Level and form of studies:	**2nd, full-time**
Kind of subject:	**obligatory**
Subject code	**W06GIK-SM1041L**
Group of courses	**NO**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)			**45**		
Number of hours of total student workload (CNPS)			**75**		
Form of crediting (Examination / crediting with grade)			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)			**1.96**		

*delete as not necessary

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Has a basic knowledge of satellite radar interferometry.
2. Has the ability to perform SAR data calculations using the DInSAR method.

SUBJECT OBJECTIVES

C1. Ability to perform time series calculations of SAR data by methods: PSI and SBI.
C2. Ability to perform critical analysis of time series results and visualize the resulting spatial data.

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge:

PEU_W01 Knows the theoretical basis of time series processing by PSI and SBI techniques.

relating to skills:

PEU_U01 Has the ability to develop an API to search and retrieve large data sets.
PEU_U02 Can perform time series calculations of SAR data by methods: PSI and SBI.
PEU_U03 Can use parallel computing techniques with large SAR datasets.
PEU_U04 Can perform analysis of PSI and SBI results with GNSS results.

relating to social competences:

PEU_K01 Is ready to behave in a professional manner and comply with the principles of professional ethics, and understands his responsibility for decisions taken. Has an awareness of the role of the surveyor in the tasks of the national economy
PEU_K02 Is ready to understand the importance of reliable performance of assigned tasks and the significance of the documentation produced, and has an awareness of the need for systematic self-education
PEU_K03 Is ready to work individually, cooperate in a group and manage the work of a team of people, as well as establish correct relations with outsiders in the performance of assigned tasks

Laboratory		**Number of hours**
Lab1	Basics of SAR data time series calculations.	3
Lab2	Preparing an API for searching and retrieving large SAR datasets.	3
Lab3	Time series calculations using the PSI method.	9
Lab4	Time series calculations using the SBI method.	9
Lab5	Interferometric phase unwrapping in time series, parallel calculations.	6
Lab6	Include atmospheric delays in SAR data calculations with PSI and SBI methods.	3
Lab7	Integration of SAR time series with GNSS measurements.	3
Lab8	Individual time series calculations for the selected area, with analysis and visualization of the results.	9
	Total hours	**45**

TEACHING TOOLS USED

N1. Acquisition of geodata (spatial databases).
N2. Developing geodata (computational, graphical and descriptive).
N3. A report of the work performed in digital or paper form.
N4. Own work (self-study).
N5. 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

F1	PEU_W01, PEU_U04, PEU_U01, PEU_K01 – PEU_K02	Grades from tests
F2	PEU_U01 - PEU_U04, PEU_K01 - PEU_K03	Grades from reports
P1 = (arithmetic mean of F1 + arithmetic mean of F2)/2 converted to academic scale		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

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

[2] GMTSAR: An InSAR Processing System Based on Generic Mapping Tools (Second Edition), Sandwell i in., Scripps Institution of Oceanography, University of California, San Diego, La Jolla, CA, USA, 2016 (https://escholarship.org/uc/item/8zq2c02m)

[3] StaMPS Environment Documentation: https://homepages.see.leeds.ac.uk/~earahoo/stamps/StaMPS_Manual_v4.1b1.pdf

SECONDARY LITERATURE:

[1] ESA Documentation: https://earth.esa.int/eogateway/search?category=document+library

[2] Ferretti, A., Prati, C., Rocca, F., 2001. Permanent scatterers in SAR interferometry. IEEE Transactions on Geoscience and Remote Sensing 39, 8–20. https://doi.org/10.1109/36.898661

[3] Ferretti, A., 2014. Satellite InSAR data: reservoir monitoring from space, Education Tour Series CIS 9. EAGE Publications, Houten.

[4] Michele Crosetto, Lorenzo Solari, Satellite Interferometry Data Interpretation and Exploitation, Elsevier, 2023, https://doi.org/10.1016/B978-0-443-13397-8.00010-8

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

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

dr inż. Anna Kopeć, anna.kopec@pwr.edu.pl

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

FACULTY OF GEOENGINEERING, MINING AND GEOLOGY

SUBJECT CARD

Name of subject in Polish	**Uczenie maszynowe w teledetekcji**
Name of subject in English	**Machine Learning in Remote Sensing**
Main field of study (if applicable):	**Geodesy and Cartography**
Specialization (if applicable):	**Geodata Engineering**
Profile:	**academic**
Level and form of studies:	**2nd, full-time**
Kind of subject:	**obligatory**
Subject code	**W06GIK-SM1042**
Group of courses	**NO**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	**15**		**30**		
Number of hours of total student workload (CNPS)	**25**		**75**		
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)	**0.92**		**1.36**		

*delete as not necessary

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge and skills in remote sensing data processing.
2. Knowledge of linear algebra and statistics.
3. Basics of Python programming.

SUBJECT OBJECTIVES

C1. Learning the basic machine learning algorithms used in working with remote sensing data.
C2. Learning about methods for extracting spatial information from satellite imagery collections using machine learning algorithms.

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge:

PEU_W01	Familiarity with basic machine learning algorithms, including neural networks, used to work with remote sensing imagery.
PEU_W02	Understanding the process of training a machine learning model.
PEU_W03	Knowledge of techniques to assess the accuracy of machine learning models used for classification and regression.
PEU_W04	Familiarity with machine learning applications for working with point cloud data.

relating to skills:

PEU_U01	Ability to prepare a training dataset to train a machine learning model, based on satellite imagery and attribute data.
PEU_U02	Ability to perform land cover classification on satellite imagery using a machine learning model.
PEU_U03	Ability to use remote sensing data in a regression model to predict the value of the dependent variable.
PEU_U04	Capability to apply a model to detect objects on satellite imagery, with an assessment of accuracy.

relating to social competences:

PEU_K01	Is ready to behave in a professional manner and comply with the principles of professional ethics, and understands his responsibility for decisions taken. Has an awareness of the role of the surveyor in the tasks of the national economy
PEU_K02	Is ready to understand the need to increase the efficiency of working with large data sets through automation and the use of artificial intelligence algorithms.
PEU_K03	Is ready to work individually, cooperate in a group and manage the work of a team of people, as well as establish correct relations with outsiders in the performance of assigned tasks

PROGRAMME CONTENT

Lecture		Number of hours
Lec 1	Overview of machine learning applications for working with remote sensing data using selected examples. Overview of remote sensing data sources for the application of machine learning methods.	1
Lec 2	Introduction to machine learning. Data preparation, model learning, validation - basic concepts. Supervised and unsupervised learning, classification and regression. Discussion of selected machine learning algorithms.	2
Lec 3	Land Use Land Cover (LULC) classification using machine learning algorithms. Comparison of classification methods. Recall of the process of assessing the accuracy of LULC classification. Confusion matrix, precision, recall, type I and II errors.	2
Lec 4	Convolutional neural networks (CNNs) and the principle of their operation in working with satellite imagery. Discussion of selected CNN models.	2
Lec 5	The role of CNNs in the tasks of object detection, object classification and change detection in satellite imagery. Assessing the accuracy of object detection by a neural network model.	2
Lec 6	3D data processing using machine learning methods.	2

Lec 7	Discussing regression using machine learning methods. Application of regression methods in predicting the dependent variable from independent variables. Preparation of independent variables from attribute data and satellite imagery.	2
Lec 8	Recurrent neural networks (RNNs) and their application in remote sensing data processing. Processing of sequential data.	2
	Total hours	**15**

Laboratory		**Number of hours**
Lab1	Preparation of Python environment for working with machine learning algorithms, installation of libraries. Installation of the CUDA environment for parallel computing with Graphical Processing Units. Data preparation, image preprocessing, variable selection.	2
Lab2	Selected unsupervised learning algorithms. Clustering. Dimensionality reduction.	2
Lab3	Land Use Land Cover (LULC) classification of satellite imagery pixels by machine learning algorithms, assessment of classification accuracy.	2
Lab4	LULC classification of satellite imagery pixels using a neural network, evaluation of classification accuracy.	4
Lab5	Object classification in satellite imagery using machine learning algorithms. Assessment of classification accuracy, confusion matrix.	2
Lab6	Object detection in satellite imagery using neural networks. Accuracy assessment for object detection.	4
Lab7	Using machine learning methods to detect changes in satellite imagery taken over large time intervals.	2
Lab8	Application of machine learning methods to the analysis of point clouds from ground-based and airborne laser scanning.	4
Lab9	Predicting the values of phenomena based on remote sensing data and machine learning, using linear and non-linear regression. Calculation of regression accuracy measures.	4
Lab10	Processing of time series of selected variables acquired by remote sensing methods. Forecasting time series values by traditional methods and using machine learning. Calculation of time series forecasting accuracy metrics.	4
	Total hours	**30**

TEACHING TOOLS USED
N1. Traditional or remote lecture with multimedia presentations
N2. Geodata processing (computational, graphical and descriptive)
N3. Digital report of completed work
N4. Own work (self-study)
N5. 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
F1	PEU_W01 - PEU_W04 PEU_K01, PEU_K03	Written exam
P1 = F1		
F2	PEU_U01 - PEU_U04, PEU_K02	Assessments from reports

F3	PEU_U01 - PEU_U04, PEU_K02	Grading of tests/quizzes
P2 – 0.4*mean(F2) + 0.6*mean(F3)		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] Camps-Valls G., Tuia D., Zhu X. X., Reichstein M. (ed.), Deep Learning for the Earth Sciences: A Comprehensive Approach to Remote Sensing, Climate Science, and Geosciences, John Wiley & Sons Ltd, 2021

[2] Lavender S., Lavender A., Practical Handbook of Remote Sensing, CRC Press, 2023

[3] Raschka S., Mirjalili V., Python: Machine Learning, Helion, 2019

SECONDARY LITERATURE:

