Zał. Nr 1 do ZW 16/2020

PROGRAM OF STUDIES

FACULTY: **Chemistry**
MAIN FIELD OF STUDY: **URBAN MINING**
BRANCH OF SCIENCE: **engineering and technology**

DISCIPLINES: D1 **chemical engineering** (major discipline)
D2 **environmental engineering, mining and energy**
D3 **chemical sciences**

EDUCATION LEVEL: **second-level studies**
FORM OF STUDIES: **full-time studies**
PROFILE: **general academic**
LANGUAGE OF STUDY: **English**

Content:

Resolution no. … of the Senate of Wroclaw University of Science and Technology
In effect since **2022/2023**

*delete as applicable

Zał. Nr 2 do ZW 16/2020
Attachment No. 1 to the study program

ASSUMED LEARNING OUTCOMES

FACULTY: **Chemistry**
MAIN FIELD OF STUDY: **URBAN MINING**
EDUCATION LEVEL: **second-level studies**
PROFILE: **general academic**

Location of the main-field-of study:

Branch of science:	**engineering and technology**	Discipline: **chemical engineering (major)**
Branch of science:	**engineering and technology**	Discipline: **environmental engineering, mining and energy**
Branch of science:	**natural sciences**	Discipline: **chemical sciences**

Explanation of the markings:
P7U – universal first degree characteristics corresponding to education at the second-level studies - 7 PRK level *
P7S – second degree characteristics corresponding to education at the second-level studies - 7 PRK level *

W - category "knowledge"
U - category "skills"
- 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"

* delete as applicable

Main field of study learning outcomes	Description of learning outcomes for the main-field-of study URBAN MINING After completion of studies, the graduate:	Reference to PRK characteristics		
		Universal first degree characteristics (U)	Second degree characteristics typical for qualifications obtained in higher education (S)	
			Characteristics for qualifications on 7 levels of PRK	Characteristics for qualifications on 7 levels of PRK, enabling acquiring engineering competences
KNOWLEDGE (W)				
K2_UM_W1	Has extended and in-depth knowledge of static analyzes necessary for the description and analysis of measurement data in the area of urban mining	P7U_W	P7S_WG	P7S_WK_inż
K2_UM_W2	Understands the technical and non-technical conditions of engineering activities and the resulting responsibility, and is able to predict and take into account in practice the effects of this activity on the natural environment, community and economy	P7U_W	P7S_WK	P7S_WG_inż
K2_UM_W3	Knows the essence and understands the goals of the company's operation and recognizes various problems in individual functional areas, also in the context of conditions occurring in the environment of enterprises	P7U_W	P7S_WK	P7S_WK_inż
K2_UM_W4	Knows and understands the basic concepts and principles of industrial property protection and copyright, and has knowledge of the need to manage intellectual property resources	P7U_W	P7S_WK	P7S_WK_inż
K2_UM_W5	Has general theoretical knowledge in the field of identification and assessment of environmental aspects and technologies used in the area of waste treatment	P7U_W	P7S_WG	P7S_WG_inż
K2_UM_W6	Has a well-established knowledge of the use of urban mining in a circular economy	P7U_W	P7S_WG	P7S_WK_inż
K2_UM_W7	Knows the principles of integrated product policy and is able to Characterize commonly used life cycle assessments for secondary raw materials	P7U_W	P7S_WG	P7S_WK_inż
K2_UM_W8	Has structured and theoretically founded knowledge of systems in the field of circular	P7U_W	P7S_WG	

	economy, including their planning and designing a resource-efficient economy			
K2_UM_W9	Has a well-established knowledge of technologies, devices and their design solutions in the area of urban mining	P7U_W	P7S_WG	P7S_WG_inż
K2_UM_W10	Has an organized knowledge of measurement techniques used in the area of urban mining	P7U_W	P7S_WG	P7S_WG_inż
K2_UM_W11	Has structured and theoretically founded knowledge of modeling systems and processes in urban mining along with knowledge of the scope of their application and knows the basic methods and tools used in solving tasks in this area	P7U_W	P7S_WG	P7S_WG_inż
K2_UM_W12	Knows the development trends in urban mining	P7U_W	P7S_WG	P7S_WK_inż
SKILLS (U)				
K2_UM_U1	Is able to use mathematical models and conduct computer simulations enabling the assessment of the life cycle of secondary raw materials, interpret the obtained results and draw conclusions	P7U_U	P7S_UW	P7S_UW_inż
K2_UM_U2	Is able to make mass and energy balances of selected processes and devices, using appropriate methods, techniques and tools; and can use design support software	P7U_U	P7S_UW	P7S_UW_inż
K2_UM_U3	Can obtain information from literature, databases and other sources and use them to formulate their own independent conclusions	P7U_U	P7S_UW	P7S_UW_inż
K2_UM_U4	Understands quite well the content and intentions of an oral statement or written text in a foreign language on a topic known from everyday and professional life; can write a short text on a known topic, including utility text; is able to participate in conversations on known topics and to a limited extent expresses himself about studies and professional work, using socio-cultural knowledge	P7U_U	P7S_UW P7S_UK	
K2_UM_U5	Understands texts from their discipline, e.g. business and technical documentation; can obtain necessary information from various sources, interpret and critically Evaluate it; has linguistic means appropriate for a specialist language in order to communicate effectively in a professional environment	P7U_U	P7S_UW P7S_UK P7S_U0	P7S_UW_inż
K2_UM_U6	Is able to develop a system concept and plan processes in the area of secondary raw materials processing using appropriate methods, techniques and tools, and is able to analyze the way they function and work	P7U_U	P7S_UW	P7S_UW_inż

K2_UM_U7	Is able to perform technical and technological calculations of system elements in the area of recycling raw materials using appropriate methods, techniques and tools	P7U_U	P7S_UW	P7S_UW_inż
K2_UM_U8	Can assess the usefulness and possibility of using new techniques and technologies in urban mining	P7U_U	P7S_UW	P7S_UW_inż
K2_UM_U9	Is able to plan and carry out experiments using appropriate methods, techniques and tools	P7U_U	P7S_UW	P7S_UW_inż
K2_UM_U10	Is able to cooperate in a group as part of team work	P7U_U	P7S_U0 P7S_UU	
K2_UM_U11	Is able to prepare and present an oral presentation containing the results of the diploma dissertation, justify in a discussion the manner of its implementation and the results achieved; can indicate alternative possibilities and directions of solving the analyzed problem	P7U_U	P7S_UW P7S_UK P7S_U0	
K2_UM_U12	Has developed research skills: forms simple hypotheses and research problems, selects adequate methods, techniques and research tools, develops, presents and interprets research results, draws conclusions, indicates directions for further research in the field of urban mining	P7U_U	P7S_UW P7S_UU	P7S_UW_inż
SOCIAL COMPETENCES (K)				
K2_UM_K1	Is ready for creative and entrepreneurial thinking and acting; is ready to properly prioritize the implementation of a specific task	P7U_K	P7S_KK	
K2_UM_K2	Is aware of the importance and understanding of non-technical aspects and effects of the activity, including its impact on the environment, and is responsible for the decisions made	P7U_K	P7S_KR	
K2_UM_K3	Is ready to cooperate with the team, adapting to specific regulations and rules, maintaining the principles of fair play	P7U_K	P7S_KO	
K2_UM_K4	Perceives the problem of civilization threats and prevents them by initiating actions for the public interest	P7U_K	P7S_KO P7S_KR	
K2_UM_K5	Is ready to learn throughout life and critically evaluate the knowledge and content received	P7U_K	P7S_KK	

*delete as applicable

Zał. nr 3 do ZW 16/2020
Attachment no. 2. to the Program of Studies

DESCRIPTION OF THE PROGRAM OF STUDIES

Main field of study**: URBAN MINING**

Profile**: general academic**

Level of studies: **2nd level studies**

Form of studies**: full time studies**

1. General description

1.1 Number of semesters: ***4***	*1.2 Total number of ECTS points necessary to complete studies at a given level:* ***120***
1.3 Total number of hours: ***1470***	*1.4 Prerequisites (particularly for second-level studies):* *are set out in the Order-"The conditions and procedures for recruitment" in the Technical University of Wroclaw*
1.5 Upon completion of studies graduate obtains professional degree of: ***magister inżynier***	*1.6 Graduate profile, employability:* *The graduate has knowledge and skills in the field of engineering and technical sciences, i.e. to: • identification and assessment of raw material potentials from the municipal waste stream from the current stream as well as from old deposits; • they can assess the basic parameters of the use of these potentials in terms of quality and quantity, taking into account the zero-waste and low-emission strategy; • is able to plan research to identify these potentials; • is able to plan detailed processing tests, taking into account physical, chemical and biological processes, necessary in terms of social demand for these raw materials, using good practices of the circular economy; • they can identify and assess the necessary infrastructure, including mining and technological and technical infrastructure, in order to use them for the needs of municipal mining; • knows the rules of designing a processing installation, taking into account the current state of the art and technology; • can define and execute an investment project and assess its technical, technological and economic parameters; • is able to define the impact of this project in terms of social and environmental; • is able to use their knowledge and skills in professional work and life in accordance with legal and ethical principles; • is able to critically evaluate the proposed solutions and perform the required analyzes together with technological calculations; • can organize group work and manage the work of teams. A graduate of Urban Mining has the skills to work in: • research institutions; • state and local government administration responsible for waste management; • enterprises; • design offices; • consulting companies; • municipal waste management plants.*

1.7 Possibility of continuing studies: ***Eligibility to apply for admission to a doctoral school, non-degree postgraduate programmes***	*1.8 Indicate connection with University's mission and its development strategy:* *The study program in the field of Urban Mining is consistent with the mission of Wrocław University of Science and Technology in the field of • shaping creative, critical and tolerant personalities of students by including these values in the learning outcomes of Urban Mining; • striving for high-quality education of students by enabling conditions for free discussion and criticism with respect for truth, property rights, and ethical standards; • cultivating university values and traditions, comprehensive cooperation with other universities through the participation of students in the Erasmus program and practical classes carried out in the form of projects and thesis in the economic environment in the country and abroad; • striving for a worthy place in the field of educating specialists in the field of Urban mining among domestic and foreign universities. The development plans of the Faculty of Chemistry and the Faculty of Geoengineering, Mining, and Geology are in line with the University's strategy. Both faculties combine theoretical, research, and expert competencies with teaching and educational competencies. They are also recognized research and teaching centers nationally and internationally. According to the principle adopted at Wrocław University of Science and Technology, studies in Urban Mining have a general academic profile. The study program meets all the requirements of applicable law and is consistent with the European and Polish Qualifications Framework. In line with the University's strategy, the proposed study program in Urban Mining is unique, as it uses the complementarity of technical education with natural, economic, and social interests based on knowledge in the field of exact sciences, which increases its attractiveness on the educational market. Following the University's strategy and the Faculty's development plans, during the studies, students' contact with the economic environment is created during the implementation of projects and thesis. In accordance with the University's development strategy, the quality of education is systematically raised, resulting in an increase in the teaching competencies of employees through their scientific development, internships, and training. The study program in Urban Mining includes a set of learning outcomes and the related substantive content of education, enabling graduates to compete in the labor market effectively. After completing the field of study, students are prepared to continue their studies at the Doctoral School and conduct their research. Graduates of the course are also aware of the need to constantly act for their professional development in cooperation with the University.*

2. Detailed description

2.1 Total number of learning outcomes in the program of study: W (knowledge) =**12**, U (skills) = **12**, K (competences) = **5**, W + U + K = **29**

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

D1 **chemical engineering** (major)	**15**
D2 **environmental engineering, mining and energy**	**9**
D3 **chemical sciences**	**7**

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

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

D1 **chemical engineering** **53 ECTS points - 40 %**

D2 **environmental engineering, mining and energy** **45 ECTS points - 35 %**

D3 **chemical sciences** **32 ECTS points - 25 %**

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) - **80**

Name of course	**ECTS**
Basics of processing methods, lec	2
Basics of processing methods, lab	2
Methods of waste streams identification and assessing the raw material potential, lec	2
Methods of waste streams identification and assessing the raw material potential, pr	4
Circularity assessment tools, pr	3
Techniques and methods of exploitation anthropogenic deposits, lec	1
Techniques and methods of exploitation anthropogenic deposits, pr	3
ESG Reporting, lec	1
ESG Reporting, pr	3
Analysis of circular economy in processing processes, lec	1
Analysis of circular economy in processing processes, pr	3
Physical and physicochemical methods of waste processing, lec.	2
Physical and physicochemical methods of waste processing, lab	4
Physical and physicochemical methods of waste processing, pr	2
Chemical and biological methods of waste processing, lec	2
Chemical and biological methods of waste processing, lab	6
Chemical and biological methods of waste processing, pr	2
Instrumental methods in biomonitoring and analysis of products, w	2
Instrumental methods in biomonitoring and analysis of products, lab	6
Graduate laboratory, lab	25
Graduate seminar	2
Project Feasibility Study	2
TOTAL	**80**

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

[2]Traditional – enter T, remote – enter Z

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

[4]University-wide course /group of courses – enter O

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

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

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

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

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

The study program in Urban Mining includes a set of learning outcomes and the related substantive content of education, enabling graduates to compete in the labor market effectively. After completing the field of study, students are prepared to continue their studies at the Doctoral School and conduct their research. Graduates of the course are also aware of the need to constantly act for their professional development in cooperation with the University. The labor market needs in English-speaking Urban mining have been indirectly presented in this Study Program in the position of the Graduate profile employment opportunities. The graduates' preparation listed therein reflect, among other things, the following learning outcomes:

- can identify and assess the secondary raw material potentials from the municipal waste stream from the current stream as well as from old deposits;
- can assess the basic parameters of the use of these potentials in terms of quality and quantity, taking into account the zero-waste and low-emission strategy;
- can plan detailed processing tests, taking into account physical, chemical, and biological processes necessary in terms of social demand for these raw materials, using good practices of the circular economy;
- can identify and assess the necessary infrastructure, including mining and technological and technical infrastructure, to use them for the needs of municipal mining;
- can define and execute an investment project and assess its technical, technological, and economic parameters;
- can use their knowledge and skills in professional work and life following legal and ethical principles;
- can critically evaluate the proposed solutions and perform the required analyzes together with technological calculations;
- can organize group work and manage the work of teams.