[1] Zhu X. X., Tuia D., Mou L., Xia G.-S., Zhang L., Xu F., Fraundorfer F., Deep Learning in Remote Sensing: A comprehensive review and list of resources, IEEE Geoscience and Remote Sensing Magazine, 2017

[2] Raschka S. Liu Y., Mirjalili V., Machine Learning with PyTorch and Scikit-Learn: Develop Machine Learning and Deep Learning Models with Python, Packt Publishing, 2022

[3] Stewart A. J., Robinson C., Corley I. A., Ortiz A., Lavista Ferres J. M., Benrjee A., TorchGeo: Deep Learning with Geospatial Data, SIGSPATIAL '22: Proceedings of the 30th International Conference on Advances in Geographic Information Systems, 2022

[4] satellite-image-deep-learning.com newsletter

[5] ESRI Training Materials

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

dr inż. Dariusz Głąbicki, dariusz.glabicki@pwr.edu.pl

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

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

FACULTY OF GEOENGINEERING, MINING AND GEOLOGY

SUBJECT CARD

Name of subject in Polish	**Systemy IoT**
Name of subject in English	**IoT Systems**
Main field of study (if applicable):	**Geodesy and Cartography**
Specialization (if applicable):	**Geodata Engineering**
Profile:	**academic**
Level and form of studies:	**2nd, full-time**
Kind of subject:	**Obligatory**
Subject code	**W06GIK-SM1043W**
Group of courses	**NO**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	**30**				
Number of hours of total student workload (CNPS)	**50**				
Form of crediting (Examination / crediting with grade)	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)	**1.36**				

*delete as not necessary

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge and skills acquired during the first level of engineering studies

SUBJECT OBJECTIVES

C1. Gaining knowledge about the basics of IoT technology and engineering
C2. Gaining knowledge about the applications and prospects of using IoT in geomatics

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge:

PEU_W01	Knows the concept of IoT and development trends of the IoT technology
PEU_W02	Knows components and the architecture of IoT systems
PEU_W03	Knows the advantages of IoT systems as complex geodetic measurement and information systems
PEU_W04	Knows fundamentals of the identification of linear dynamic systems.

relating to social competences:

PEU_K01	Is ready to behave in a professional manner and comply with the principles of professional ethics, and understands his responsibility for decisions taken. Has an awareness of the role of the surveyor in the tasks of the national economy
PEU_K02	Is ready to understand the importance of reliable performance of assigned tasks and the significance of the documentation produced, and has an awareness of the need for systematic self-education
PEU_K03	Is ready to work individually, cooperate in a group and manage the work of a team of people, as well as establish correct relations with outsiders in the performance of assigned tasks

PROGRAMME CONTENT

	Lecture	Number of hours
Lec 1	Geodetic measurement-information systems vs IoT	1
Lec 2	Geodetic measurement-information systems vs IoT con.	2
Lec 3	The concept of IoT architecture	2
Lec 4	Components of the IoT system	2
Lec 5	IoT sensors	2
Lec 6	IoT actuators	2
Lec 7	Test	2
Lec 8	Telecommunications and 5G technology	2
Lec 9	Application of IoT systems in geosciences	2
Lec 10	Introduction to the identification of natural dynamic systems	4
Lec 11	IoT in the identification of linear dynamic systems	4
Lec 11	Final test	2
	Total hours	**30**

TEACHING TOOLS USED

N1. Lecture or online lecture, including a multimedia presentation
N2. Self study
N3. Consultations
N4. Activity in class

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT

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

F1	PEU_W01 – PEU_W02, PEU_K01 – PEU_K02	Test
F2	PEU_W01 – PEU_W04, PEU_K01 – PEU_K02	Final test
F3	PEU_W01 – PEU_W04, PEU_K01 – PEU_K03	Activity in class
P = 0,2*F1 + 0,5*F2 + 0.3*F3		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] Bęcek, K. (2014). The Internet of Things: Are We at the Fringes of a Paradigm Shift in Geomatics? Proceedings of the FIG Congress, Kuala Lumpur, Malaysia 16-21 June 2014, http://www.fig.net/pub/fig2014/papers/ts01e/TS01E_becek_7042_abs.pdf.

[2] Bęcek, K. (2016). Real-time Mapping: Contemporary Challenges and the Internet of Things as the Way Forward. Geodesy and Cartography. Vol. 65, No 2, 2016, pp. 129-138.

SECONDARY LITERATURE:

[1] Eykhoff, P. (1974). System identification: Parameter and State Estimation. London: John Wiley & Sons.

[2] Selected papers from the following source page https://ieee-iotj.org/

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

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

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

FACULTY OF GEOENGINEERING, MINING AND GEOLOGY

SUBJECT CARD

Name of subject in Polish	**Wybrane zastosowania skaningu laserowego**
Name of subject in English	**Selected Applications of Laser Scanning**
Main field of study (if applicable):	**Geodesy and Cartography**
Specialization (if applicable):	**Geodata Engineering**
Profile:	**academic**
Level and form of studies:	**2nd, full-time**
Kind of subject:	**obligatory**
Subject code	**W06GIK-SM1044L**
Group of courses	**NO**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)			**45**		
Number of hours of total student workload (CNPS)			**75**		
Form of crediting (Examination / crediting with grade)			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)			**2.00**		

*delete as not necessary

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Has a knowledge of classic geodetic measurement techniques and is able to determine their accuracy
2. Knows the terrestrial reference frames and systems used in Poland
3. Has a knowledge of basic computer computation and visualization

SUBJECT OBJECTIVES

C1. Student develops skills and knowledge in the field of photogrammetric and remote sensing measurement techniques
C2. Ability to use terrestrial laser scanning in selected engineering and environmental application
C3. Student get to know the workflow of processing laser scanning data along with a preliminary assessment of their accuracy

SUBJECT EDUCATIONAL EFFECTS

relating to skills:

PEU_U01	Has the ability to process the mobile laser scanning data
PEU_U02	Has the ability to detect the components of scanning system
PEU_U03	Can download the LiDAR data from GUGiK databases
PEU_U04	Has the ability to visualize and process the LiDAR data
PEU_U05	Can use the LiDAR for engineering and environmental analysis

relating to social competences:

PEU_K01	Is ready to behave in a professional manner and comply with the principles of professional ethics, and understands his responsibility for decisions taken. Has an awareness of the role of the surveyor in the tasks of the national economy
PEU_K02	Is ready to understand the importance of reliable performance of assigned tasks and the significance of the documentation produced, and has an awareness of the need for systematic self-education
PEU_K03	Is ready to work individually, cooperate in a group and manage the work of a team of people, as well as establish correct relations with outsiders in the performance of assigned tasks

PROGRAMME CONTENT

Laboratory		Number of hours
Lab1	LiDAR databases in Head Office of Geodesy and Cartography (GUGiK)	3
Lab2	Airborne laser scanning visualization and processing	3
Lab3	LiDAR point clouds calassification	3
Lab4	Application of LiDAR data	3
Lab5	LiDAR data in Smart City	3
Lab6	Mobile Laser Scanning data post-processing	9
Lab7	MLS and ALS data integration	3
Lab8	Preliminary accuracy assessment of LiDAR data models	3
Lab9	Infrastructure and vegetation collision detection using LiDAR	9
Lab10	Point cloud-based change detection	6
	Total hours	**45**

TEACHING TOOLS USED

N1. Acquisition of geodata (spatial databases).
N2. Developing geodata (computational, graphical and descriptive)
N3. A report of the work performed in digital or paper form
N4. Own work (self-study)
N5. 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
F1	PEU_U01-PEU_U05, PEU_K01-PEU_K03	Grades from reports

F2	PEU_U01-PEU_U05, PEU_K01	Grades from tests
P1 = 0,33*(arithmetic mean of F1) + 0,67*F2		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] Pfeifer, N., & Mandlburger, G. (2018). LiDAR data filtering and digital terrain model generation. In Topographic laser ranging and scanning (pp. 349-378). CRC Press.

[2] Vosselman G., Mass H-G., 2010. Airborne and Terrestrial Laser Scanning, Whittles Publishing, UK

[3] Wężyk P. (Ed.), 2014. Manual for participants of training in the use of LiDAR products. Warszawa

SECONDARY LITERATURE:

[1] Shan, J., & Toth, C. K. (2018): Topographic laser ranging and scanning: principles and processing. CRC pressxxx

[2] Fernandez-Diaz, J. C., Carter, W. E., Shrestha, R. L., & Glennie, C. L. (2014). : Now you see it… now you don't: Understanding airborne mapping LiDAR collection and data product generation for archaeological research in Mesoamerica. Remote Sensing, 6(10), 9951-10001.

[3] Hebel, M., Arens, M., & Stilla, U. (2013). Change detection in urban areas by object-based analysis and on-the-fly comparison of multi-view ALS data. ISPRS Journal of Photogrammetry and Remote Sensing, 86, 52-64.

[4] http://szkolenialidar.gugik.gov.pl/

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

dr inż. Jarosław Wajs, jaroslaw.wajs@pwr.edu.pl

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

FACULTY OF GEOENGINEERING, MINING AND GEOLOGY

SUBJECT CARD

Name of subject in Polish	**Analiza i harmonizacja danych przestrzennych**
Name of subject in English	**Analysis and Harmonization of Spatial Data**
Main field of study (if applicable):	**Geodesy and Cartography**
Specialization (if applicable):	**Geodata Engineering**
Profile:	**academic**
Level and form of studies:	**2nd, full-time**
Kind of subject:	**obligatory**
Subject code	**W06GIK-SM1045L**
Group of courses	**NO**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)			**30**		
Number of hours of total student workload (CNPS)			**75**		
Form of crediting (Examination / crediting with grade)			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)			**1.36**		

*delete as not necessary

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Student knows models and formats for spatial data storage and the associated terminology.
2. Student is familiar with sources of digital geographic data and databases.
3. Student understands the basics of applicable standards and norms in the field of spatial data recording.