2.6. The total number of ECTS points that a student must obtain in classes requiring direct participation of academic teachers or other persons conducting classes and students (enter the sum of ECTS points for courses / groups of courses marked with the BU[1] code) **84 ECTS**

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

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

Number of ECTS points for obligatory subjects	**20**
Number of ECTS points for optional subjects	**-**
Total number of ECTS points	**20**

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

Number of ECTS points for obligatory subjects	**56**
Number of ECTS points for optional subjects	**35**
Total number of ECTS points	**91**

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

5 ECTS points

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

37 ECTS points

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

Verification and assessment of learning outcomes with reference to courses or groups of courses throughout the entire education cycle takes place in relation to the information contained in the subject cards (syllabuses).

The student acquires knowledge and skills by participating in theoretical and practical classes, which are largely based on the results of scientific research conducted by academic teachers - course tutors conducting classes with students. The basis of teaching and learning process are laboratory, seminar and project courses. Education in the field of studies is conducted in accordance with the principle of increasing the complexity of theoretical and practical tasks set for students. Modern teaching methods are implemented in the teaching practice, thanks to which the students' activity during the classes increases. Theoretical courses in the form of lectures and seminars are supplemented with project and laboratory classes, which include, among others: computer modelling and design, as well as conducting scientific research. The program is complemented by humanities and foreign language courses. The course (study programme) ends with a master thesis preparation and its defence checking the student's theoretical knowledge.

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

4. 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 3 ECTS points):*

No.	Course/ group of courses code	Name of course/group of courses (denote group of courses with symbol **GK**)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form[2] of course/group of courses	Way[3] of crediting	Course/group of courses			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN[5] classes	BU[1] classes			University-wide[4]	Concerning scientific activities[5]	Practical[6]	Type[7]
1.		Formal, legal and economic aspects of anthropogenic deposits exploitation	2					K2_UM_W3, K2_UM_W4	30	90	3		2,1	T/Z	Z				KO
		Total	**2**						**30**	**90**	**3**		**2,1**						

4.1.1.2 *Foreign languages* block *(min….. ECTS points):*

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

4.1.1.3 *Sporting classes* block *(0 ECTS points):*

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

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

4.1.1.4 *Information technologies* block *(min. .... ECTS points):*

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

Altogether for general education blocks

Total number of hours					Total number of ZZU hours	Total number of CNPS hours	Total number of ECTS points	Total number of ECTS points for DN classes[5]	Number of ECTS points for BU classes[1]
lec	cl	lab	pr	sem					
2					**30**	**90**	**3**	**0**	**2,1**

[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 courses – after the letter E or Z - enter in brackets the final course form (lec, cl, lab, pr, sem)
[4]University-wide course /group of courses – enter O
[5]DN - number of ECTS points assigned to the classes related to the University's academic activity in the discipline/disciplines to which the main field of study is assigned
[6]Practical course / group of courses – enter P. For the group of courses – in brackets enter the number of ECTS points assigned to practical courses
[7]KO – general education courses, PD – basic sciences courses, K – main field of study courses, S – specialization courses

4.1.2 List of basic sciences blocks

4.1.2.1 *Mathematics* block:

No.	Course/ group of courses code	Name of course/group of courses (denote group of courses with symbol **GK**)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form[2] of course/group of courses	Way[3] of crediting	Course/group of courses			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN[5] classes	BU[1] classes			University - wide[4]	Concerning scientific activities[5]	Practical[6]	Type[7]
1.		Statistical methods in waste management	2					K2_UM_W1, K2_UM_W10	30	60	2		1,4	T/Z	Z				PD
2.		Statistical methods in waste management			2			K2_UM_U1, K2_UM_U3	30	90	3		2,1	T	Z			P	PD
		Total	**2**		**2**				**60**	**150**	**5**		**3,5**						

4.1.2.2 *Physics* block:

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

4.1.2.3 *Chemistry* block:

No.	Course/ group of courses code	Name of course/group of courses (denote group of courses with symbol **GK**)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form[2] of course/group of courses	Way[3] of crediting	Course/group of courses			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN[5] classes	BU[1] classes			University - wide[4]	Concerning scientific activities[5]	Practical[6]	Type[7]
1.		Process engineering	2					K2_UM_W2, K2_UM_W4, K2_UM_ W8, K2_UM_W9	30	60	2		1,4	T/Z	**E**				PD

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

								K2_UM_W11, K2_UM_W12											
		Total	**2**						**30**	**60**	**2**		**1,4**						

4.1.2.4 *Other basic* courses block:

No.	Course/ group of courses code	Name of course/group of courses (denote group of courses with symbol **GK**)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form[2] of course/group of courses	Way[3] of crediting	Course/group of courses			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN[5] classes	BU[1] classes			University -wide[4]	Concerning scientific activities[5]	Practical[6]	Type[7]
1.		Basics of processing methods	1					K2_UM_W5, K2_UM_W8, K2_UM_W9	15	60	2	2	1,4	T/Z	**E**		DN		PD
2.		Basics of processing methods			1			K2_UM_U2, K2_UM_U6	15	60	2	2	1,4	T	Z		DN	P	PD
3.		Biological factors in industry - fundamentals			2			K2_UM_W9, K2_UM_W12	30	90	3		1,4	T	Z			P	PD
4.		Biological factors in industry - fundamentals					1	K2_UM_U6 K2_UM_U8	15	60	2		2,1	T/Z	Z			P	PD
5.		Occupational Health and Safety in waste management	1					K2_UM_W2, K2_UM_W3	15	30	1		0,7	T/Z	Z				PD
6.		Occupational Health and Safety in waste management				1		K2_UM_U6, K2_UM_U7, K2_UM_K1	15	60	2		1,4	T/Z	Z			P	PD
7.		Occupational Health and Safety in waste management					1	K2_UM_U6, K2_UM_U7, K2_UM_K1, K2_UM_K3, K2_UM_K4	15	30	1		0,7	T/Z	Z			P	PD
		Total	**2**	**0**	**3**	**1**	**1**		**120**	**390**	**13**	**4**	**9,1**		**1**				

Altogether for basic sciences blocks:

Total number of hours					Total number of ZZU hours	Total number of CNPS hours	Total number of ECTS points	Total number of ECTS points for DN classes[5]	Number of ECTS points for BU classes[1]
lec	cl	lab	pr	sem					
6	**0**	**5**	**1**	**1**	**210**	**600**	**20**	**4**	**14**

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

4.1.3 List of the main field of study blocks

4.1.3.1 *Obligatory main field of study* blocks:

No.	Course/ group of courses code	Name of course/group of courses (denote group of courses with symbol **GK**)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form[2] of course/group of courses	Way[3] of crediting	Course/group of courses			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN[5] classes	BU[1] classes			University - wide[4]	Concerning scientific activities[5]	Practical[6]	Type[7]
1.		Urban mining – utility of waste	3					K2_UM_W2, K2_UM_W4, K2_UM_W5, K2_UM_W7, K2_UM_W6, K2_UM_W10, K2_UM_W11, K2_UM_W12	45	120	4		2,8	T/Z	**E**				K
2.		Methods of waste streams identification and assessing the raw material potential	2					K2_UM_W2, K2_UM_W4, K2_UM_W9, K2_UM_W10	30	60	2	2	1,4	T/Z	Z		DN		K
3.		Methods of waste streams identification and assessing the raw material potential				3		K2_UM_U3 K2_UM_U6, K2_UM_U7, K2_UM_U8, K2_UM_U9, K2_UM_U10	45	120	4	4	2,8	T/Z	Z		DN	P	K
4.		Identification and assessment of environmental aspects	1					K2_UM_W2, K2_UM_W6, K2_UM_W7, K2_UM_W9, K2_UM_W10	15	30	1		0,7	T/Z	Z				K
5.		Circularity assessment tools				2		K2_UM_U1, K2_UM_U2, K2_UM_U3, K2_UM_U5, K2_UM_U6, K2_UM_U7, K2_UM_W8, K2_UM_K3	30	90	3	3	2,1	T/Z	Z		DN	P	K
6.		Techniques and methods of exploitation anthropogenic deposits	1					K2_UM_W4, K2_UM_W5, K2_UM_W8, K2_UM_W9,	15	30	1	1	0,7	T/Z	**E**		DN		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 courses – after the letter E or Z - enter in brackets the final course form (lec, cl, lab, pr, sem)
[4]University-wide course /group of courses – enter O
[5]DN - number of ECTS points assigned to the classes related to the University's academic activity in the discipline/disciplines to which the main field of study is assigned
[6]Practical course / group of courses – enter P. For the group of courses – in brackets enter the number of ECTS points assigned to practical courses
[7]KO – general education courses, PD – basic sciences courses, K – main field of study courses, S – specialization courses

								K2_UM_W10, K2_UM_W11											
7.		Techniques and methods of exploitation anthropogenic deposits				2		K2_UM_U2, K2_UM_U3, K2_UM_U6, K2_UM_U7, K2_UM_U8, K2_UM_U9, K2_UM_U10, K2_UM_K2, K2_UM_K3	30	90	3	3	2,1	T/Z	Z		DN	P	K
8.		ESG reporting	1					K2_UM_W2, K2_UM_W3, K2_UM_W4, K2_UM_W5, K2_UM_W6, K2_UM_W7, K2_UM_W8, K2_UM_W11, K2_UM_W12, K2_UM_K2	15	30	1	1	0,7	T/Z	Z		DN		K
9.		ESG reporting				2		K2_UM_U1, K2_UM_U2, K2_UM_U3, K2_UM_U5, K2_UM_U6, K2_UM_U7, K2_UM_U10, K2_UM_K2, K2_UM_K3	30	90	3	3	2,1	T/Z	Z		DN	P	K
10.		Process engineering				4		K2_UM_U1, K2_UM_U2, K2_UM_U3, K2_UM_U6, K2_UM_U7, K2_UM_K3, K2_UM_K4	60	150	5		3,5	T/Z	Z			P	K
11.		Analysis of circular economy in processing processes	1					K2_UM_W2, K2_UM_W6, K2_UM_W7, K2_UM_W9, K2_UM_W10	15	30	1	1	0,7	T/Z	Z		DN		K
12.		Analysis of circular economy in processing processes				2		K2_UM_U1, K2_UM_U2, K2_UM_U3, K2_UM_U5, K2_UM_U6, K2_UM_U7,	30	90	3	3	2,1	T/Z	Z		DN	P	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 courses – after the letter E or Z - enter in brackets the final course form (lec, cl, lab, pr, sem)
[4]University-wide course /group of courses – enter O
[5]DN - number of ECTS points assigned to the classes related to the University's academic activity in the discipline/disciplines to which the main field of study is assigned
[6]Practical course / group of courses – enter P. For the group of courses – in brackets enter the number of ECTS points assigned to practical courses
[7]KO – general education courses, PD – basic sciences courses, K – main field of study courses, S – specialization courses

								K2_UM_U10, K2_UM_K2, K2_UM_K4											
13.		Physical and physicochemical methods of waste processing	2					K2_UM_W9, K2_UM_W10, K2_UM_W11, K2_UM_W12	30	60	2	2	1,4	T/Z	**E**		DN		K
14.		Physical and physicochemical methods of waste processing			3			K2_UM_U3, K2_UM_U5, K2_UM_U6, K2_UM_U8, K2_UM_U9, K2_UM_U10	45	120	4	4	2,8	T	Z		DN	P	K
15.		Physical and physicochemical methods of waste processing					1	K2_UM_U3, K2_UM_U5, K2_UM_U6, K2_UM_U8, K2_UM_U9, K2_UM_U10, K2_UM_U12, K2_UM_K3	15	60	2	2	1,4	T/Z	Z		DN	P	K
16.		Chemical and biological methods of waste processing	2					K2_UM_W9, K2_UM_W10, K2_UM_W11, K2_UM_W12	30	60	2	2	1,4	T/Z	**E**		DN		K
17.		Chemical and biological methods of waste processing			6			K2_UM_U3, K2_UM_U5, K2_UM_U6, K2_UM_U8, K2_UM_U9, K2_UM_U10	90	180	6	6	4,2	T	Z		DN	P	K
18.		Chemical and biological methods of waste processing					1	K2_UM_U3, K2_UM_U5, K2_UM_U6, K2_UM_U8, K2_UM_U9, K2_UM_U10, K2_UM_U12, K2_UM_K3	15	60	2	2	1,4	T/Z	Z		DN	P	K
19.		Instrumental methods in biomonitoring and analysis of products	2					K2_UM_W9, K2_UM_W10, K2_UM_W11, K2_UM_W12	30	60	2	2	1,4	T/Z	Z		DN		K
20.		Instrumental methods in biomonitoring and analysis of products			5			K2_UM_U3, K2_UM_U5, K2_UM_U6, K2_UM_U8,	75	180	6	6	4,2	T	Z		DN	P	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 courses – after the letter E or Z - enter in brackets the final course form (lec, cl, lab, pr, sem)
[4]University-wide course /group of courses – enter O
[5]DN - number of ECTS points assigned to the classes related to the University's academic activity in the discipline/disciplines to which the main field of study is assigned
[6]Practical course / group of courses – enter P. For the group of courses – in brackets enter the number of ECTS points assigned to practical courses
[7]KO – general education courses, PD – basic sciences courses, K – main field of study courses, S – specialization courses

								K2_UM_U9, K2_UM_U10											
21.		Project Feasibility Study	1					K2_UM_W1, K2_UM_W2, K2_UM_W3, K2_UM_W4, K2_UM_W6, K2_UM_W7, K2_UM_W8, K2_UM_W11,	15	30	1		0,7	T/Z	Z				K
22.		Project Feasibility Study				2		K2_UM_U1, K2_UM_U2, K2_UM_U3, K2_UM_U5, K2_UM_U6,	30	60	2	2	1,4	T/Z	Z		DN	P	K
		Total	**16**	**0**	**14**	**17**	**2**		**735**	**1800**	**60**	**49**	**42**		**4**				

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					
16	**0**	**14**	**17**	**2**	**735**	**1800**	**60**	**49**	**42**

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

4.2 List of optional blocks

4.2.1 List of general education blocks

4.2.1.1 Liberal-managerial subjects blocks *(min. 2. ECTS points):*

No.	Course/ group of courses code	Name of course/group of courses (denote group of courses with symbol **GK**)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form[2] of course /group of courses	Way[3] of crediting	Course/group of courses			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN[5] classes	BU[1] classes			University -wide[4]	Concerning scientific activities[5]	Practical[6]	Type[7]
1.		Humanities and management course	2					K2_UM_W3, K2_UM_W4	30	60	2		1,4	T/Z	Z	O			KO
		Total	**2**	**0**	**0**	**0**	**0**		**30**	**60**	**2**		**1,4**						

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

No.	Course/ group of courses code	Name of course/group of courses (denote group of courses with symbol **GK**)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form[2] of cours e/grou p of cours es	Way[3] of crediting	Course/group of courses			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN[5] classes	BU[1] classes			University-wide[4]	Concerning scientific activities[5]	Practical[6]	Type[7]
1.		Foreign language II		3				K2_UM_U4	45	60	2		1,4	T/Z	Z	O		P	KO
2.		Foreign language I		1				K2_UM_U4	15	30	1		0,7	T/Z	Z	O		P	KO
		Total	**0**	**4**	**0**	**0**	**0**		**60**	**90**	**3**		**2,1**						

4.2.1.3 Sporting classes block *(0. ECTS points):*

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

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

4.2.1.4 *Information technologies* block *(min. .... ECTS points):*

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

Altogether for general education blocks:

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

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

4.2.2 List of basic sciences blocks

4.2.2.1 ***Mathematics*** **block** *(min. .... ECTS points):*

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

4.2.2.2 ***Physics*** **block** *(min. .... ECTS points):*

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

4.2.2.3 ***Chemistry*** **block** *(min. .... ECTS points):*

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

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

Altogether for general 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					

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

4.2.3 List of the main field of study blocks

4.2.3.1 Diploma profile block *(min. 27 ECTS points):*

No.	Course/ group of courses code	Name of course/group of courses (denote group of courses with symbol **GK**)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form[2] of course/group of courses	Way[3] of crediting	Course/group of courses			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN[5] classes	BU[1] classes			University - wide[4]	Concerning scientific activities[5]	Practical[6]	Type[7]
1		Graduate laboratory			20			K2_UM_U12, K2_UM_K1, K2_UM_K5	300	750	25	25	17,5	T	Z		DN	P	K
2		Graduate seminar					2	K2_UM_U11, K2_UM_K1, K2_UM_K5	30	60	2	2	1,4	T/Z	Z		DN	P	K
		Total			**20**		**2**		**330**	**810**	**27**	**27**	**18,9**						

4.2.3.2 Optional courses block (*min. 5 ECTS points):*

No.	Course/ group of courses code	Name of course/group of courses (denote group of courses with symbol **GK**)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form[2] of course/group of courses	Way[3] of crediting	Course/group of courses			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN[5] classes	BU[1] classes			University - wide[4]	Concerning scientific activities[5]	Practical[6]	Type[7]
1.		**Elective course Block 1**			**2**				**30**	**60**	**2**		**1,4**	**T/Z**	**Z**			**P**	**K**
		GIS Fundamentals			2			K2_UM_U1, K2_UM_U2 K2_UM_U6	30	60	2		1,4						
		Technical drawing			2			K2_UM_U1, K2_UM_U2 K2_UM_U6	30	60	2		1,4						
2.		**Elective course Block II**				**3**			**45**	**90**	**3**		**2,1**	**T/Z**	**Z**			**P**	**K**
		Fundamentals of process engineering				3		K2_UM_U1, K2_UM_U2 K2_UM_U3, K2_UM_U6 K2_UM_U7,	45	90	3		2,1						
		Technological Design Process				3		K2_UM_U1, K2_UM_U2 K2_UM_U3, K2_UM_U6 K2_UM_U7,	45	90	3		2,1						
		Total			**2**	**3**			**75**	**150**	**5**		**3,5**						

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

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					
		22	**3**	**2**	**405**	**960**	**32**	**27**	**22,4**

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

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

Not applicable

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**		

4.4 „Diploma dissertation" block

Type of diploma dissertation	~~Licencjat~~ / ~~inżynier~~ / ~~magister~~ / magister inżynier*	
Number of diploma dissertation semesters	**Number of ECTS points**	**Code**
4	Graduate laboratory 25 ECTS	
	Graduate seminar 2 ECTS	
Character of diploma dissertation		
Thesis of the second cycle (master) should have traits of scientific, experimental or theoretical, with a primary or practical. Work should lead to new results of original research or technical and technological solutions, and its presentation in the form of written work should include the results and show the knowledge and skills of the author, including but not limited to:(1)The ability to formulate objectives and research questions; (2)Ability to use literature and other sources of knowledge ;(3)The ability to plan and carry out research and other activities to achieve its objectives and problems; (4)Ability to correctly interpret the results; (5)Ability to use precise and clear language and the proper matching of the images presented to illustrate the problem.		
Number of BU[1] ECTS points	**18,9**	

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

5. Ways of verifying assumed learning outcomes

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

6. Range of diploma examination

The diploma examination consists of the presentation of the diploma thesis and the diploma examination, during which the student answers questions in the areas corresponding to the program of studies and covers the following issues:

- urban mining and the circular economy;
- sustainable resource management, circularity assessment;
- secondary raw materials management;
- chemical, biological and physical technologies for waste processing;
- product and process life cycle assessment.

A detailed list of the diploma examination issues in a given academic year is consulted with the academic teachers conducting individual courses. Then, after approval by the Program Committee of the field of study, it is published on the Faculty's website.

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

Each course should be passed in accordance with the study plan. If it is necessary to repeat a course, it should be completed in the next semester in which it is offered.

***T/Z** Remote form of classes requires Dean's approved, but cannot exceed 75 % of ECTS points.
T/Z option is accepted only for lectures, exercises and seminars

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

8. Plan of studies (attachment no. 4)

Approved by faculty student government legislative body:

.....
Date

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

.....
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 courses – after the letter E or Z - enter in brackets the final course form (lec, cl, lab, pr, sem)
[4]University-wide course /group of courses – enter O
[5]DN - number of ECTS points assigned to the classes related to the University's academic activity in the discipline/disciplines to which the main field of study is assigned
[6]Practical course / group of courses – enter P. For the group of courses – in brackets enter the number of ECTS points assigned to practical courses
[7]KO – general education courses, PD – basic sciences courses, K – main field of study courses, S – specialization courses

Zał. nr 4 do ZW 16/2020
Attachment no. 3 to Program of Studies

PLAN OF STUDIES

FACULTY: **Chemistry**

MAIN FIELD OF STUDY: **URBAN MINING**

EDUCATION LEVEL: **second-level studies**

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

PROFILE: **general academic**

LANGUAGE OF STUDY: **English**

In effect since **2022/2023**

*delete as applicable

Plan of studies structure (optionally)

1) in ECTS point layout

(space for scheme of plan)

2) in hourly layout

(space for scheme of plan)

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

STUDIA II LEVEL - MAGISTERSKIE (4 sem.) DIRECTION**: URBAN MINING** **inter-faculty studies W3 i W6**

SEM.	I	II	III	IV
hours	**24h / 30 ECTS / 2E**	**24h / 30 ECTS / 2E**	**25h / 30 ECTS / 2E**	**25h / 30 ECTS / 0E**
1	E Urban mining-utility of waste 3w **4 ECTS**	Methods of waste streams identification and assessing the raw material potential 2w + 3p **(2+4) ECTS**	E Physical and physicochemical methods of waste processing 2w + 3l + 1s **(2+4+2) ECTS**	Gradudate laboratory 20l **25 ECTS**
2				
3				
4	E Basics of processing methods 1w + 1l / **(2+2) ECTS**			
5				
6	Biological factors in industry – fundamentals 1s + 2l **(2+3) ECTS**	Identification and assessment of environmental aspects / 1w / **1 ECTS**		
7		Circularity assessment tools 2p / **3 ECTS**	E Chemical and biological methods of waste processing 2w + 6l + 1s **(2 + 6 + 2) ECTS**	
8				
9	Statistical methods in waste management 2w + 2l **(2+3) ECTS**	E Techniques and methods of exploitation anthropogenic deposits. 1w + 2p **(1+3) ECTS**		
10				
11				
12		ESG reporting 1w + 2p **(1 +3) ECTS**		
13	Humanities and management course 2W **2 ECTS**			
14				
15	Block I (elective course) 2l **2 ECTS**	E Process engineering 2w + 4p **(2 + 5) ECTS**		
16			Instrumental methods in biomonitoring and analysis of products 2w + 5l **(2 + 6) ECTS**	
17	Block II (elective course) 3p **3 ECTS**			
18				
19				
20	Formal, legal and economic aspects of anthropogenic deposits exploitation 2w / **3ECTS**			
21		Analysis of circular economy in processing processes 1w + 2p **(1 + 3) ECTS**		Project Feasibility Study 1w + 2p **(1 + 2) ECTS**
22	Foreign language II/ 3c / **2 ECTS**			
23			Occupational Health and Safety in waste management 1w + 1p + 1s **(1+ 2+ 1) ECTS**	
24		Foreign language I /1c/ **1 ECTS**		Graduate seminar 2s / **2 ECTS**
25				

Elective course I: GIS Fundamentals / 2l / 2ECTS
Technical drawing / 2l / 2ECTS

Elective course II: Fundamentals of process engineering / 3p / 3ECTS
Technological Design Process / 3p / 3ECTS