SUBJECT OBJECTIVES

C1. The aim is to present the principles and practical methods of feeding spatial information systems with data.

C2. Understanding the technical, organizational, and legal principles intended to achieve mutual coherence of spatial data sets and geoinformation services.

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge:

PEU_W01 Student is familiar with the principles of spatial information systems functioning and the possibilities of utilizing data gathered in these systems.

relating to skills:

PEU_U01 Student can perform basic and complex spatial analyses, create spatial metadata, and effectively use these metadata.

PEU_U02 The student can assess the quality and suitability of geospatial data.

PEU_U03 The student is capable of integrating, filtering, and validating geospatial data.

relating to social competences:

PEU_K01 Is ready to behave in a professional manner and comply with the principles of professional ethics, and understands his responsibility for decisions taken. Has an awareness of the role of the surveyor in the tasks of the national economy

PEU_K02 Is ready to understand the importance of reliable performance of assigned tasks and the significance of the documentation produced, and has an awareness of the need for systematic self-education

PEU_K03 Is ready to work individually, cooperate in a group and manage the work of a team of people, as well as establish correct relations with outsiders in the performance of assigned tasks

PROGRAMME CONTENT

Laboratory		Number of hours
Lab1	Introduction to the FME Platform – theoretical concepts and familiarization with the FME form components interface	4
Lab2	Creating and Understanding Metadata for Data Assessment and Localization	4
Lab3	Data Integration and Filtering, Working with Databases. Data Integration and Generalization Using FME	4
Lab4	Advanced Attribute Work and Script Parameterization	4
Lab5	Data Validation – Attribute and Geometric	4
Lab6	Utilizing Data Provided by Internet Services – APIs, WMS, WFS, and Others	4
Lab7	Working with Raster Data	4
Lab8	Introduction to FME Server	4
	Total hours	**30**

TEACHING TOOLS USED

N1. Exercise Instructions
N2. Acquisition of Geospatial Data (Spatial Databases)
N3. Processing Geospatial Data (Computational, Graphic, and Descriptive)
N4. Report or Documentation of Completed Work in Digital or Paper Form
N5. Independent Work (Self-Education)

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
F1	PEU_W01, PEU_U01 - PEU_U03	Grades for Quizzes/Tests
F2	PEU_W01, PEU_U01 - PEU_U03, PEU_K01 - PEU_K03	Evaluation for Reports
F3	PEU_U01, PEU_K01, PEU_K02, PEU_K03	Assessment for Timeliness in Completing Individual Stages of the Report
P1 = 0,3*F1 + 0,4*F2 + 0,3*F3		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

Tomas Mildorf, Jan Jezek, Otakar Cerba, Christian Malewski, Simon Templer, Michal Sredl, Karel Charvat, 2014. Open Data Platform for Data Integration, Visualisation and Map Design. In T. Bandrova, M. Konecny, & S. Zlatanova, eds. Thematic Cartography for the Society. Lecture Notes in Geoinformation and Cartography. Springer International Publishing, pp. 3–11.

SECONDARY LITERATURE:

https://fme.safe.com/platform/

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

dr inż. Joanna Krupa-Kurzynowska, joanna.krupa-kurzynowska@pwr.edu.pl,
mgr inż. Aleksandra Kozłowska-Woszczycka, aleksandra.kozlowska-woszczycka@pwr.edu.pl

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

FACULTY OF GEOENGINEERING, MINING AND GEOLOGY

SUBJECT CARD

Name of subject in Polish	**Seminarium dyplomowe I**
Name of subject in English	**Graduate Seminar I**
Main field of study (if applicable):	**Geodesy and Cartography**
Specialization (if applicable):	**Geodata Engineering**
Profile:	**academic**
Level and form of studies:	**2nd, full-time**
Kind of subject:	**optional**
Subject code	**W06GIK-SM1046S**
Group of courses	**NO**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)					**15**
Number of hours of total student workload (CNPS)					**50**
Form of crediting (Examination / crediting with grade)					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)					**2**
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)					**0.76**

*delete as not necessary

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knows the basic stages of conducting research work

SUBJECT OBJECTIVES

C1. Obtain the ability to seek the selective knowledge necessary to create their own original solutions.
C2. Gain the ability to prepare a presentation to communicatively convey to the audience the current state of knowledge for a selected issue in the field.
C3. Acquire the ability to conduct substantive and creative discussions in the area of research work.

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge:

PEU_W01 Is familiar with selected trends and new developments in the field of geodesy and cartography, with a particular focus on geodata processing. xxxxx

relating to skills:

PEU_U01 Can obtain specialized information from traditional and electronic information sources.

PEU_U02 Able to critically evaluate the acquired information and present the results of the literature review in a concise and organized form.

PEU_U03 Can, in a principled manner, prepare a multimedia presentation.

relating to social competences:

PEU_K01 Is ready to engage in substantive and critical discussion of selected specialized issues in the field of surveying and cartography.

PEU_K02 Is ready to understand the importance of reliable performance of assigned tasks and the significance of the documentation produced, and has an awareness of the need for systematic self-education

PEU_K03 Is ready to work individually, cooperate in a group and manage the work of a team of people, as well as establish correct relations with outsiders in the performance of assigned tasks

Seminar		**Number of hours**
Semin1	Introduction: purpose and scope of the course, rules of participation, conditions for passing.	1
Semin2	Discuss the topic of students' research studies, how to study the literature, prepare research documentation and presentations.	4
Semin3-6	Individual presentations on the discussion of the current state of knowledge related to the problems of the thesis and the expected original own contribution to the achievements of the literature.	8
Semin7	Summary of classes. Passing.	2
	Total hours	**15**

TEACHING TOOLS USED

N1. Multimedia presentations
N2. Disscussion
N3. Own work (self-study)
N4. Consultation

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT

Evaluation (F – forming during semester), P – concluding (at semester end)	Learning outcomes code	Way of evaluating learning outcomes achievement
F1	PEU_W01	Evaluation of the content of the presentation
F2	PEU_U01, PEU_02, PEU_U03	Evaluation of the form of speech and the quality of the presentation

F3	PEU_K01, PEU_K2, PEU_K03	Active participation in the problem discussion
P1 = (F1+F2+F3)/3		

PRIMARY AND SECONDARY LITERATURE
PRIMARY LITERATURE: [1] Gruba P., Zobel J., How To Write Your First Thesis, Springer, 2017 [2] Murray R. How to Write a Thesis, Open University Press, 2017 **SECONDARY LITERATURE:** [1] Specialized literature agreed with the supervisor.
SUBJECT SUPERVISOR (NAME AND SURNAME, E-MAIL ADDRESS)
Teachers of individual groups in the subject: Diploma Seminar I Subject card development: dr Anna Kopeć, anna.kopec@pwr.edu.pl

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

FACULTY OF GEOENGINEERING, MINING AND GEOLOGY

SUBJECT CARD

Name of subject in Polish	**Kształtowanie kultury pracy**
Name of subject in English	**Work Culture Shaping**
Main field of study (if applicable):	**Geodesy and Cartography**
Specialization (if applicable):	**Geodata Engineering**
Profile:	**academic**
Level and form of studies:	**2nd, full-time**
Kind of subject:	**obligatory**
Subject code	**W06GIK-SM1047P**
Group of courses	**NO**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)				**30**	
Number of hours of total student workload (CNPS)				**50**	
Form of crediting (Examination / crediting with grade)				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)				**1.52**	

*delete as not necessary

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Ability to use a text editor and software to prepare a multimedia presentation.

SUBJECT OBJECTIVES

C1. Presentation of the importance of organization culture shaping.
C2. Presenting examples of solutions for the proper functioning of companies in terms of work culture.

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge:

PEU_W01 The student knows the issue of "work culture" and the basic concepts related to it.

relating to skills:

PEU_U01 The student is able to construct statements taking into account 4 levels of communication

PEU_U02 The student is able to consciously select means to influence employee motivation

PEU_U03 The student is able to identify undesirable phenomena in the organization and take remedial actions

PEU_U04 The student is able to present good practices in managing diversity in the workplace

relating to social competences:

PEU_K01 Is ready to work individually, cooperate in a group and manage the work of a team of people and establish good relationships with other people while performing assigned tasks

PROGRAMME CONTENT

	Project	**Number of hours**
Proj 1	Introduction to the classes, presentation of the rules of participation and passing conditions. Syllabus. Basic concepts related to the subject matter.	2
Proj 2	Employee participation. Work management: Motivational forms of work organization (constructing a message, factors limiting effective communication, selection of motivators).	8
Proj 3	Principles of work organization. Employee interests and their protection. Negotiations, negotiation strategies.	6
Proj 4	Dysfunctions in the organization. Mobbing in the workplace.	6
Proj 5	Well-being in the organization. Diversity management.	6
Proj 6	Summary of classes, comments on completed tasks.	2
	Total hours	**30**

TEACHING TOOLS USED

N1. Multimedia presentations
N2. Independent and/or group implementation of tasks based on guidelines
N3. Report on completed work in digital or paper form
N4. Didactic discussion
N5. Own work (self-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
F1	PEU_W01, PEU_U02, PEU_U03	Grades for reports
F2	PEU_U01, PEU_U04, PEU_K01	Presentation grades
F3	PEU_U01, PEU_U02, PEU_U03, PEU_U04, PEU_K01	Participation in discussions during classes
P1 – the final grade results from the arithmetic mean of the partial grades		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] Guirdham M., Guirdham O. (2017) Communicating across cultures at work, p. 266
[2] Alvesson, M. (2012). Understanding organizational culture. Sage Publications Ltd, 1-248
[3] Psimmenos I. (1997) Globalisation and employee participation. Aldershot: Ashgate.
[4] The Labour Code

SECONDARY LITERATURE:

[1] Scientific journals

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

dr hab. inż. Katarzyna Pactwa, katarzyna.pactwa@pwr.edu.pl

SEMESTER 3

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

FACULTY OF GEOENGINEERING, MINING AND GEOLOGY

SUBJECT CARD

Name of subject in Polish	**Zarządzanie projektami geoinformacyjnymi**
Name of subject in English	**Geoinformation Project Management**
Main field of study (if applicable):	**Geodesy and Cartography**
Specialization (if applicable):	**Geodata Engineering**
Profile:	**academic**
Level and form of studies:	**2nd, full-time**
Kind of subject:	**obligatory**
Subject code	**W06GIK-SM1048L**
Group of courses	**NO**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)			**30**		
Number of hours of total student workload (CNPS)			**50**		
Form of crediting (Examination / crediting with grade)			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)			**2**		
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)			**1.36**		

*delete as not necessary

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge of economics
2. Basic knowledge of how GIS systems work

SUBJECT OBJECTIVES

C1. Acquiring a basic knowledge of project management - approaches, methodologies, methods and tools.
C2. Acquiring the ability to select the project management methodology according to the project characteristics.
C3. Acquiring a competence to think and act in a design way.