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

Semester 1

Obligatory courses / groups of courses Number of ECTS points 23

No.	Course/ group of courses code	Name of course/group of courses (denote group of courses with symbol **GK**)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form[2] of course/group of courses	Way[3] of crediting	Course/group of courses			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN[5] classes	BU[1] classes			University-wide[4]	Concerning scientific activities[5]	Practical[6]	Type[7]
1		Statistical methods in waste management	2					K2_UM_W1 K2_UM_W10	30	60	2		1,4	T/Z	Z				PD
2		Statistical methods in waste management			2			K2_UM_U1 K2_UM_U3	30	90	3		2,1	T	Z			P	PD
3		Basics of processing methods	1					K2_UM_W5 K2_UM_W8 K2_UM_W9	15	60	2	2	1,4	T/Z	**E**		DN		PD
4		Basics of processing methods			1			K2_UM_U2 K2_UM_U6	15	60	2	2	1,4	T	Z		DN	P	PD
5		Urban mining – utility of waste	3					K2_UM_W2 K2_UM_W4 K2_UM_W5 K2_UM_W7 K2_UM_W6 K2_UM_W10 K2_UM_W11 K2_UM_W12	45	120	4		2,8	T/Z	**E**				K
6		Humanities and management course	2					K2_UM_W3 K2_UM_W4	30	60	2		1,4	T/Z	Z	O			KO
7		Formal, legal and economic aspects of anthropogenic deposits exploitation	2					K2_UM_W3 K2_UM_W4	30	90	3		2,1	T/Z	Z				KO
8		Biological factors in industry - fundamentals			2			K2_UM_W9 K2_UM_W12	30	90	3		1,4	T	Z			P	PD

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

9		Biological factors in industry - fundamentals					1	K2_UM_U6 K2_UM_U8	15	60	2		2,1	T/Z	Z			P	PD
		Total	**10**		**5**	**0**	**1**		**240**	**690**	**23**	**4**	**16,1**		**2**				

Optional courses / groups of courses (7 ECTS points)

No.	Course/ group of courses code	Name of course/group of courses (denote group of courses with symbol **GK**)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form[2] of course/group of courses	Way[3] of crediting	Course/group of courses			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN[5] classes	BU[1] classes			University -wide[4]	Concerning scientific activities[5]	Practical[6]	Type[7]
1.		**Elective course Block 1**			**2**				**30**	**60**	**2**		**1,4**	**T/Z**	**Z**			**P**	**K**
		GIS Fundamentals			2			K2_UM_U1 K2_UM_U2 K2_UM_U6	30	60	2		1,4						
		Technical drawing			2			K2_UM_U1 K2_UM_U2 K2_UM_U6	30	60	2		1,4						
2.		**Elective course Block II**				**3**			**45**	**90**	**3**		**2,1**	**T/Z**	**Z**			**P**	**K**
		Fundamentals of process engineering				3		K2_UM_U1 K2_UM_U2 K2_UM_U3 K2_UM_U6 K2_UM_U7,	45	90	3		2,1						
		Technological Design Process				3		K2_UM_U1 K2_UM_U2 K2_UM_U3, K2_UM_U6 K2_UM_U7,	45	90	3		2,1						
3		Foreign language II		3				K2_UM_U4	45	60	2		1,4	T/Z	Z	O		P	KO
		Total	**0**	**3**	**2**	**3**	**0**		**120**	**210**	**7**		**4,9**						

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

Altogether in semester

Total number of hours					Total number of ZZU hours	Total number of CNPS hours	Total number of ECTS points	Total number of ECTS points for DN classes[5]	Number of ECTS points for BU classes[1]
lec	cl	lab	pr	sem					
10	**3**	**7**	**3**	**1**	**360**	**900**	**30**	**4**	**21**

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

Semester 2

Obligatory courses / groups of courses Number of ECTS points 29

No.	Course/ group of courses code	Name of course/group of courses (denote group of courses with symbol **GK**)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form[2] of course/group of courses	Way[3] of crediting	Course/group of courses			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN[5] classes	BU[1] classes			University-wide[4]	Concerning scientific activities[5]	Practical[6]	Type[7]
1.		Process engineering	2					K2_UM_W2, K2_UM_W4 K2_UM_ W8, K2_UM_W9 K2_UM_W11, K2_UM_W12	30	60	2		1,4	T/Z	**E**				PD
2.		Methods of waste streams identification and assessing the raw material potential	2					K2_UM_W2 K2_UM_W4 K2_UM_W9 K2_UM_W10	30	60	2	2	1,4	T/Z	Z		DN		K
3.		Methods of waste streams identification and assessing the raw material potential				3		K2_UM_U3 K2_UM_U6 K2_UM_U7 K2_UM_U8 K2_UM_U9 K2_UM_U10	45	120	4	4	2,8	T/Z	Z		DN	P	K
4.		Identification and assessment of environmental aspects	1					K2_UM_W2 K2_UM_W6 K2_UM_W7 K2_UM_W9 K2_UM_W10	15	30	1		0,7	T/Z	Z				K
5.		Circularity assessment tools				2		K2_UM_U1 K2_UM_U2 K2_UM_U3 K2_UM_U5 K2_UM_U6 K2_UM_U7 K2_UM_W8	30	90	3	3	2,1	T/Z	Z		DN	P	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 courses – after the letter E or Z - enter in brackets the final course form (lec, cl, lab, pr, sem)
[4]University-wide course /group of courses – enter O
[5]DN - number of ECTS points assigned to the classes related to the University's academic activity in the discipline/disciplines to which the main field of study is assigned
[6]Practical course / group of courses – enter P. For the group of courses – in brackets enter the number of ECTS points assigned to practical courses
[7]KO – general education courses, PD – basic sciences courses, K – main field of study courses, S – specialization courses

								K2_UM_K3											
6.		Techniques and methods of exploitation anthropogenic deposits	1					K2_UM_W4 K2_UM_W5 K2_UM_W8 K2_UM_W9 K2_UM_W10 K2_UM_W11	15	30	1	1	0,7	T/Z	**E**		DN		K
7.		Techniques and methods of exploitation anthropogenic deposits				2		K2_UM_U2 K2_UM_U3 K2_UM_U6 K2_UM_U7 K2_UM_U8 K2_UM_U9 K2_UM_U10 K2_UM_K2 K2_UM_K3	30	90	3	3	2,1	T/Z	Z		DN	P	K
8.		ESG reporting	1					K2_UM_W2 K2_UM_W3 K2_UM_W4 K2_UM_W5 K2_UM_W6 K2_UM_W7 K2_UM_W8 K2_UM_W11 K2_UM_W12 K2_UM_K2	15	30	1	1	0,7	T/Z	Z		DN		K
9.		ESG reporting				2		K2_UM_U1 K2_UM_U2 K2_UM_U3 K2_UM_U5 K2_UM_U6 K2_UM_U7 K2_UM_U10 K2_UM_K2 K2_UM_K3	30	90	3	3	2,1	T/Z	Z		DN	P	K
10.		Process engineering				4		K2_UM_U1 K2_UM_U2 K2_UM_U3 K2_UM_U6 K2_UM_U7 K2_UM_K3	60	150	5		3,5	T/Z	Z			P	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 courses – after the letter E or Z - enter in brackets the final course form (lec, cl, lab, pr, sem)
[4]University-wide course /group of courses – enter O
[5]DN - number of ECTS points assigned to the classes related to the University's academic activity in the discipline/disciplines to which the main field of study is assigned
[6]Practical course / group of courses – enter P. For the group of courses – in brackets enter the number of ECTS points assigned to practical courses
[7]KO – general education courses, PD – basic sciences courses, K – main field of study courses, S – specialization courses

								K2_UM_K4										
11.		Analysis of circular economy in processing processes	1					K2_UM_W2 K2_UM_W6 K2_UM_W7 K2_UM_W9 K2_UM_W10	15	30	1	1	0,7	T/Z	Z		DN		K
12.		Analysis of circular economy in processing processes				2		K2_UM_U1 K2_UM_U2 K2_UM_U3 K2_UM_U5 K2_UM_U6 K2_UM_U7 K2_UM_U10 K2_UM_K2 K2_UM_K4	30	90	3	3	2,1	T/Z	Z		DN	P	K
		Total	**8**	**0**	**0**	**15**	**0**		**345**	**870**	**29**	**21**	**20,3**		**2**				

Optional courses / groups of courses (1 ECTS points)

No.	Course/ group of courses code	Name of course/group of courses (denote group of courses with symbol **GK**)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form[2] of course/group of courses	Way[3] of crediting	Course/group of courses			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN[5] classes	BU[1] classes			University -wide[4]	Concerning scientific activities[5]	Practical[6]	Type[7]
1		Foreign language I		1				K2_UM_U4	15	30	1		0,7	T/Z	Z	O		P	KO
		Total		**1**					**15**	**30**	**1**		**0,7**						

Altogether in semester

Total number of hours					Total number of ZZU hours	Total number of CNPS hours	Total number of ECTS points	Total number of ECTS points for DN classes[5]	Number of ECTS points for BU classes[1]
lec	cl	lab	pr	sem					
8	**1**	**0**	**15**	**0**	**360**	**900**	**30**	**21**	**21**

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

Semester 3

Obligatory courses / groups of courses Number of ECTS points 30

No.	Course/ group of courses code	Name of course/group of courses (denote group of courses with symbol **GK**)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form[2] of course/group of courses	Way[3] of crediting	Course/group of courses			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN[5] classes	BU[1] classes			University-wide[4]	Concerning scientific activities[5]	Practical[6]	Type[7]
1		Occupational Health and Safety in waste management	1					K2_UM_W2 K2_UM_W3	15	30	1		0,7	T/Z	Z				PD
2		Occupational Health and Safety in waste management				1		K2_UM_U6 K2_UM_U7 K2_UM_K1	15	60	2		1,4	T/Z	Z			P	PD
3		Occupational Health and Safety in waste management					1	K2_UM_U6 K2_UM_U7 K2_UM_K1 K2_UM_K3 K2_UM_K4	15	30	1		0,7	T/Z	Z			P	PD
4		Physical and physicochemical methods of waste processing	2					K2_UM_W9 K2_UM_W10 K2_UM_W11 K2_UM_W12	30	60	2	2	1,4	T/Z	**E**		DN		K
5		Physical and physicochemical methods of waste processing			3			K2_UM_U3 K2_UM_U5 K2_UM_U6 K2_UM_U8 K2_UM_U9 K2_UM_U10	45	120	4	4	2,8	T/Z	Z		DN	P	K
6		Physical and physicochemical methods of waste processing					1	K2_UM_U3 K2_UM_U5 K2_UM_U6 K2_UM_U8 K2_UM_U9 K2_UM_U10 K2_UM_U12 K2_UM_K3	15	60	2	2	1,4	T/Z	Z		DN	P	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 courses – after the letter E or Z - enter in brackets the final course form (lec, cl, lab, pr, sem)
[4]University-wide course /group of courses – enter O
[5]DN - number of ECTS points assigned to the classes related to the University's academic activity in the discipline/disciplines to which the main field of study is assigned
[6]Practical course / group of courses – enter P. For the group of courses – in brackets enter the number of ECTS points assigned to practical courses
[7]KO – general education courses, PD – basic sciences courses, K – main field of study courses, S – specialization courses

7		Chemical and biological methods of waste processing	2					K2_UM_W9 K2_UM_W10 K2_UM_W11 K2_UM_W12	30	60	2	2	1,4	T/Z	**E**		DN		K
8		Chemical and biological methods of waste processing			6			K2_UM_U3 K2_UM_U5 K2_UM_U6 K2_UM_U8 K2_UM_U9 K2_UM_U10	90	180	6	6	4,2	T	Z		DN	P	K
9		Chemical and biological methods of waste processing					1	K2_UM_U3 K2_UM_U5 K2_UM_U6 K2_UM_U8 K2_UM_U9 K2_UM_U10 K2_UM_U12 K2_UM_K3	15	60	2	2	1,4	T/Z	Z		DN	P	K
10		Instrumental methods in biomonitoring and analysis of products	2					K2_UM_W9 K2_UM_W10 K2_UM_W11 K2_UM_W12	30	60	2	2	1,4	T/Z	Z		DN		K
11		Instrumental methods in biomonitoring and analysis of products			5			K2_UM_U3 K2_UM_U5 K2_UM_U6 K2_UM_U8 K2_UM_U9 K2_UM_U10	75	180	6	6	4,2	T	Z		DN	P	K
		Total	**7**	**0**	**14**	**1**	**3**		**375**	**900**	**30**	**26**	**21**		**2**				

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

Optional courses / groups of courses(……. ECTS points)

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

Altogether in semester

Total number of hours					Total number of ZZU hours	Total number of CNPS hours	Total number of ECTS points	Total number of ECTS points for DN classes[5]	Number of ECTS points for BU classes[1]
lec	cl	lab	pr	sem					
7	**0**	**14**	**1**	**3**	**375**	**900**	**30**	**26**	**21**