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge:

PEU_W01 Has knowledge of project management methodologies. Knows the main processes involved in project management and planning.

relating to skills:

PEU_U01 Has the ability to apply methods and tools to support project planning and management.

PEU_U02 Has the ability to select competencies in project teams - their roles and resources.

PEU_U03 Can define and solve problems using a creative approach.

relating to social competences:

PEU_K01 Is ready to act and think creatively.

PEU_K02 Is ready to present the results of his work in a concise and understandable manner

PEU_K03 Is ready to work individually, cooperate in a group and manage the work of a team of people, as well as establish correct relations with outsiders in the performance of assigned tasks

Laboratory		Number of hours
Lab1	Introduction to project management, project structure. Project management in its life cycle.	2
Lab2	Project management methodologies: traditional, hybrid, agile.	2
Lab3	Project card - introduction, analysis of the problem, environment and stakeholders.	2
Lab4	Project card - background, objectives and scope of the project, products.	2
Lab5	Project card - limitations and assumptions.	2
Lab6	Project card - the formula and implementation structure of the project.	2
Lab7	Project card - risk assessment.	2
Lab8	Project card - scheduling, delays, project tracking.	4
Lab9	Budget of the project.	2
Lab10	Competencies in a project team. Roles in project teams.	2
Lab11	Agile project management.	4
Lab12	Creative problem solving - design thinking.	4
	Total hours	**30**

TEACHING TOOLS USED

N1. Multimedia presentation.
N2. Workshop exercises.
N3. Team work - development of project card.
N4. Own work (self-study).
N5. 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
F1	PEU_W01	Grades from tests.
F2	PEU_U01, PEU_U02, PEU_U03, PEU_K01, PEU_K02, PEU_K03	Grades from results of group workshop exercises.
F3	PEU_U01, PEU_U02, PEU_K01, PEU_K02, PEU_K03	Grade from the project cart.
P1 = 0.2*F1 + 0.3*F2 + 0.5*F3		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] Nicholas, J. M., Steyn, H. (2008). Project management for business, engineering, and technology : principles and practice. Boston: Routledge.

[2] Lock, D. (2020). Project Management. Wielka Brytania: Taylor & Francis.

SECONDARY LITERATURE:

[1] PMI, 2017. A Guide to the Project Management Body of Knowledge: PMBOK® Guide (Sixth Edition). Project Management Institute

[2] Holdbrook, P. (2016). Prince2 for Beginners : For Certification and Study Guide for Project Management. Turcja: Paul Holdbrook.

[3] Polskie wytyczne kompetencji IPMA wersja 4.0, Stowarzyszenie Project Menagment Polska, 2019

[4] Dekker, T. d. (2020). Design Thinking. Holandia: Taylor & Francis.

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

mgr inż. Natalia Bugajska-Jędraszek, natalia.bugajska@pwr.edu.pl

dr inż. Anna Kopeć, anna.kopec@pwr.edu.pl

dr inż. Joanna Krupa-Kurzynowska, joanna.krupa-kurzynowska@pwr.edu.pl

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

FACULTY OF GEOENGINEERING, MINING AND GEOLOGY

SUBJECT CARD

Name of subject in Polish	**Modele i języki wymiany geodanych**
Name of subject in English	**Models and Languages for Geodata Exchange**
Main field of study (if applicable):	**Geodesy and Cartography**
Specialization (if applicable):	**Geodata Engineering**
Profile:	**academic**
Level and form of studies:	**2nd, full-time**
Kind of subject:	**obligatory**
Subject code	**W06GIK-SM1049L**
Group of courses	**NO**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)			**30**		
Number of hours of total student workload (CNPS)			**50**		
Form of crediting (Examination / crediting with grade)			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)			**2**		
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)			**1.36**		

*delete as not necessary

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. The student has basic knowledge and skills in geographic information systems
2. The student has basic knowledge of databases
3. The student has basic skills in group work and presentation of own work results

SUBJECT OBJECTIVES

C1. To provide skills in the fundamentals of object-oriented modelling, spatial data standardization, and a structured approach to building geoinformatics systems, including UML notation and the creation of entity relationship diagrams and application schemas.
C2. To learn how to model geometry and topology.
C3. To get to know basics of data interchange languages, XML and GML, and the structure of an XML document.

SUBJECT EDUCATIONAL EFFECTS

relating to skills:

PEU_U01	The student is able to define and describe the basic concepts of XML, GML and UML class diagrams
PEU_U02	The student is capable to create entity relationship diagram and build UML diagram and represent spatial data in GML language
PEU_U03	The student can define the requirements for a designed spatial information system.

relating to social competences:

PEU_K01	Is ready to behave in a professional manner and comply with the principles of professional ethics, and understands his responsibility for decisions taken. Has an awareness of the role of the surveyor in the tasks of the national economy
PEU_K02	Is ready to understand the importance of reliable performance of assigned tasks and the significance of the documentation produced, and has an awareness of the need for systematic self-education
PEU_K03	Is ready to work individually, cooperate in a group and manage the work of a team of people, as well as establish correct relations with outsiders in the performance of assigned tasks

Laboratory		**Number of hours**
Lab1	Presentation of the course syllabus, credit requirements and literature. Recall of basic concepts of geographic information systems and spatial information infrastructure.	2
Lab2	Basics of XML syntax, elements and attributes	2
Lab3	XML Schema	2
Lab4	UML basics	2
Lab5	UML class diagrams	2
Lab6	XML editors and parsers	2
Lab7	GML: simple geometric objects	2
Lab8	GML: spatial reference systems	2
Lab9	GML: geometric models, GML diagrams	2
Lab10	LinkedData basics	2
Lab11	Building a UML application diagram for a specific domain 1/3	2
Lab12	Building a UML application diagram for a specific domain 2/3	2
Lab13	Building a UML application diagram for a specific domain 3/3	2
Lab14	Repetition of the material	2
Lab15	Presentations of student assignments	2
	Total hours	**30**

TEACHING TOOLS USED

N1. Individual semester assignment
N2. Reports on completed laboratory exercises (in digital form)
N3. Tests
N4. Self-study
N5. 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
F1	PEU_U01, PEU_U02, PEU_U03	evaluation from tests
F2	PEU_U01, PEU_U02, PEU_U03, PEU_K01, PEU_K02	evaluation from reports
F3	PEU_U01, PEU_U02, PEU_U03, PEU_K03	evaluation from presentations
P1 = arithmetic mean of the formative assessments (F1, F2, F3)		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] Ostman A., Basic concepts of XML and GML. Geospatial Knowledge Base (GKB) Training Platform, https://inspire.ec.europa.eu/training/basic-concepts-xml-and-gml

[2] OGC® Geography Markup Language (GML) – Extended schemas and encoding rules, https://www.ogc.org/standard/gml/

[3] The Unified Modeling Language Specification Version 2.0 https://www.omg.org/spec/UML/2.0/About-UML

[4] Laboratory notes and instructions

SECONDARY LITERATURE:

[1] Parzyński Z., Chojka A. Infrastruktura informacji przestrzennej w UML. Wydawnictwo Geodeta, 2013 (in Polish)

[2] Pachelski W. Modelowanie informacji geograficznej. Podstawy, (W) Modelowanie danych przestrzennych. Roczniki Geomatyki, Tom VIII, Zeszyt 40 (4), Warszawa (in Polish)

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

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

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

FACULTY OF GEOENGINEERING, MINING AND GEOLOGY

SUBJECT CARD

Name of subject in Polish	**WebGIS**
Name of subject in English	**WebGIS**
Main field of study (if applicable):	**Geodesy and Cartography**
Specialization (if applicable):	**Geodata Engineering**
Profile:	**academic**
Level and form of studies:	**2nd, full-time**
Kind of subject:	**obligatory**
Subject code	**W06GIK-SM1050L**
Group of courses	**NO**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)			**30**		
Number of hours of total student workload (CNPS)			**50**		
Form of crediting (Examination / crediting with grade)			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)			**2**		
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)			**1.36**		

*delete as not necessary

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Has basic knowledge of acquiring and processing spatial data in a GIS environment and storing it in spatial databases.
2. Proficiently can use GIS software.
3. Knows the basics of programming.

SUBJECT OBJECTIVES

C1. Acquire the ability to prepare geodata for sharing in spatial data services.
C2. Acquire the ability to develop spatial data services and optimize them.

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge:

PEU_W01 Has an expanded knowledge of the use of available GIS environments in the presentation of spatial data on the Internet.

PEU_W02 Knows current solutions in map portal development techniques. Knows the most important free standards for geodata and services.

relating to skills:

PEU_U01 Can develop the design of a simple, in terms of functionality, map portal.

PEU_U02 Can process spatial data for presentation on the Internet.

PEU_U03 Has the ability to perform optimization of the operation of a spatial data service based on open source solutions.

PEU_U04 Can develop tools designed to perform simple spatial analysis from a web site.

PEU_U05 Has the ability to implement external libraries into the structure of a spatial data service to improve its efficiency and scope of use.

relating to social competences:

PEU_K01 Is ready to behave in a professional manner and comply with the principles of professional ethics, and understands his responsibility for decisions taken. Has an awareness of the role of the surveyor in the tasks of the national economy

PEU_K02 Is ready to understand the importance of reliable performance of assigned tasks and the significance of the documentation produced, and has an awareness of the need for systematic self-education

PEU_K03 Is ready to work individually, cooperate in a group and manage the work of a team of people, as well as establish correct relations with outsiders in the performance of assigned tasks

Laboratory		Number of hours
Lab1	Mapserver/GeoServer/QGIS, OGC standards - introduction classes.	2
Lab2	MapServer - launching and configuring a spatial data server.	2
Lab3	MapServer - development of spatial data in .map file structure.	4
Lab4	GeoServer - launch and configuration of spatial data server.	2
Lab5	Geoserver - using and sharing a database in WebGIS.	4
Lab6	Mapserver/GeoServer - optimize the display of spatial data using tiles.	2
Lab7	Introduction to the Leaflet library - creating an interactive map, adding layers, plugins and additional functionality.	4
Lab8	Introduction to the OpenLayers library - creating an interactive map, adding layers, plugins and additional functionality.	4
Lab9	Development of a thematic map portal.	6
	Total hours	**30**

TEACHING TOOLS USED

N1. Acquisition of geodata (spatial databases).

N2. Developing geodata (computational, graphical and descriptive).

N3. A report of the work performed in digital or paper form.

N4. Own work (self-study).

N5. 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
F1	PEU_W01, PEU_W02, PEU_U01 – PEU_U05, PEU_K01, PEU_K02	Grades from reports
F2	PEU_U01 – PEU_U05, PEU_K03	Grade from the developed map portal
P1 = (arithmetic mean of F1 + F2)/2		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] MapServer Documentation: https://mapserver.org/documentation.html
[2] Geoserver Documentation: https://docs.geoserver.org/
[3] Leaflet Documentation: https://leafletjs.com/reference.html
[4] OpenLayers Documentation: https://openlayers.org/doc/

SECONDARY LITERATURE:

[1] Concepts & Applications of Web GIS, Anuj Tiwari, Kamal Jain, Nova Science Publishers Inc., 2017
[2] Getting to Know Web GIS, fifth edition, Pinde Fu, Publisher: Esri Press; Fifth edition, 2022
[3] Brooks, David R. *Guide to HTML, JavaScript and PHP For Scientists and Engineers*. 1st ed. 2011. London: Springer London, 2011. Web.

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

dr inż. Anna Kopeć, anna.kopec@pwr.edu.pl
dr hab. inż. Wojciech Milczarek, wojciech.milczarek@pwr.edu.pl

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

FACULTY OF GEOENGINEERING, MINING AND GEOLOGY

SUBJECT CARD

Name of subject in Polish	**Seminarium dyplomowe II**
Name of subject in English	**Graduate Seminar II**
Main field of study (if applicable):	**Geodesy and Cartography**
Specialization (if applicable):	**Geodata Engineering**
Profile:	**academic**
Level and form of studies:	**2nd, full-time**
Kind of subject:	**optional**
Subject code	**W06GIK-SM1051S**
Group of courses	**NO**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)					**30**
Number of hours of total student workload (CNPS)					**50**
Form of crediting (Examination / crediting with grade)					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)					**2**
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)					**1.36**

*delete as not necessary

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knows the basic stages of conducting research work

SUBJECT OBJECTIVES

C1. Development of the ability to elaborate, critically evaluate and present the results of experimental research and study work.
C2. Gain the ability to take a critical and comprehensive view of the issues studied and engineering problems solved.

SUBJECT EDUCATIONAL EFFECTS

relating to skills:

PEU_U01	Is able to develop a presentation including the results of own work and applied solutions.
PEU_U02	Can justify the solutions used in his work.
PEU_U03	Is able to critically evaluate the scientific and technical solutions of others.

relating to social competences:

PEU_K01	Is ready to engage in substantive and critical discussion of selected specialized issues in the field of surveying and cartography.
PEU_K02	Is ready to understand the importance of reliable performance of assigned tasks and the significance of the documentation produced, and has an awareness of the need for systematic self-education
PEU_K03	Is ready to work individually, cooperate in a group and manage the work of a team of people, as well as establish correct relations with outsiders in the performance of assigned tasks

Seminar		**Number of hours**
Semin1	Introduction: purpose and scope of the course, rules of participation, conditions for passing.	2
Semin2	Discuss the principles of preparing and writing a thesis, and in particular, present the editorial rules.	4
Semin3-14	Individual presentations on the discussion of the obtained results realized in the implementation of the thesis. Discussion in the seminar group.	22
Semin15	Summary of classes. Passing.	2
	Total hours	**30**

TEACHING TOOLS USED

N1. Multimedia presentations
N2. Disscussion
N3. Own work (self-study)
N4. Consultation

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT

Evaluation (F – forming during semester), P – concluding (at semester end)	Learning outcomes code	Way of evaluating learning outcomes achievement
F1	PEU_U01, PEU_02, PEU_U03	Evaluation of the content of the presentation
F2	PEU_U01, PEU_02, PEU_U03	Evaluation of the form of speech and the quality of the presentation
F3	PEU_K01, PEU_K02, PEU_K03	Active participation in the problem discussion
P1 = (F1+F2+F3)/3		

PRIMARY AND SECONDARY LITERATURE
PRIMARY LITERATURE: [1] Gruba P., Zobel J., How To Write Your First Thesis, Springer, 2017 [2] Murray R. How to Write a Thesis, Open University Press, 2017 **SECONDARY LITERATURE:** [1] Specialized literature agreed with the supervisor.
SUBJECT SUPERVISOR (NAME AND SURNAME, E-MAIL ADDRESS)
Teachers of individual groups in the subject: Graduate Seminar II Subject card development: dr Anna Kopeć, anna.kopec@pwr.edu.pl

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

FACULTY OF GEOENGINEERING, MINING AND GEOLOGY

SUBJECT CARD

Name of subject in Polish	**Praca dyplomowa**
Name of subject in English	**Master Thesis**
Main field of study (if applicable):	**Geodesy and Cartography**
Specialization (if applicable):	**Geodata Engineering**
Profile:	**academic**
Level and form of studies:	**2nd, full-time**
Kind of subject:	**optional**
Subject code	**W06GIK-SM1052D**
Group of courses	**NO**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)				**15**	
Number of hours of total student workload (CNPS)				**500**	
Form of crediting (Examination / crediting with grade)				crediting with grade	
For group of courses mark (X) final course					
Number of ECTS points				**20**	
including number of ECTS points for practical classes (P)				**20**	
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)				**1,8**	

*delete as not necessary

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knows the basic stages of conducting research work

SUBJECT OBJECTIVES

C1. Develop the ability to assess the usefulness and applicability of using a variety of tools and information sources to solve engineering problems.
C2. Gain the ability to develop a master's thesis.

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge:

PEU_W01 Knows the different types of sources of scientific knowledge in the field of the thesis topic

PEU_W02 Has in-depth knowledge related to the thesis topic

relating to skills:

PEU_U01 Is able to obtain the information necessary for the thesis topic and evaluate the quality, completeness and timeliness of this information

PEU_U02 Is able to use specific tools to acquire and process data necessary for the thesis

PEU_U03 Knows how to process the results, evaluate the accuracy and draw conclusions from the completed work

relating to social competences:

PEU_K01 Is ready to behave in a professional manner and comply with the principles of professional ethics, and understands his responsibility for decisions taken. Has an awareness of the role of the surveyor in the tasks of the national economy

PEU_K02 Is ready to understand the importance of reliable performance of assigned tasks and the significance of the documentation produced, and has an awareness of the need for systematic self-education

PEU_K03 Is ready to work individually and solve engineering problems independently

Project		**Number of hours**
Proj 1-15	Individual work of the student on the selected topic according to the schedule agreed with the Thesis Supervisor	15
	Total hours	**15**

TEACHING TOOLS USED

N1. Acquisition of geodata (field surveys, spatial databases)
N2. Processing of geodata (computational, graphical and descriptive)
N3. Thesis preparation
N4. Own work (self-study)
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
F1	PEU_W01-PEU_W02, PEU_U01-PEU_U03, PEU_K01-PEU_K03	Supervisor's evaluation for the thesis
P1 = F1		

PRIMARY AND SECONDARY LITERATURE
PRIMARY LITERATURE: [1] Gruba P., Zobel J., How To Write Your First Thesis, Springer, 2017 [2] Murray R. How to Write a Thesis, Open University Press, 2017 **SECONDARY LITERATURE:** [1] Specialized literature agreed with the supervisor.
SUBJECT SUPERVISOR (NAME AND SURNAME, E-MAIL ADDRESS)
Supervisors of the subject: Master Thesis. Subject card development: dr Anna Kopeć, anna.kopec@pwr.edu.pl

BLOCK OF OPTIONAL SUBJECTS

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

FACULTY OF GEOENGINEERING, MINING AND GEOLOGY

SUBJECT CARD

Name of subject in Polish	**Bazy danych typu NoSQL**
Name of subject in English	**NoSQL Databases**
Main field of study (if applicable):	**Geodesy and Cartography**
Specialization (if applicable):	**Geodata Engineering**
Profile:	**academic**
Level and form of studies:	**2nd, full-time**
Kind of subject:	**optional**
Subject code	**W06GIK-SM1053L**
Group of courses	**NO**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)			**30**		
Number of hours of total student workload (CNPS)			**50**		
Form of crediting (Examination / crediting with grade)			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)			**2**		
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)			**1.36**		