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

Semester 4

Obligatory courses / groups of courses Number of ECTS points 3

No.	Course/ group of courses code	Name of course/group of courses (denote group of courses with symbol **GK**)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form[2] of course/group of courses	Way[3] of crediting	Course/group of courses			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN[5] classes	BU[1] classes			University -wide[4]	Concerning scientific activities[5]	Practical[6]	Type[7]
1		Project Feasibility Study	1					K2_UM_W1 K2_UM_W2 K2_UM_W3 K2_UM_W4 K2_UM_W6 K2_UM_W7 K2_UM_W8 K2_UM_W11	15	30	1		0,7	T/Z	Z				K
2		Project Feasibility Study				2		K2_UM_U1 K2_UM_U2 K2_UM_U3 K2_UM_U5 K2_UM_U6	30	60	2	2	1,4	T/Z	Z		DN	P	K
		Total	**1**	**0**	**0**	**2**	**0**		**45**	**90**	**3**	**2**	**2,1**						

[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 courses – after the letter E or Z - enter in brackets the final course form (lec, cl, lab, pr, sem)
[4]University-wide course /group of courses – enter O
[5]DN - number of ECTS points assigned to the classes related to the University's academic activity in the discipline/disciplines to which the main field of study is assigned
[6]Practical course / group of courses – enter P. For the group of courses – in brackets enter the number of ECTS points assigned to practical courses
[7]KO – general education courses, PD – basic sciences courses, K – main field of study courses, S – specialization courses

Optional courses / groups of courses (27 ECTS points)

No.	Course/ group of courses code	Name of course/group of courses (denote group of courses with symbol **GK**)	Weekly number of hours					Learning effect symbol	Number of hours		Number of ECTS points			Form[2] of course/group of courses	Way[3] of crediting	Course/group of courses			
			lec	cl	lab	pr	sem		ZZU	CNPS	Total	DN[5] classes	BU[1] classes			University -wide[4]	Concerning scientific activities[5]	Practical[6]	Type[7]
1		Graduate laboratory			20			K2_UM_U12 K2_UM_K1 K2_UM_K5	300	750	25	25	17,5	T	Z		DN	P	K
2		Graduate seminar					2	K2_UM_U11 K2_UM_K1 K2_UM_K5	30	60	2	2	1,4	T/Z	Z		DN	P	K
		Total			**20**		**2**		**330**	**810**	**27**	**27**	**18,9**						

Altogether in semester

Total number of hours					Total number of ZZU hours	Total number of CNPS hours	Total number of ECTS points	Total number of ECTS points for DN classes[5]	Number of ECTS points for BU classes[1]
lec	cl	lab	pr	sem					
1	**0**	**20**	**2**	**2**	**375**	**900**	**30**	**29**	**21**

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

2. Set of examinations in semestral arrangement

Course / group of courses code	Names of courses / groups of courses ending with examination	Semester
	1.Urban mining – utility of waste 2. Basics of processing methods	1
	1. Techniques and methods of exploitation anthropogenic deposits 2. Process engineering	2
	1. Physical and physicochemical methods of waste processing 2. Chemical and biological methods of waste processing	3

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

Semester	Allowable deficit of ECTS points after semester
1	6
2	6
3	6
4	0

***T/Z** Remote form of classes requires Dean's approved, but cannot exceed 75 % of ECTS points.
T/Z option is accepted only for lectures, exercises and seminars

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

Opinion of student government legislative body

.....
Date

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

.....
Date

DZIEKAN
prof. dr hab. Piotr Młynarz
(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 courses – after the letter E or Z - enter in brackets the final course form (lec, cl, lab, pr, sem)
[4]University-wide course /group of courses – enter O
[5]DN - number of ECTS points assigned to the classes related to the University's academic activity in the discipline/disciplines to which the main field of study is assigned
[6]Practical course / group of courses – enter P. For the group of courses – in brackets enter the number of ECTS points assigned to practical courses
[7]KO – general education courses, PD – basic sciences courses, K – main field of study courses, S – specialization courses

Zał. nr 5 do ZW 16/2020

FACULTY OF CHEMISTRY

SUBJECT CARD

Name of subject in Polish:	Analiza GOZ w procesach przeróbczych
Name of subject in English:	Analysis of circular economy in processing processes
Main field of study (if applicable):	Urban mining
Specialization (if applicable):	—
Profile:	academic / ~~practical~~*
Level and form of studies:	~~1st~~/ 2nd level, ~~uniform magister studies~~*, full-time / ~~part-time~~*
Kind of subject:	obligatory / ~~optional / university-wide~~*
Subject code	
Group of courses	YES / ~~NO~~*

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15			30	
Number of hours of total student workload (CNPS)	15			90	
Form of crediting	~~Examination~~ / crediting with grade*			~~Examination~~ / crediting with grade*	
For group of courses mark (X) final course					
Number of ECTS points	1			3	
including number of ECTS points for practical classes (P)				3	
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	0,7			2,1	

*delete as not necessary

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCIES

1. Knowledge of the basics of waste processing
2. Basic knowledge of Environmental protection

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SUBJECT OBJECTIVES

C1. Student knows the key terms in the area of circular economy
C2. Acquiring the ability to identify circular economy potentials in waste processing

SUBJECT EDUCATIONAL EFFECTS

relating to the knowledge:

PEU_W01 - Knows the concept of a circular economy, its importance in the modern world and in waste management

PEU_W02 - Knows what sources of streams for circular economy exist in processing processes

relating to skills:
PEU_U01 - Can identify aspects of circular economy in the processing processes
PEU_U02 - Can design the processing process taking into account the aspects of circular economy
PEU_U03 - Can design the process of obtaining raw materials from a waste landfill, taking into account circular economy

relating to social competencies:
PEU_K01 - Arguments selected design solutions based on knowledge
PEU_K02 - Participates in group thematic discussions
PEU_K03 - He understands the importance of the documentation he is doing and is aware of the continuous improvement of his own knowledge and skills

Lecture		**Number of hours**
Le 1	Circular economy and Urban mining	1
Le 2	Sources of waste collection. Urban mining and landfill mining	2
Le 3	Identification and description of the processes of obtaining raw materials. Specification of aspects of circular economy.	2
Le 4	Possibilities of reusing the waste stream.	2
Le 5	Possibility to use water and wastewater.	2
Le 6	Possibility of using waste energy.	2
Le 7	Possibilities of using the land	2
Le 8	Test	2
	Total hours	15

Project		**Number of hours**
Pr1-2	Defining the LC of the process of obtaining and processing waste. Characteristics of the products	4
Pr3-4	Designing the waste disposal process, its process assessment and identification of aspects of circular economy of this process and development of a circularity program	4
Pr5-6	Designing the process of segregating waste, its process evaluation and identification of aspects of circular economy of this process as well as developing a circularity program	4

Pr7-8	Designing the process of crushing and classification of waste, its process evaluation and identification of aspects of circular economy of this process and development of a circularity program	4
Pr9-10	Designing a chemical-physical waste processing process, its process evaluation and identification of aspects of circular economy of this process and development of a circularity program	4
Pr11-12	Designing the process of thermal processing of waste, its process evaluation and identification of aspects of circular economy of this process and development of a circularity program	4
Pr13-14	Designing the process of obtaining raw materials from deposited waste in a landfill, its process evaluation and identification of aspects of circular economy of this process and development of a circularity program	4
Pr15	Project defense	2
	Total hours	30

TEACHING TOOLS USED
N1. Presentation N2. Moderated discussion N3. Consultation

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT

Evaluation (F – forming during the semester), P – concluding (at semester end)	Learning outcomes code	Way of evaluating learning outcomes achievement
P (lecture)	PEU_W01-W02 PEU_U01	P – final grade
F,P (project)	PEU_W01-W02 PEU_U01-U03 PEU_K01-K03	F – forming projects grades P – final grade

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] Development of a guidance document on best practices in the extractive waste management
[2] Current communications of the European Commission in the field of Circular Economy
[3] Rosendal R.M, : Landfill Mining. Process, Feasibility, Economy, Benefits and Limitations. Reno San. 2009.
[4] Environmental Guidelines Solid Waste Landfills. Second edition 2016. www.epa.nsw.gov.au
[5] Lopez G.C, Clausen A.,Pretz T.: Landfill Mining

[6] Determination of the potential Landfill and need remediation of landfill in Flandres. Final Report 2013.
[7] Urban mining and sustainable Waste Management pod red Ghosh B.K. Springer.A case study on sampling, processing and characterization of excavated waste from an Austrian landfill. RWTH Aachen . Sardinia. 2017.Sixteenth International Waste Management and Landfill Symposium.
[8] Frandegard P.F.,Krook J., Svenson N., Eklund M.:A novel approach for environmental evaluation of landfill mining. Linkoping University Post Print 2013. Journal of Cleaner Production no 55.

SECONDARY LITERATURE:

[1] Reports of companies operating in the area of Waste Management and circular economy

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Załącznik nr 5 do ZW 16/2020

FACULTY OF CHEMISTRY

SUBJECT CARD

Name of subject in Polish Podstawy procesów przeróbczych
Name of subject in English Basics of processing methods
Main field of study (if applicable): Urban mining
Specialization (if applicable): ……..
Profile: academic / ~~practical~~*
Level and form of studies: ~~1st~~/ 2nd level, ~~uniform magister studies*~~, full-time / ~~part-time~~*
Kind of subject: obligatory / ~~optional / university-wide~~*
Subject code …….
Group of courses ~~YES~~ / NO

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15		15		
Number of hours of total student workload (CNPS)	60		60		
Form of crediting	Examination	Examination / crediting with grade*	Crediting with grade	Examination / crediting with grade*	Examination / crediting with grade*
For group of courses mark (X) final course					
Number of ECTS points	2		2		
including number of ECTS points for practical classes (P)	1		2		
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	1.4		1.4		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Has a basic knowledge of chemistry, physics and environmental protection.

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SUBJECT OBJECTIVES

C1 to acquaint the students with the foundations of separation methods.
C2 to acquaint the students with the analysis and assessment of separation process.

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge:

PEU_W01 The student has knowledge of the utilization of useful materials, by learning about the properties and basic separation methods.
PEU_W02 The student has knowledge of the characteristics of the basic separation methods.

relating to skills:

PEU_U01 The student is able to properly select and characterize separation process.
PEU_U02 The student is able to carry out laboratory methods of processing, in the range of basic measurements in processing, comminution and classification processes, gravity and magnetic separation, flotation and chemical leaching, and determination of physico-mechanical properties of useful materials.

relating to social competences:

PEU_K01 The student should be ready to critically evaluate the content and recognize the importance of knowledge in solving problems focused on waste treatment.

PROGRAMME CONTENT

	Lecture	**Number of hours**
Lec 1	Introduction, aim and scope of lectures.	1
Lec 2	Separation characteristics. Product separation. Sorting. Distribution.	2
Lec 3	Basics of comminution and classification.	2
Lec 4	Basics of flotation process.	2
Lec 5	Basics of magnetic, electric and optical separation.	2
Lec 6	Basics of gravity separation.	2
Lec 7	Analysis of separation process.	2
Lec 8	Basics of hydro- and pyrometallurgical processes.	2
	Total hours	**15**

Laboratory		Number of hours
Lab 1	Introduction. OHS. Basic physicochemical measurements in processing.	2
Lab 2	Sorting of waste materials.	2
Lab 3	Comminution and classification.	2
Lab 4	Flotation.	2
Lab 5	Magnetic separation.	2
Lab 6	Thin stream separation. Gravity separation.	2
Lab 7	Chemical leaching.	2
Lab 8	Final test.	1
	Total hours	**15**

TEACHING TOOLS USED
N1. Lecture - informative lecture, contents illustrated by multimedia presentations N2. Laboratory exercises – test of the knowledge from the preparation to exercise N3. Laboratory exercises – discussion on the scope and methodology of research N4. Laboratory exercises – carrying out research based on the instruction N5. Own work – preparation for laboratory exercises N6. Own work – preparation of report from conducted laboratory test N7. Own work – individual studies and preparation for the exam N8. 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_K01	P1 - Written examination
F1 F2 P2	PEU_U01 PEU_U02	F1 - assessment of preparation for laboratory classes F2 - evaluation of exercise reports P2 - final mark for laboratory classes (as a weighted average with 40% F1 and 60% F2)

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] Drzymała J., 2007, Mineral processing: foundations of theory and practice of minerallurgy, Oficyna Wydawnicza Politechniki Wrocławskiej.
[2] Wills B.A., Finch J.A., 2015, Wills' Mineral Processing Technology, 8th edition, Butterworth-Heinemann.

SECONDARY LITERATURE:

[1] Lottermoser B., 2007, Mine Wastes: Characterization, Treatment and Environmental Impacts. Springer.
[2] Rogoff M.J., 2013, Solid Waste Recycling and Processing. Planning of Solid Waste Recycling Facilities and Programs, Elsevier.
[3] Khan A., Inamuddin, Asiri A.M., 2020, E-waste Recycling and Management, Present Scenarios and Environmental Issues, Springer.
[4] Nakamura T., Halada K., 2015, Urban Mining Systems. Springer.