*delete as not necessary

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Spatial databases
2. Fundamentals of programming

SUBJECT OBJECTIVES

C1. Acquiring knowledge and skills in designing and creating NoSQL databases for the purpose of collecting geospatial data
C2. Acquiring knowledge and skills in creating simple applications for managing NoSQL databases

SUBJECT EDUCATIONAL EFFECTS

relating to skills:

PEU_U01	Has skills in designing and creating NoSQL databases for the purpose of collecting geospatial data
PEU_U02	Has skills in creating simple applications for managing NoSQL databases

relating to social competences:

PEU_K01	Is ready to behave in a professional manner and comply with the principles of professional ethics, and understands his responsibility for decisions taken. Has an awareness of the role of the surveyor in the tasks of the national economy
PEU_K02	Is ready to understand the importance of reliable performance of assigned tasks and the significance of the documentation produced, and has an awareness of the need for systematic self-education
PEU_K03	Is ready to work individually, cooperate in a group and manage the work of a team of people, as well as establish correct relations with outsiders in the performance of assigned tasks

Laboratory		**Number of hours**
Lab1	Basic concepts and definitions related to NoSQL databases. Introduction to the NoSQL database environment	4
Lab2	Types of data models in NoSQL databases	2
Lab3	Configuration of the development environment and database	4
Lab4	Query languages used in NoSQL databases	4
Lab5	Creating a database for the key-value data model	2
Lab6	Creating a database for the key-document data model	2
Lab7	Creating a database for the column family data model	2
Lab8	Creating a graph database	4
Lab9	Indexing databases - selected data models	4
Lab10	Final colloquium	2
	Total hours	**30**

TEACHING TOOLS USED

N1. Traditional or remote lecture with multimedia presentations
N2. Acquisition of geospatial data (spatial databases)
N3. Processing geospatial data (computational, graphical, and descriptive)
N4. Report or documentation of completed work in digital or paper form
N5. Independent work (self-learning)
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
F1	PEU_U01, PEU_U02, PEU_K01	Assessment from the colloquium
F2	PEU_U01, PEU_U02, PEU_K01	Quiz grade

F3	PEU_U01, PEU_U02, PEU_K02, PEU_K03	Grade for the project
P2 = 0,5*F2+0,3*F3+0,2*F4		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] Sadalage Pramod J., Fowler Martin, NoSQL Distilled, Pearson Education, 2012

[2] Harrison Guy, Next Generation Databases : NoSQL, NewSQL, and Big Data, Apress, 2015

[3] Sullivan Dan, Addison-Wesley Professional, Addison-Wesley Professional, 2015

SECONDARY LITERATURE:

[4] Guo, D., & Onstein, E. (2020). State-of-the-art geospatial information processing in NoSQL databases. *ISPRS International Journal of Geo-Information*, *9*(5). https://doi.org/10.3390/ijgi9050331

[5] Khare, A. (2016). A Review of NoSQL Databases , Types and Comparison with Relational Database. *International Journal of Engineering Science and Computing*, *3*(7), 4963–4966. https://doi.org/10.4010/2016.1226

[6] Moniruzzaman, A. B. M., & Hossain, S. A. (2013). NoSQL Database: New Era of Databases for Big data Analytics-Classification, Characteristics and Comparison. In *International Journal of Database Theory and Application* (Vol. 6, Issue 4). http://hortonworks.com/blog/7-key-drivers-for-the-big-data-market/

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

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

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

FACULTY OF GEOENGINEERING, MINING AND GEOLOGY

SUBJECT CARD

Name of subject in Polish	**Geomorfologia dynamiczna**
Name of subject in English	**Dynamic Geomorphology**
Main field of study (if applicable):	**Geodesy and Cartography**
Specialization (if applicable):	**Geodata Engineering**
Profile:	**academic**
Level and form of studies:	**2nd, full-time**
Kind of subject:	**optional**
Subject code	**W06GIK-SM1054L**
Group of courses	**NO**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)			**30**		
Number of hours of total student workload (CNPS)			**50**		
Form of crediting (Examination / crediting with grade)			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)			**2**		
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)			**1.36**		

*delete as not necessary

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Student have a solid grasp of basic concepts in the field of geology.
2. Student is capable of conducting basic morphometric measurements in a GIS

SUBJECT OBJECTIVES

C1. Acquiring knowledge about factors and processes shaping the Earth's surface relief. Understanding the relationship between the course, intensity, and effectiveness of relief-forming processes and geological structure, terrain relief, as well as climatic and hydrological conditions.

C2. Ability to recognize landforms based on the analysis of relief (topographic maps, digital elevation models, satellite images) and field observations.

SUBJECT EDUCATIONAL EFFECTS

relating to skills:

PEU_U01 Student recognizes landforms and explains the processes (phenomena) leading to their formation, as well as predicts the direction of further evolution of the relief.

PEU_U02 Student applies selected methods of measurement and analysis used in geomorphological research.

relating to social competences:

PEU_K01 Is ready to behave in a professional manner and comply with the principles of professional ethics, and understands his responsibility for decisions taken. Has an awareness of the role of the surveyor in the tasks of the national economy

PEU_K02 Is ready to understand the importance of reliable performance of assigned tasks and the significance of the documentation produced, and has an awareness of the need for systematic self-education

PEU_K03 Is ready to work individually, cooperate in a group and manage the work of a team of people, as well as establish correct relations with outsiders in the performance of assigned tasks

PROGRAMME CONTENT

Laboratory		Number of hours
Lab1	Morphological and morphometric analysis of landforms	2
Lab2	Research methods in geomorphology - studying processes and dynamics.	2
Lab3	Genetic classification of landforms based on relief analysis (topographic maps, digital elevation models, satellite images).	2
Lab4	Genetic classification of landforms based on sediment analysis (geological drilling).	2
Lab5	Landslide analysis, considering environmental background, existing and potential damages, forecasting further movements (using Geoportal and the Instructions for the preparation of landslide and mass movement hazard maps; PIG).	2
Lab6	Elements of a river valley.	2
Lab7	Dynamics of slope processes.	2
Lab8	Glacial and periglacial forms in relation to glacier dynamics.	2
Lab9	Forms and structures of contemporary and fossil periglacial environments.	2
Lab10	Morphology, morphometry, and morphogenesis of inland dunes.	2
Lab11	Anthropogenic transformations.	2
Lab12	Structural conditions of terrain landforms in relation to rock resistance and rock arrangement.	2
Lab13	Geomorphological maps – methods of construction and practical applications. Using relief analysis for assessing geohazards, anthropogenic transformations, and recognizing contemporary geodynamic processes.	2
Lab14	Geomorphological sketch.	2
Lab15	Concluding presentations.	2
	Total hours	**30**

TEACHING TOOLS USED
N1. Multimedia presentation N2. Acquisition of geodata (field measurements, spatial databases) N3. Processing geodata (computational, graphical, and descriptive) N4. Report or document summarizing the conducted work in digital or paper form N5. Independent work (self-education) 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
F1	PEU_U01, PEU_U02, PEU_K01, PEU_K02, PEU_K03	Evaluation of presentation of the report
F2	PEU_U01, PEU_U02,	Assessment of reports on partial project tasks
F3	PEU_U01, PEU_U02,	Semester work evaluation
P1 – (F1 + arithmetic mean of F2 and F3)/3 converted to an academic scale.		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] Anderson, R.S. and Anderson, S.P. (2010) Geomorphology: The Mechanics and Chemistry of Landscapes. Cambridge University Press, Cambridge, 637 p

[2] Wilson, L. (1968). Dynamic geomorphology . In: Geomorphology. Encyclopedia of Earth Science. Springer, Berlin, Heidelberg. https://doi.org/10.1007/3-540-31060-6_103

[3] Goudie, A. S., 2004. Encyclopedia of Geomorphology (Volume 1). Routledge Taylor and francis group, LTD., USA.

SECONDARY LITERATURE:

[1] Geomorphological mapping based on DEMs and GIS: A review, Abstr. Int. Cartogr. Assoc., 1, 275, https://doi.org/10.5194/ica-abs-1-275-2019, 2019

[2] Mark, David M. “Geomorphometric Parameters: A Review and Evaluation.” Geografiska Annaler: Series A, Physical Geography 57.3–4 (1975): 165–177.

[3] Smith, M.J, Paron, P. and Griffiths, J.S., 2011. Geomorphological mapping-methods and applications. Elsevier, 15

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

dr inż. Joanna Krupa-Kurzynowska, joanna.krupa-kurzynowska@pwr.edu.pl

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

FACULTY OF GEOENGINEERING, MINING AND GEOLOGY

SUBJECT CARD

Name of subject in Polish	**Hydrogeologia z elementami geologii inżynierskiej**
Name of subject in English	**Hydrogeology with Elements of Engineering Geology**
Main field of study (if applicable):	**Geodesy and Cartography**
Specialization (if applicable):	**Geodata Engineering**
Profile:	**academic**
Level and form of studies:	**2nd, full-time**
Kind of subject:	**optional**
Subject code	**W06GIK-SM1055L**
Group of courses	**NO**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)			**30**		
Number of hours of total student workload (CNPS)			**50**		
Form of crediting (Examination / crediting with grade)			(~~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)			**2**		
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)			**1.36**		

*delete as not necessary

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Has knowledge of fundamentals of mathematical analysis, hydrogeology, and geology.
2. Basic knowledge concerning soil and rock mechanics, can present and characterize a lithological cross-section.
3. Using the Microsoft Office environment in the scope of preparing documents in Word, working with Excel spreadsheet

SUBJECT OBJECTIVES

C1. Familiarizing students with the role and tasks of hydrogeology as a science dealing with the study of the properties, movement, and resources of groundwater.
C2. Learning the basic properties of groundwater.
C3. Providing students with knowledge about the factors shaping the geological-engineering conditions of the building subsoil.
C4. Developing the ability to recognize and documenting hydrogeological/geological-engineering conditions and natural and anthropogenic threats to the soil.

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge:

PEU_W01 A student has knowledge of the basic hydrogeological properties of rocks and groundwater

PEU_W02 The student has basic knowledge of a geological-engineering environment as well as the identification of mass movements.

relating to skills:

PEU_U01 Based on the hydrogeological properties of rocks, he can estimate the ability to collection, conduction and discharging water from the rock.

PEU_U02 A student can determine the complexity of hydrogeological/geological-engineering conditions of the building subsoil.

relating to social competences:

PEU_K01 Is ready to behave in a professional manner and comply with the principles of professional ethics, and understands his responsibility for decisions taken. Has an awareness of the role of the surveyor in the tasks of the national economy

PEU_K02 Is ready to understand the importance of reliable performance of assigned tasks and the significance of the documentation produced, and has an awareness of the need for systematic self-education

PEU_K03 Is ready to work individually, cooperate in a group and manage the work of a team of people, as well as establish correct relations with outsiders in the performance of assigned tasks

Laboratory		**Number of hours**
La1	The scope of the course, form of evaluation, occupational health, and safety. Introduction to classes: groundwater as part of the hydrosphere; water in the aeration and saturation zone.	2
La2	Introduction to classes: water occurrence depending on geological structure; hydrogeological properties of soil and rocks; granulometric analysis of soil and rocks; determination of hydrogeological properties of soil and rocks I	4
La3	Introduction to classes: Physico-chemical properties of groundwaters; determination of hydrogeological parameters of rocks II	4
La4	Introduction to classes: impact of groundwater on the soil-rock medium (dissolution, leaching, suffusion, slurry); determination of hydrogeological parameters of rocks III	4
La5	Introduction to classes: impact of groundwater on the soil-rock medium (swelling, freezing, breakthroughs); documenting the hydrogeological conditions, text part	4
La6	Introduction to classes: processes shaping the surface of the Earth's crust: endogenic, exogenic, anthropogenic; documenting the hydrogeological conditions, graphic part	2
La7	Introduction to classes: GPR in engineering geology research; analysis of the building subsoil structure based on GPR tests	4
La8	Introduction to classes: documenting the hydrogeological and geological-engineering conditions; preparation of text and graphic parts of geological-engineering documentation for simple geological conditions	4
La9	Final colloquium	2
	Total hours	**30**

TEACHING TOOLS USED	
N1.	Lecture aided by presentation.
N2.	Individual study and preparation of reports.
N3.	Discussion and 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
F1	PEU_W01 – PEU_W02, PEU_U01 – PEU_U02, PEU_K01	Partial reports
F2	PEU_W01 – PEU_W02, PEU_U01 – PEU_U02, PEU_K01	Final colloquium
P = average of F1 i F2		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] Hydrogeology, Hölting, Bernward. Autor | Coldewey, Wilhelm Georg. Autor | Springer Nature 2019
[2] Field hydrogeology, Brassington, Rick, 199
[3] Introduction to hydrogeology, Deming, David (1954). cop. 2002
[4] Introduction to Hydrogeology, Nonner, Johannes C. (1948-). | CRC Press/Balkema, cop. 2016
[5] Engineering geology : principles and practice, Price, David G. | De Freitas, M. H. cop. 2009
[6] Engineering geology for underground rocks, Peng, Suping. | Zhang, Jincai., cop. 2007

SECONDARY LITERATURE:

[1] Environmental isotopes in hydrogeology, Clark, Ian Douglas (1954-). | Fritz, Peter (1937). 1999
[2] Mine water hydrogeology and geochemistry, Younger, Paul L. Redakcja. | Robins, N. S., 2002
[3] Engineering Geology, Zaruba, Quido (X) | MENCL, VOJTECH (X), 1976

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

dr Barbara Kiełczawa; barbara.kielczawa@pwr.edu.pl

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

FACULTY OF GEOENGINEERING, MINING AND GEOLOGY

SUBJECT CARD

Name of subject in Polish	**Podstawy projektowania obiektowego C/C++**
Name of subject in English	**Object-Oriented Programming C/C++**
Main field of study (if applicable):	**Geodesy and Cartography**
Specialization (if applicable):	**Geodata Engineering**
Profile:	**academic**
Level and form of studies:	**2nd, full-time**
Kind of subject:	**optional**
Subject code	**W06GIK-SM1056L**
Group of courses	**NO**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)					
Number of hours of total student workload (CNPS)					
Form of crediting (Examination / crediting with grade)			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)			**2**		
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)			**1.36**		

*delete as not necessary

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge in the basics of computer science and programming
2. Proficiency in programming in a chosen language (e.g., C, Python)

SUBJECT OBJECTIVES

C1. Acquisition of knowledge in the field of object-oriented programming
C2. Acquisition of skills in designing and programming complex applications

SUBJECT EDUCATIONAL EFFECTS

relating to skills:

PEU_U01	Student can design and program an application in a chosen object-oriented programming language
PEU_U02	Student can prepare documentation for their own computer application

relating to social competences:

PEU_K01	Is ready to behave in a professional manner and comply with the principles of professional ethics, and understands his responsibility for decisions taken. Has an awareness of the role of the surveyor in the tasks of the national economy
PEU_K02	Is ready to understand the importance of reliable performance of assigned tasks and the significance of the documentation produced, and has an awareness of the need for systematic self-education
PEU_K03	Is ready to work individually, cooperate in a group and manage the work of a team of people, as well as establish correct relations with outsiders in the performance of assigned tasks

Laboratory		Number of hours
Lab1	Project of a multi-module console application	2
Lab2	Division of the application into modules - team project. Creating libraries	2
Lab3	Compilation of multi-module programs - utilizing a team project	2
Lab4	Introduction to object-oriented programming environment	2
Lab5	Introduction to object-oriented design. Identification of classes and relationships between classes for a team project	2
Lab6	Application design using the designed classes - team project	2
Lab7	Implementation of the application - team project	2
Lab8	Creating constructors and destructors	2
Lab9	Introduction to the environment for designing graphical interfaces of applications	2
Lab10	Design and implementation of graphical interfaces for applications - team project	2
Lab11	Introduction to concurrent programming	2
Lab12	Design and implementation of threads in the application - team project	2
Lab13	Implementation of exception handling - team project	2
Lab14	Compilation of an application with a graphical interface - utilizing a team project	2
Lab15	Preparation of documentation for the application code	2
	Total hours	30

TEACHING TOOLS USED

N1. Traditional or remote lecture with multimedia presentations
N2. Laboratory exercises - solving practical problems using C++ software
N3. Team project - Report or documentation of completed work in digital or paper form
N4. Independent work (self-learning)
N5. 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
F1	PEU_U01, PEU_U02, PEU_K03	Team project - application project
F2	PEU_U01, PEU_U02, PEU_K02	Reports prepared at home - for the discussed programming techniques
F3	PEU_U01, PEU_U02, PEU_K01	Written test
Final grade for laboratory exercises is equal to: • 0.3F1 + 0.3F2 + 0.4F4, if F1, F2, and F3 are positive, • ndst, if F1 or F2 or F3 is negative.		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] Julie Violet Joyslin S, The Object Oriented Concepts of C++ Programming Language, LAP LAMBERT Academic Publishing, 2023

[2] T. H. Cormen, Ch. E. Leiserson, R. L. Rivest., Introduction to Algorithms, (Fourth Edition). The MIT Press, Cambridge, Massachusetts London, England, 2023

[3] R. Sedgewick., Algorithms in C++, Parts 1-4, Pearson Education, 1998

[4] Goodrich Michael T., Data Structures and Algorithms in C++, Wiley, 2011

[5] Nicolai M. Josuttis Object-Oriented Programming in C++, John Wiley & Sons INC International Concepts, 2002

SECONDARY LITERATURE:

[6] Brett D. McLaughlin, Gary Pollice, Dave West, Head First Object-Oriented Analysis and Design, O'Reilly Media; 1 edition (December 4, 2006)

[7] Bernhard Rumpe, Modeling with UML, Springer International Publishing AG, 2018

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

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

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

FACULTY OF GEOENGINEERING, MINING AND GEOLOGY

SUBJECT CARD

Name of subject in Polish	**Systemy Informacji Geograficznej (GIS) w modelowaniu georóżnorodności**
Name of subject in English	**Geographic Information System (GIS) in Geodiversity modeling**
Main field of study (if applicable):	**Geodesy and Cartography**
Specialization (if applicable):	**Geodata Engineering**
Profile:	**academic**
Level and form of studies:	**2nd, full-time**
Kind of subject:	**optional**
Subject code	**W06GIK-SM1057L**
Group of courses	**NO**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)			**30**		
Number of hours of total student workload (CNPS)			**50**		
Form of crediting (Examination / crediting with grade)	(Examination / crediting with grade)	(Examination / crediting with grade)	(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**		
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)			**1.36**		

*delete as not necessary

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Student have basic knowledge of techniques for acquiring spatial data from publicly available databases (topographic data, environmental data, climate data, and others).
2. Student have basic knowledge of digital cartography.
3. Student can practically use GIS software packages extensively in their functionalities (e.g., ArcGIS ESRI, QGIS).

SUBJECT OBJECTIVES

C1. Acquisition of basic knowledge in geographic diversity.
C2. Acquisition of fundamental skills in spatial analysis using gis software related to assessing geodiversity.
C3. Development of competence in planning and resource management with consideration for geodiversity.

C4. Acquisition of skills in formulating and solving tasks using analytical functions in GIS.

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge:

PEU_W01 Has knowledge in determining the geographical diversity of an area.

relating to skills:

PEU_U01 Can use advanced tools available in GIS software to assess geographical diversity of an area.