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Zał. nr 5 do ZW 16/2020

FACULTY OF CHEMISTRY

SUBJECT CARD

Name of subject in Polish Czynniki biologiczne w przemyśle - podstawy
Name of subject in English Biological factors in industry - fundamentals
Main field of study (if applicable): Urban mining
Specialization (if applicable):
Profile: academic
Level and form of studies: 2nd level, full-time
Kind of subject: obligatory
Subject code …….
Group of courses: NO

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)			30		15
Number of hours of total student workload (CNPS)			60		30
Form of crediting	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			3		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)			2,1		1,4

*delete as not necessary

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Biology and organic chemistry fundamentals

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SUBJECT OBJECTIVES

C1 Learning about acquisition, improvement and identification of microbial strains of practical importance;
C2 Cognition of microflora of selected anthropogenic products.
C3 Cognition of microorganism related to environment protection.

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge:

PEU_W01 Student knows and understands the dependency between microbial features and given application.

relating to skills:

PEU_U01 Students is able to design and conduct an experiment that enables evaluation of microorganisms usability for defined purpose;
PEU_U02 Students is able to apply biocatalyst in defined bioconversion leading to desired product;

relating to social competences:

PEU_K01 The student is able to work independently and collaborate in a group, taking various roles in it;

PROGRAMME CONTENT

Laboratory (weeks 8-15)		**Number of hours**
Lab 1	General microbiological techniques - practice	2
Lab 2	Microbiological techniques directed to defined goals. Microorganisms isolation from environment.	4
Lab 3	Adjustment of microbes to particular process to maximise its efficiency – biotechnological fermentation	4
Lab 4	Adjustment of biocatalysts to a particular process - enzymatic catalysis.	4
Lab 5	Adjustment of biocatalysts to a particular process - whole-cell catalysis.	4
Lab 6	Analysis of microbial populations of selected anthropogenic products.	4
Lab 7	Biological material in environment protection - microorganisms.	4
Lab 8	Biological material in environment protection - enzymes.	4
	Total hours	30

Seminar (weeks 1-7)		**Number of hours**
Sem 1	Project assumption as key factor determining selection of biological material for given biotechnological process - part I	2
Sem 2	Project assumption as key factor determining selection of biological material for given biotechnological process - part II	2
Sem 3	Project assumption as key factor determining selection of biological material for given biotechnological process - part III	2
Sem 4	Biological agents for commercial applications - part I	2
Sem 5	Biological agents for commercial applications - part II	2
Sem 6	Biological agents for commercial applications - part III	2
Sem 7	Microorganisms for environment protection	1
	Total hours	15

TEACHING TOOLS USED
N1. Multimedial tools – case study N2. Problem solving supported by analysis of literature data N3. Practical demonstration of laboratory techniques

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 (seminar)	PEU_W01	Evaluation of student conceptual work related to a given subject.
P2 (laboratory)	PEU_U01 - U02	Evaluation of student laboratory skills related to the general microbiology methods.
P		

PRIMARY AND SECONDARY LITERATURE
PRIMARY LITERATURE: [1] Current literature data [2] Rittmann B.E; McCarty P.L. "Environmental Biotechnology. Principles and Applications", 2020.
SUBJECT SUPERVISOR (NAME AND SURNAME, E-MAIL ADDRESS)
Prof dr hab inż Ewa Żymańczyk-Duda (ewa.zymanczyk-duda@pwr.edu.pl)

Zał. nr 5 do ZW 16/2020

FACULTY OF CHEMISTRY

SUBJECT CARD

Name of subject in Polish: Chemiczne i biologiczne metody przerobu odpadów
Name of subject in English: Chemical and biological methods of waste processing
Main field of study (if applicable): …….
Specialization (if applicable): Urban mining
Profile: academic
Level and form of studies: 2nd level, full-time
Kind of subject: obligatory
Subject code …….
Group of courses: NO

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30		90		15
Number of hours of total student workload (CNPS)	60		180		60
Form of crediting	Examination	Examination / crediting with grade*	crediting with grade*	Examination / crediting with grade*	crediting with grade*
For group of courses mark (X) final course					
Number of ECTS points	2		6		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)	1,4		4,2		1,4

*delete as not necessary

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge of basic chemistry
2. General knowledge and practical skills in classical methods of chemical analysis
3. Knowledge of inorganic chemistry in the scope of the courses included in the program of the bachelor's degree
4. Student can perform simple stoichiometric and engineering calculations
5. Student has basic knowledge of the properties of base metals and precious metals
6. Student can distinguish the chemical properties of metals
7. Student can assess the applications and economic importance of metals
8. Computer skills
9. Microbiological knowledge - fundamentals.

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SUBJECT OBJECTIVES

C1. Understanding the basics of unit processes in metallurgy

C2. Familiarization with leaching reactions in hydrometallurgical processes
C3. Understanding the principles of the choice of leaching conditions for secondary raw materials
C4. Familiarization with separation and purification techniques
C5. Ability to plan and perform a leaching experiment
C6. The student acquires the ability to model and select optimal process parameters.
C7. The student acquires the skills of elementary analysis.
C8. Understanding the correlation between microbial physiology and practical applications.
…

SUBJECT EDUCATIONAL EFFECTS

relating to the knowledge:
PEU_W01 has basic information about raw materials and their processing by the hydrometallurgical route
PEU_W02 knows the rules for the selection of parameters and leaching systems
PEU_W03 has knowledge about the processes of purification and separation of metals from leaching solutions
PEU_W04 has knowledge of microbiological technologies in biorecovery of metals
PEU_W05 Knows the methods of utilization of the CO2 produced
PEU_W06 Knows and understands the exemplary application of microbes to anthropogenic waste management
PEU_W07 Knows how nutrients can be recovered from secondary raw materials …
PEU_W08 Knows raw materials, chemical and biological processing methods and technologies in valorisation of waste for fertilization and feed purposes

relating to skills:
PEU_U01 The student is able to plan an experiment
PEU_U02 The student is able to perform statistical evaluation of analytical results and their interpretation in terms of accuracy and precision of determinations
PEU_U03 can correctly interpret the experimental results
PEU_U04 Student is able to apply elementary analysis to determine carbon and nitrogen content
PEU_U05 Student is able to perform multistage analytical procedures
PEU_U06 The student is able to carry out the process of bioleaching and bio-recovery of metals
PEU_U07 The student is able to carry out the process of chemical and biological sequestration of CO2
PEU_U08 Student is able to design and conduct an experiment that allows gaining the added-value products from anthropogenic waste.
PEU_U09 Student can choose the microbiological factor in the valorization process of nutrients into fertilizer preparations.
PEU_U10 Student is able to use raw materials, chemical and biological processing methods and technologies for valorisation of waste for fertilization and feed purposes
…
relating to social competences:
PEU_K01 The student is able to work independently and collaborate in a group, taking various roles in it
PEU_K02 cares for the natural environment
PEU_K03 The student is ready to critically evaluate his knowledge and perceived content

PEU_K04 Responsibly interacts with the group, taking on various roles within it, including leadership

PROGRAMME CONTENT		
Lecture		**Number of hours**
Lec 1	The role of hydrometallurgy in the production of non-ferrous and precious metals - general issues. Processing of secondary raw materials for hydrometallurgical treatment	2
Lec 2	Leaching and leaching systems. Basics of kinetics and thermodynamics in leaching	2
Lec 3	Separation processes and recovery of metals and their compounds from purified solutions	2
Lec 4	Thermochemical conversion of waste for energy	2
Lec 5	Sustainable Metals Management - Metals recovery from spent catalysts	2
Lec 6	Biohydrometallurgical methods for e-wastes treatment	2
Lec 7	Valorisation of waste for fertilization purposes - introduction	2
Lec 8	Valorisation of waste for fertilization purposes - classification, legal conditions	2
Lec 9	Valorisation of waste for fertilization purposes - raw materials, chemical and biological processing methods	2
Lec 10	Valorisation of waste for fertilization purposes - available technologies, trends	2
Lec 11	Microbiological management of anthropogenic waste.	2
Lec 12	Microbiological management of anthropogenic waste.	2
Lec 13	Microbial valorization of food waste into fertilizer preparations -part I	2
Lec 14	Microbial valorization of food waste into fertilizer preparations - part II	
Lec 15	CO2 sequestration and carbonisation	2
	Total hours	30

Laboratory		**Number of hours**
Lab 1	Preparation and characterization of waste material (digestion + composition analysis)	6
Lab 2	Extraction of metallic components from waste material (leaching + ongoing analysis)	6
Lab 3	Recovery of metals by selected unit operations (SX/ electrolysis… + analyses)	6
Lab 4	Fixed-bed pyrolysis of solid waste	6
Lab 5	Metals recovery from spent catalysts	6
Lab 6	Recovery of valuable and toxic metals from e-waste using bioleaching methods - bioleaching	6
Lab 7	Recovery of valuable and toxic metals from e-waste using bioleaching methods - biosorption and bioaccumulation	6

Lab 8	Recovery of valuable and toxic metals from e-waste using bioleaching methods - metals biorecovery	6
Lab 9	Production of cellulases via fungal fermentation of textile waste	6
Lab 10	Enzymatic recovery of polyester from textile waste.	6
Lab 11	Valorization of waste biomass for fertilizer and feed purposes - production of fertilizers and feed additives with micronutrients - biosorption and/or solubilization	6
Lab 12	Microbial valorization of food waste into fertilizer preparations and evaluation of its utilitarian properties	6
Lab 13	Extraction of humic substances from waste materials - process optimization.	6
Lab 14	Recovery of ruthenium from waste by distillation of ruthenium oxide	6
Lab 15	CO2 sequestration and carbonisation - chemical sequestration and biomineralization	6
		6
	Total hours	90

Seminar		**Number of hours**
Semin 1	Application of metallurgical processes for the recovery of metals from secondary raw materials	1
Semin 2	Application of metallurgical processes for the recovery of metals from secondary raw materials	1
Semin 3	Application of metallurgical processes for the recovery of metals from secondary raw materials	1
Semin 4	Thermochemical conversion of waste for energy	1
Semin 5	Sustainable metals management – metals recovery from spent catalysts	1
Semin 6	Biohydrometallurgical methods for e-wastes treatment	1
Semin 7	Valorisation of waste for fertilization purposes - classification, legal conditions	1
Semin 8	Valorisation of waste for fertilization purposes - raw materials, chemical and biological processing methods	1
Semin 9	Valorisation of waste for fertilization purposes - available technologies, trends	1
Semin 10	Microbiological management of anthropogenic waste.	1
Semin 11	Microbiological management of anthropogenic waste.	1
Semin 12	Microbial valorization of food waste into fertilizer preparations - case study	1
Semin 13	Microbial valorization of food waste into fertilizer preparations - case study	1
Semin 14	CO2 sequestration and carbonisation	1
Semin 15	Summary	
	Total hours	15

TEACHING TOOLS USED
N1. Lecture with a multimedia presentation. N2. Solving computational problems

N3. Experiment planning N4. Performing chemical analyses N5. Preparing the report and presentation N6. Modeling with computer software

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 (lectrue)		
F2 (laboratory)		
F3 (seminar)		
P		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] Gupta C.K., Mukherjee T.K., Hydrometallurgy in Extraction Processes Vol.1+2

[2] Hocheng, H., Chakankar, M., Jadhav, U. Biohydrometallurgical Recycling of Metals from Industrial Wastes, 2019, CRC Press, ISBN: 9780367888589

[3] Hussain,C. M.; Kadeppagari, R.K. (Eds.) Biotechnology for Zero Waste: Emerging Waste Management Techniques, Willey 2022, ISBN: 978-3-527-34898-5

[4] Ritcey G.M., Solvent Extraction. Principles and Applications to Process Metallurgy Vol 1+2

[5] Current literature data

[6] D.E. Rawlings Biomining, Theory, Microbes and Industrial Processes, Springer 2012

[7] L.P.Cook,K. Huang,L. Li, W.Wong-Ng, Materials and processes for CO2 capture, conversion, and sequestration, The American Ceramic Society/Wiley 2018

SECONDARY LITERATURE:

[1] Habashi F., Kinetics of metallurgical processes, Metallurgie Extractive Quebec, Enr., 1999

[2] Janyasuthiwong, S. Metal Removal and Recovery from Mining Wastewater and E-waste Leachate, 2016, CRC Press, ISBN: 9781138029491

[3] Reith, F., Shuster, J.(Eds.) Geomicrobiology and Biogeochemistry of Precious Metals, MDPI, 2018, ISBN: 978-3-03897-346-1; https://doi.org/10.3390/books978-3-03897-347-8

[4] D.J.DePaolo, D.R.Cole, A.Navrotsky, I.C.Bourg, Geochemistry of Geologic CO2 Sequestration, Mineralogical Society of America; Geochemical Society 2013