PEU_U02 Can formulate and solve spatial tasks related to geodiversity analysis in a GIS environment.

PEU_U03 Can interpret obtained results and draw conclusions.

relating to social competences:

PEU_K01 Is ready to work individually, cooperate in a group and manage the work of a team of people, as well as establish correct relations with outsiders in the performance of assigned tasks.

PROGRAMME CONTENT

Laboratory		Number of hours
Lab1	Discussion of class rules and assessment.	2
Lab2	Discussion and preparation of data for analysis: e.g.: State Geological Institute, Forest Data Bank, Central Register of Nature Protection Forms, Main Inspectorate for Environmental Protection: Corine Land Cover, monitoring systems for environmental quality elements, Institute of Meteorology and Water Management: Meteorological data.	2
Lab3	Criteria for assessing landscape elements and features.	4
Lab4	Landscape measures.	4
Lab5	Methodology for assessing geodiversity.	2
Lab6	Object diversity based on the number of units and categories.	2
Lab7	Object diversity based on entropy.	2
Lab8	Object diversity based on pixel value statistics.	2
Lab9	Landscape feature diversity.	4
Lab10	Point-based assessment method.	4
Lab11	Presentation and evaluation of project results.	2
	Total hours	**30**

TEACHING TOOLS USED

N1. Multimedia Presentation by the Instructor.
N2. Discussion Regarding Analysis Methods.
N3. Independent Completion of Laboratory Tasks Based on Instructions.
N4. Independent Preparation of Written Reports.
N5. Multimedia Presentation of Project Results.
N6. Independent Literature Studies and Preparation for Assessments.
N7. Written 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
F1	PEU_W01 PEK_U01, PEK_U02 PEK_U03 PEK_K01	Assessment of written or oral preparation for laboratory exercises and evaluation of the scope of laboratory research.
F2	PEU_W01 PEK_U01, PEK_U02 PEK_U03 PEK_K01	Evaluation of written reports from laboratory exercises.
F3	PEU_W01 PEK_U01, PEK_U02 PEK_U03 PEK_K01	Presentation of project results.
P: The final grades for laboratory exercises are calculated as the average of F1 + F2 + F3.		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] Eiden G., Kayadjanian M., Vidal C., 2000. *Quantifying Landscape Structures: spatial and temporal dimensions*. W: *From land cover to landscape diversity in the European Union*, Report of the European Commission. URL: http://ec.europa.eu/agriculture/publi/landscape/ch1.htm

[2] Forman, R.T.T., & Godron, M., 1986. *Landscape Ecology*. Wiley and Sons, New York

SECONDARY LITERATURE:

[1] Rossi R.E., Mulla D.J., Journel A.G., Franz E.H., 1992. *Geostatistical tools for modeling and interpreting ecological dependence*. Ecological Monographs, 62

[2] Suchożebrski J., 2004. *The size of the basic unit in geographical analysis*. Miscallanea Geographica, 11

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

dr hab. inż. Justyna Górniak-Zimroz, justyna.gorniak-zimroz@pwr.edu.pl
dr inż. Joanna Krupa-Kurzynowska, joanna.krupa-kurzynowska@pwr.edu.pl

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

FACULTY OF GEOENGINEERING, MINING AND GEOLOGY

SUBJECT CARD

Name of subject in Polish	**Wybrane działy kartografii**
Name of subject in English	**Selected Issues in Cartography**
Main field of study (if applicable):	**Geodesy and Cartography**
Specialization (if applicable):	**Geodata Engineering**
Profile:	**academic**
Level and form of studies:	**2nd, full-time**
Kind of subject:	**optional**
Subject code	**W06GIK-SM1058L**
Group of courses	**NO**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)			**30**		
Number of hours of total student workload (CNPS)			**50**		
Form of crediting (Examination / crediting with grade)			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)			**2**		
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)			**1.36**		

*delete as not necessary

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. The Student has theoretical and practical knowledge of thematic cartography and georeferenced databases.
2. Can use GIS software on an advanced level.

SUBJECT OBJECTIVES

C1. To expand knowledge in the principles of thematic map development.
C2. To acquire the skill of the most communicative way of presenting geodata.
C3. To acquire the competence of thinking and acting in evaluating the presentation on thematic maps.

SUBJECT EDUCATIONAL EFFECTS

relating to skills:

PEU_U01 The student know how to apply non-standard procedures for creating thematic maps in GIS and graphics programs, based on state records and individually developed databases.

relating to social competences:

PEU_K01 Is ready to understand the importance of reliable performance of assigned tasks and the significance of the documentation produced, and has an awareness of the need for systematic self-education.

PEU_K02 Is ready to work individually, cooperate in a group and manage the work of a team of people, as well as establish correct relations with outsiders in the performance of assigned tasks.

Laboratory		Number of hours
Lab1	Establishing the principle of participation and work in the project and the rules of teamwork. Report. Proposals for changes in the presentation of geodata in the thematic part of https://geoportal.dolnyslask.pl/ i.in. and foreign portals, made by qualitative methods.	6
Lab2	Report. Proposals for changes in the presentation of geodata in the thematic section of https://geoportal.dolnyslask.pl/ et al. and foreign portals, made by cartogram and cartodiagram methods.	6
Lab3	Report. Proposals for changes in the presentation of geodata in the thematic section of https://geoportal.dolnyslask.pl/ et al. and foreign portals, made by isoline and dot methods.	3
Lab4	Copying collections and making selected maps proposed in projects 1,2 and 3.	6
Lab5	Proposing a map with special attention to hydrographic factors.	6
Lab6	Presentation of completed projects and discussion.	3
	Total hours	**30**

TEACHING TOOLS USED

N1. Computer lab or remote lab (with multimedia presentations).
N2. Report on completed work in digital form.
N3. Own work (self-study).
N4. Consultation.

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT

Evaluation (F – forming during semester), P – concluding (at semester end)	Learning outcomes code	Way of evaluating learning outcomes achievement
F1	PEU_U01, PEU_K01 - PEU_K02	evaluation from tasks and reports
F2	PEU_U01, PEU_K01 - PEU_K02	evaluation from tests
P1=0.7*mean(F1) +0.3*mean(F2).		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] Boodala J.,Dikshit O. and Balasubramanian N., 2020. Towards the derivation of Multiple Representation Database. 2020 IEEE International Conference on Electronics, Computing and Communication Technologies (CONECCT), Bangalore, India, pp. 1-6, doi: 10.1109/CONECCT50063.2020.9198528.

[2] Głażewski A., Kowalski P.J., Olszewski R., Bac-Bronowicz J. 2010. New Approach to Multi Scale Cartographic Modelling of Reference and Thematic Databases in Poland [in:] Gartner G. and Ortag F. (Eds.): Lecture Notes in Geoinformation and Cartography, Cartography in Central and Eastern Europe Selected Papers of the 1st ICA Symposium on Cartography for Central and Eastern Europe, Springer-Verlag, Berlin - Heidelberg.

[3] Głażewski, A., Kowalski, P. J., Olszewski, R., & Ostrowski, W. 2011. New approach to cartographic presentation of Georeference Database in Poland. In *Proceedings of the 25th International Cartographic Conference, Paris* (Vol. 3, No. 8).

[4] Gotlib D., Iwaniak A., Olszewski R., *SDI in Poland – concept of topographic reference system for thematic, harmonized databases*, ICA Conference, La Coruna 2005

[5] Główny Urząd Geodezji i Kartografii. Rozporządzenia, instrukcje i wytyczne techniczne wydawane od 2012 r.

[6] Hampe M, Sester M and Harrie L, 2004, Multiple representation databases to support visualisation on mobile devices. In: Altan O (eds), Proc. 20th ISPRS Congress, volume XXXV (Part B4), series International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences, Istanbul, Turkey, pages 135–140.

[7] Izdebski W., Zwirowicz-Rutkowska A., Nowak da Costa J.: Open data in spatial data infrastructure: the practices and experiences of Poland, International Journal of Digital Earth, 2021 DOI: 10.1080/17538947.2021.1952323

[8] Kilpeläinen T. 2000. Maintenance of Multiple Representation Databases for Topographic Data, The Cartographic Journal, 37:2, 101-107, DOI: 10.1179/0008704.37.2.p101

[9] Kowalski P.J., Olszewski R., Bac-Bronowicz J. 2010. A Multiresolution, Reference and Thematic Database as the NSDI Component in Poland – The Concept and Management Systems [in:] Gartner G. and Ortag F. (Eds.): Lecture Notes in Geoinformation and Cartography, Cartography in Central and Eastern Europe Selected Papers of the 1st ICA Symposium on Cartography for Central and Eastern Europe, Springer-Verlag, Berlin – Heidelberg.

[10] Lupa M., Kozioł K. 2013. The use of merging and aggregation operators for MRDB data feeding. *Geoinformatica Polonica*. 12: 17-24.

[11] Olszewski R.2009. Distribution of Topographic Data in Geoinformation Services. Geomatics and Environmental Engineering.Vol.3, No.1/1

SECONDARY LITERATURE:

[1] ICA News www.icaci.org

[2] Geomatics and Environmental Enginneering. AGH

[3] Polish Cartographical Review

[4] https://geoportal.dolnyslask.pl/imap/#gpmap=gp1

[5] https://www.geoportal.gov.pl/documents/

[6] https://phavi.umcs.pl/at/attachments/2020/0826/072207-podstawy-wizualizacji-kartograficznej-2015.pdf

[7] www.statista.com/chartoftheday/
[8] https://mapsvg.com/blog/statistical-maps
[9] https://stat.gov.pl/statystyka-regionalna/publikacje-regionalne/podreczniki-atlasy/podreczniki/statistical-maps-data-visualisation-methods,3,1.html
[10] https://www.esri.com/about/newsroom/arcuser/understanding-statistical-data-for-mapping-purposes/

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