[5] Critical Metals Handbook, Gus Gunn (ed.), British Geological Survey, Keyworth, Nothingham, UK, 2015, Online ISBN:9781118755341 |DOI:10.1002/9781118755341

[6] E.Lichtfouse, J.Schwarzbauer, D.Robert, EditorsCO2 Sequestration, Biofuels and Depollution, Springer 2015

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

Zał. nr 5 do ZW 16/2020

FACULTY OF CHEMISTRY

SUBJECT CARD

Name of subject in Polish: Narzędzia oceny cyrkularności
Name of subject in English: Circularity assessment tools
Main field of study (if applicable): Urban mining
Specialization (if applicable): -
Profile: academic
Level and form of studies: 2nd level, full-time
Kind of subject: obligatory
Subject code …….
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)				90	
Form of crediting				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)				2	
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)				2.1	

*delete as not necessary

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Has basic knowledge of urban mining
2. Has basic knowledge of the circular economy
3. Can use web tools, including search engines and open databases
4. Can operate MS Office environment and Google platform tools

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SUBJECT OBJECTIVES

C1 To increase circular thinking of students
C2 Upskilling the student in the waste, repair & reuse industry
C3 To teach the student how to facilitate the transition towards the circular economy

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge:
PEU_W01 Knows the basic methods of assessing the circularity of products and processes

PEU_W02 Has knowledge of commonly available tools for assessing the circularity of products and processes
PEU_W03 Has basic knowledge about the life cycle of products and processes

relating to skills:
PEU_U01 Knows how to apply theories to make the transition from a linear model to a circular economy
PEU_U02 Can apply theories based on circular economy approaches to design more sustainable products
PEU_U03 Can assess the technical feasibility of industrial, service, social and primary production processes and systems to minimize environmental impacts
PEU_U04 Can understand the complex interdependencies of both local and global waste management issues

relating to social competences:
PEU_K01 Can work in a group and accept responsibility for his/her own work
PEU_K02 Understands the need for continuous learning.
PEU_K03 He/she is aware and understands the social aspects of practical application of his/her knowledge skills.
PEU_K04 Has the ability to formulate opinions on professional matters and to present his/her knowledge in a simple and understandable way.

PROGRAMME CONTENT

Project		Number of hours
Proj. 1	Product and process circularity - introduction, basic concepts Introduction to classes, breakdown into groups, explanation of project tasks, assignment of cases	2
Proj. 2 and 3	Case study analysis with the Circular Economy Toolkit implementation	4
Proj. 4 and 5	Product Recovery Multi-Criteria Decision Tool (PR-MCDT) - introduction and case study based on the tool	4
Proj. 6 and 7	Case study applying Product Circularity Assessment (CPA) methodology	4
Proj. 8 and 9	Fundamentals and application of Material Circularity Indicator (MCI) and calculation of MCI for the given case study	4
Proj. 10 and 11	The Circularity Potential Indicator (CPI) Tool - tool analysis and case study involving the CPI	4
Proj. 12	UrbanMinePlatform - functionality and practical aspects of the tool - case study	2
Proj. 13, 14 and 15	Product Life Cycle and its assessment based on openLCA tools	6
	Total hours	**30**

TEACHING TOOLS USED

N1.Project and case study

N2. Group work
N3. Guided self-study
N4. Short video lectures
N5. Microteaching

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_U04, PEU_W01- PEU_W03	percentage assessment - partial reports and presentations
F2	PEU_K01 - PEU_K04	percentage assessment - final report and presentation, activity in discussion
F3	PEU_K02	percentage assessment - activity in e-portal course with additional material

Tresholds for each F equal 50%, then P= F1*50%+F2*30%+F3*20%
Grades:
3 if P is more than 50%
3,5 if P is more than 60%
4 if P is more than 70%
4,5 if P is more than 80%
5 if P is more than 90%
5,5 if P is more than 99%

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

1. Ellen MacArthur Foundation, SUN and McKinsey Center for Business and Environment, Growth Within: a
2. circular economy vision for a competitive Europe (2015)
3. Ellen MacArthur Foundation. *Delivering the circular economy: A toolkit for policymakers*. Ellen MacArthur Foundation (2015)
4. Korhonen, Jouni, Antero Honkasalo, and Jyri Seppälä. "Circular economy: the concept and its limitations." *Ecological economics* 143 (2018): 37-46.
5. Stahel, Walter R., and Ellen MacArthur. *The circular economy: A user's guide*. Routledge, 2019.
6. Morseletto, Piero. "Targets for a circular economy." *Resources, Conservation and Recycling* 153 (2020): 104553.
7. Lacy, Peter, and Jakob Rutqvist. *Waste to wealth: The circular economy advantage*. Springer, 2016.
8. Charter, Martin, ed. *Designing for the circular economy*. Routledge, 2018.
9. Corona, Blanca, et al. "Towards sustainable development through the circular economy—A review and critical assessment on current circularity metrics." *Resources, Conservation and Recycling* 151 (2019): 104498.

SECONDARY LITERATURE:

Articles:

Angioletti, Cecilia Maria, Mélanie Despeisse, and Roberto Rocca. "Product circularity assessment methodology." *IFIP International Conference on Advances in Production Management Systems*. Springer, Cham, 2017.
Saidani, Michael, et al. "How to assess product performance in the circular economy? Proposed requirements for the design of a circularity measurement framework." *Recycling* 2.1 (2017): 6.
Janik, Agnieszka, and Adam Ryszko. "Towards measuring circularity at product level–Methodology and application of material circularity indicator." *7th Carpathian Logistics Congress-CLC*. 2017.
Trollman, Hana, James Colwill, and Sandeep Jagtap. "A circularity indicator tool for measuring the ecological embeddedness of manufacturing." *Sustainability* 13.16 (2021): 8773.

Websites:

https://circitnord.com/
https://ellenmacarthurfoundation.org/
http://www.urbanmineplatform.eu/homepage

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Zał. nr 5 do ZW 16/2020

FACULTY OF CHEMISTRY

SUBJECT CARD

Name of subject in Polish Raportowanie ESG
Name of subject in English ESG Reporting
Main field of study (if applicable): Urban mining.
Specialization (if applicable): —
Profile: academic / ~~practical~~*
Level and form of studies: ~~1st~~/ 2nd level, ~~uniform magister studies~~*, full-time / ~~part-time~~*
Kind of subject: obligatory / ~~optional / university-wide~~*
Subject code …….
Group of courses YES / ~~NO~~*

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15			30	
Number of hours of total student workload (CNPS)	30			90	
Form of crediting	~~Examination~~ / crediting with grade*	Examination / crediting with grade*	Examination / crediting with grade*	~~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)					
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	0,7			2,1	

*delete as not necessary

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge of urban mining.
2. Can use the Microsoft Office software.

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SUBJECT OBJECTIVES

C1. Learning about the assumptions of ESG reporting.
C2. Understanding the assumptions of ESG issue.
C3. Learning reporting tools of environmental, social, governance aspects.

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge:

PEU_W01 Has recent knowledge of ESG reporting, including applicable legal regulations obliging entities to prepare reports.

PEU_W02 Knows content and form of non-financial reports.

PEU_W03 Understands the role and importance of ESG reporting.

relating to skills:

PEU_U01 The student can identify the data needed to prepare an ESG report in companies managing landfills and waste disposal centers.

PEU_U02 Can assess the completeness and correctness of the report.

relating to social competences:

PEU_K01 The student is able to work independently and collaborate in a group, taking various roles in it.

PEU_K02 Cares for the natural environment

PEU_K03 The student can present self-prepared content.

PROGRAMME CONTENT		
Lecture		**Number of hours**
Lec 1	Organization of classes, rules of participation, conditions for passing. ESG - basic definitions.	1
Lec 2	Sustainable waste management. CSR and ESG strategies of companies.	2
Lec 3	Non-financial reporting standards. Structure of non-financial reports.	2
Lec 4	Influence of ESG factors on the results and value of the enterprise. ESG ratings.	2
Lec 5	Environmental, social and corporate governance factors in the report. Principle "7"	2
Lec 6	The process of defining the content of the ESG report	2
Lec 7	Materiality of the reported ESG indicators	2
Lec 8	Project of implementing good practices in the field of waste management Test.	2
	Total hours	15

Project	**Number of hours**

Pr 1	Organization of classes, rules of participation, conditions for passing.	1
Pr 2	ESG reporting for landfill management companies: environmental aspects (data availability and discussion).	2
Pr 3	Presentation of environmental data reporting methods	2
Pr 4	ESG reporting for landfill management companies: social aspects (data availability and discussion).	2
Pr 5	Presentation of social data reporting methods.	2
Pr 6	Governance (data availability and discussion). Importance of corporate governance in a landfill management company.	2
Pr 7	Presentation of the results in the form of an ESG report	4
Pr 8	ESG reporting for waste disposal center: environmental aspects (data availability and discussion).	2
Pr 9	Presentation of environmental data reporting methods	2
Pr 10	ESG reporting for waste disposal center: social aspects (data availability and discussion).	2
Pr 11	Presentation of social data reporting methods.	2
Pr 12	Governance (data availability and discussion). Importance of corporate governance in waste disposal center.	2
Pr 13	Presentation of the results in the form of an ESG report.	4
Pr 14	Summary, discussion of the results, assessment.	1
	Total hours	30

TEACHING TOOLS USED
N1. Lecture with a multimedia presentation. N2. Discussion N3. Problem solving N4. Case study

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT

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

concluding (at semester end)		
F1 (lectrue)	PEU_W01- PEU_W03	Test multiple choice
F2 (project)	PEU_U01- U02	Presentation
P		

PRIMARY AND SECONDARY LITERATURE
PRIMARY LITERATURE: [1] ESG Reporting Guidelines, May 2021, ttps://www.gpw.pl/pub/GPW/ESG/ESG_Reporting_Guidelines.pdf. [2] Corporate sustainability reporting https://ec.europa.eu/info/business-economy-euro/company-reporting-and-auditing/company-reporting/corporate-sustainability-reporting_en **SECONDARY LITERATURE:** [1] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52019XC0620(01) [2] Roadmap 2050 https://www.roadmap2050.eu/
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Zał. nr 5 do ZW 16/2020

FACULTY OF CHEMISTRY

SUBJECT CARD

Name of subject in Polish Aspekty formalno-prawne i ekonomiczne udostępnienia i eksploatacji depozytów antropogenicznych

Name of subject in English Formal, legal and economic aspects of anthropogenic deposits exploitation

Main field of study (if applicable): Urban mining.

Specialization (if applicable): —

Profile: academic / practical*

Level and form of studies: ~~1st/~~ 2nd level, ~~uniform magister studies~~*, full-time / ~~part-time~~*

Kind of subject: obligatory / ~~optional~~ / ~~university-wide~~*

Subject code …….

Group of courses ~~YES~~ / NO*

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30				
Number of hours of total student workload (CNPS)	90				
Form of crediting	~~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	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)	2,1				

*delete as not necessary

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCIES

1. Ability to querry legal acts
2. Knowledge of mathematics and data analysis on bachelor level

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SUBJECT OBJECTIVES

C1. Learning about the legal and economic aspects of development and the exploitation of anthropogenic deposits

C2. Understanding the importance of the use of secondary raw materials in the economy

SUBJECT EDUCATIONAL EFFECTS

relating to the knowledge:

PEU_W01 - Understands the importance of the use of secondary raw materials in the economy.

PEU_W02 - Knows legal regulations in the field of storage and production of waste from anthropogenic deposits.

PEU_W03 - Knows the basic methods of assessing the profitability of investments.

relating to skills:

PEU_U01 - Can define a project involving the exploitation of a deposit of secondary raw materials.

PEU_U02 - Can define legal risks in the field of waste management.

PEU_U03 - Can make a comparative analysis of formal and legal requirements for different countries (Poland, EU, OECD)

PEU_U04 - Can apply defined legal requirements for urban mining projects.

PEU_U05 - Can use good practices in this area

relating to social competencies:

PEU_K01 - the ability to argue one's arguments about the use of the environment

PROGRAMME CONTENT		
Lecture		**Number of hours**
Lec 1	Definition of waste according to the EU and selected waste management organizations	2
Lec 2	Property rights and zoning restrictions	2
Lec 3	Legal bases of waste management in the EU. A horizontal framework of waste legislation in the EU	2
Lec 4	European directives for selected waste fractions and waste disposal technologies	2
Lec 5	Legal aspects of obtaining and trading secondary raw materials	2
Lec 6	The role of Urban Mining in the economy in the light of EU directives	2
Lec 7	Policy of increasing the efficiency of the use of raw materials in the UN, OECD and EU agendas	2
Lec 8	Waste management - principles, good practices	2

Lec 9	Overview of actions and solutions to achieve waste generation prevention, their implementation areas and restrictions (regulatory actions, collaborative actions, economic actions, preventive measures)	2
Lec 10	Case study Urban mining Germany	2
Lec 11	Case study Urban mining Poland	2
Lec 12	Financing of waste management	2
Lec 13	Obligations of producers in the field of product labeling	2
Lec 14	Valuation and the assessment of the economic efficiency of the access and use of anthropogenic deposits (secondary deposits)	2
Lec 15	Test	2
	Total hours	30

TEACHING TOOLS USED
N1. Presentation N2. Moderated discussion N3. Consultation

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT

Evaluation (F – forming during the semester), P – concluding (at semester end)	Learning outcomes code	Way of evaluating learning outcomes achievement
P	PEU_W01-W03 PEU_U01-U05 PEU_K01	Test multiple choice

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] Directive 2008/98/EC of the European Parliament and of the Council of 19 November 2008 on waste and repealing certain Directives (OJ L 312 22.11.2008, p. 3)
[2] Directive 2006/21/EC of the European Parliament and of the Council of 15 March 2006 on the management of waste from extractive industries and amending Directive 2004/35/EC
[3] Consolidated text: Council Directive 1999/31/EC of 26 April 1999 on the landfill of waste
[4] UN Economic Commission for Europe, 2018. Specifications for the application of the United Nations Framework Classification for Resources to Anthropogenic Resources. Geneva

SECONDARY LITERATURE:

[1] Townsend, Timothy G, et al. Sustainable Practices for Landfill Design and Operation. 2015th ed., Springer New York, 2015.
[2] Wolfsberger, T., Pinkel, M., Polansek, S., Sarc, R., Hermann, R., Pomberger, R., 2016. Landfill mining: Development of a cost simulation model. Waste Manag Res 34, 356–367. https://doi.org/10.1177/0734242X16628980
[3] Global Tailings Review. Global Industry Standard on Tailings Management. https://globaltailingsreview.org/global-industry-standard/
[4] Damodaran, Aswath. (2012). *Investment Valuation* (3. Aufl. ed., Vol. 666, Wiley finance). New York: Wiley.

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Zał. nr 5 do ZW 16/2020

FACULTY OF CHEMISTRY

SUBJECT CARD

Name of subject in Polish: Podstawy inżynierii procesowej
Name of subject in English: Fundamentals of process engineering
Main field of study (if applicable): Urban mining
Specialization (if applicable): ……..
Profile: academic / ~~practical~~*
Level and form of studies: ~~1st~~/ 2nd level, ~~uniform magister studies*~~, full-time / ~~part-time~~*
Kind of subject: ~~obligatory~~ / optional /~~ university-wide*~~
Subject code …….
Group of courses ~~ YES /~~ NO

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)				45	
Number of hours of total student workload (CNPS)				90	
Form of crediting	Examination / crediting with grade*	Examination / crediting with grade*	Examination / crediting with grade*	Crediting with grade	Examination / crediting with grade*
For group of courses mark (X) final course					
Number of ECTS points				3	
including number of ECTS points for practical classes (P)				3	
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)				2.1	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge of physics and mathematics

SUBJECT OBJECTIVES

C1 To introduce students to the basic principles of process engineering.
C2 To acquaint students with the chemical and physical bases of selected process engineering operations and processes.

C3 To get acquainted with the principles of formulating mass and heat balances under stationary and non-stationary conditions.
C4 Apply the principles of hydrostatics and hydrodynamics to describe apparatus and devices occurring in industrial installations.
C5 Learn the principles of selecting pumps and other flow devices.
C6 Learn the principles of volume and mass flow measurement.
C7 Learn mathematical modelling and design principles of processes and apparatuses used in process engineering.
C8 To become familiar with mathematical description and design principles and heat exchangers.
C9 To become familiar with the principles of mathematical description and design methods of selected mass exchangers.
C10 To gain basic knowledge about design procedures and to use this knowledge to solve problems and tasks related to momentum, heat, and mass exchange processes.
C11 To learn the principles of scale transfer.
C12 Learn the principles of preparing a schematic diagram of an industrial installation and selecting apparatus.

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge:

PEU_W01 - Knows the chemical and physical basis of selected engineering operations and processes.
PEU_W02 - Can define mass and heat balances in stationary and non-stationary conditions.
PEU_W03 - Can describe using mathematical models and design selected processes and apparatuses used in process engineering.
PEU_W04 - Knows the principles of scale transfer.

relating to skills:

PEU_U01 - can describe the operation of apparatus and devices occurring in industrial installations using the principles of hydrostatics and hydrodynamics.
PEU_U02 - can select pumps and other flow devices.
PEU_U03 - can apply adequate measuring devices to determine pressure drop and calculate fluid flow velocities.
PEU_U04 - Can measure the flow rate of gas or liquid.
PEU_U05 - Can calculate heat transfer area and determine its operating parameters.
PEU_U06 - Can formulate mass balances and determine operating parameters of selected mass exchangers.
PEU_U07 - Can select and design basic process apparatuses in selected operations and unit momentum, heat, and mass transfer processes.

relating to social competences:

PEU_K01 - The student is able to cooperate in a project group
PEK_K02 - Student is able to present the results of work

PROGRAMME CONTENT

	Project	Number of hours
Pr1	Presentation of the course program. Discussion of requirements and conditions for passing the course. Basic terms and quantities. Applied units and their	3

	mutual conversion. Principles of mass and energy balancing in chemical engineering processes.	
Pr2	Hydrostatics. Calculation of pressure distribution in systems.	3
Pr3	Hydrodynamics. Phenomena associated with fluid flows. Calculation of resistance to flow.	3
Pr4	Bernoulli's equation and its use.	3
Pr5	Pumps and calculations of pumping systems. Principles of connecting pumps and network expansion. Calculation of pump operating point in selected pump-network configurations.	3
Pr6	Particle deposition. Precipitation of single-particle and group precipitation. Calculations of settling tank, dust chamber, cyclone. Fluidization. Sedimentation.	3
Pr7	Filtration. Filtration equation and its use in filter design.	3
Pr8	Mixing. Design of stirrers and mixers.	3
Pr9	Design of heat exchangers. Calculation of heat exchanger operating parameters.	3
Pr10	Calculations for selected unit mass transfer operations: absorption, adsorption, extraction, distillation. Mass balance calculations.	3
Pr11		3
Pr12	Rectification column calculations for binary solution separation. Determination of the ratio in a rectification column and graphical interpretation of the workings of this apparatus.	3
Pr13	Calculations of chemical reactors.	3
Pr14	Preparation of a schematic diagram of a plant and selection of apparatus. Principles of scale transfer.	3
Pr15	Passing the course. Discussion of own projects.	3
	Total hours	**45**

TEACHING TOOLS USED
N1. Informative lecture N2. Multimedia presentation N3. Solving engineering and design tasks N4. Use of Excel to perform more labour-intensive calculations

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 (project)	PEU_W01-W04 PEU_U01-U07	Crediting with grade

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] **D.M. Himmelblau**, Basic principles and calculation in chemical engineering, New York 1986.
[2] **D.W. Green, R.H. Perry** (red.), Perry's chemical engineers' handbook, 8th ed., McGraw-Hill, 2007
[3] **W.M. Deen,** Introduction to Chemical Engineering Fluid Mechanics, Cambridge Series in Chemical Engineering, Cambridge University Press 2016
[4] **G. Towler, R. Sinnott**, Chemical Engineering Design, Elsevier LTD, Oxford 2021

SECONDARY LITERATURE:

[1] **T. Hicks,** Standard Handbook of Engineering Calculations, McGraw-Hill Professional; 4th edition 2004
[2] **D. Suman,** Optimization in Chemical Engineering, Cambridge University Press 2016
[3] **W. Ciesielczyk, K. Kupiec**, Chemical engineering calculations. Pt. 1, Flow processes, Wydawnictwo Politechniki Krakowskiej 2012
[4] **W. Ciesielczyk, K. Kupiec**, Chemical engineering calculations. Pt. 2, Thermal processes, Wydawnictwo Politechniki Krakowskiej 2012
[5] **W. Ciesielczyk, K. Kupiec**, Chemical engineering calculations. Pt. 3, Theory of mass transfer, Wydawnictwo Politechniki Krakowskiej 2012
[6] **W. Ciesielczyk, K. Kupiec**, Chemical engineering calculations. Pt. 4, Mass transfer process calculations, Wydawnictwo Politechniki Krakowskiej 2012

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

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Dr inż. Justyna Ulatowska (justyna.ulatowska@pwr.edu.pl) (preparing the Subject Card)

Zał. nr 5 do ZW 16/2020

FACULTY OF CHEMISTRY

SUBJECT CARD

Name of subject in Polish Podstawy GIS
Name of subject in English GIS Fundamentals
Main field of study (if applicable): Urban mining
Specialization (if applicable): —
Profile: academic / ~~practical~~*
Level and form of studies: ~~1st~~/ 2nd level, ~~uniform magister studies~~*, full-time / ~~part-time~~*
Kind of subject: obligatory / ~~optional / university-wide~~*
Subject code …….
Group of courses YES / ~~NO~~*****

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)			30		
Number of hours of total student workload (CNPS)			60		
Form of crediting	Examination / crediting with grade*	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)			1,4		

*delete as not necessary

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge of databases.
2. Basic knowledge of numerical maps.

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SUBJECT OBJECTIVES

C1. Presentation of the geographic information systems components.
C2. Acquisition of knowledge and skills related to the construction and management of spatial databases.
C3. Getting the knowledge on the basic methods, procedures and stages of spatial analysis.
C4. Presentation of the fundamentals of the formal language and their implementation in geographic information system environment.
C5. Understanding the principles of spatial data visualization in GIS.
C6. Usage of the GIS tools to solve selected spatial problems and to analyze phenomena and processes taking place in space, regardless of the software.

SUBJECT EDUCATIONAL EFFECTS

Relating to knowledge:

PEU_W01 The student knows what data is available in institutions dealing with the acquisition of topographic, statistical and waste management data.

PEU_W02 He knows the basic concepts of geographic information systems.

PEU_W03 The student knows so called “free and open software” for processing and visualization of spatial data in GIS.

Relating to skills:

PEU_U01 He can use geoinformatics tools in the field of acquiring, managing, processing and integrating spatial data (raster data and vector data).

PEU_U02 Has the ability to use GIS tools to analyze phenomena and processes taking place in space, regardless of the hardware platform.

PEU_U03 Has the ability to solve selected spatial problems, including the use of raster analyzes and multi-criteria analyzes.

PEU_U04 The student is able prepare and share spatial data with the use of available Internet platforms.

PEU_U05 Can present graphically and interpret the results of spatial analyzes.

Relating to social competences:

PEU_K01 The student can cooperate in a project group.

PEU_K02 Can present the results of work.

PEU_K03 He can formulate and share knowledge on the use of GIS in spatial analyzes.

PEU_K04 Understands the importance of spatial information in professional work.

PROGRAMME CONTENT		
Project		**Number of hours**
Proj 1	Organization of classes. Information on the principles of health and safety in the computer room. Discussion of the method of conducting classes and the conditions of passing. Introduction to the GIS software. Getting to know the program's interface, discussing the main components, selected toolbars on the examples.	2
Proj 2	Acquisition and processing of raster and vector data. Creating thematic map compositions based on reference data.	2
Proj 3	Development of a spatial database of potential anthropogenic raw materials resources in a given geographical space with the use of topographic, demographic, air and satellite data.	2
Proj 4	Development of maps of the density of the accumulation of potential anthropogenic raw materials in a given geographical space.	2
Proj 5	Development of maps with spatial statistics of the occurrence of potential anthropogenic raw materials accumulation in a given geographical space.	2

Proj 6	Analysis of changes in the size of potential accumulations of anthropogenic raw materials.	2
Proj 7	Development of a heat map of the concentration of anthropogenic resources in a given geographical space.	2
Proj 8	Development of a Hot Spot map of the concentration of anthropogenic resources in a given geographical space.	2
Proj 9	Development of an interactive map with results 4-8. Presentation and evaluation of the project results (4-8).	2
Proj 10	Finding of the optimal location of a given investment related to waste management with the use of tools available in GIS software. Selection of investments and setting criteria.	2
Proj 11	Finding of the optimal location of a given investment: construction of a geodatabase of investment location criteria.	2
Proj 12	Finding of the optimal location of a given investment: multi-criteria data analysis (e.g. weighted sum, map algebra).	2
Proj 13	Finding of the optimal location of a given investment: visualization of results in the form of cartographic studies.	2
Proj 14	Presentation and evaluation of the project results (10-13).	2
Proj 15	Summary, discussion of the results, assessment.	2
	Total hours	30

TEACHING TOOLS USED
N1. Information lecture.
N2. Multimedia presentation.
N3. Laboratory exercises and preparation of exercise reports.
N4. Use of the ArcGIS software package.
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

F, P	PEU_W01-W03 PEU_U01-U05 PEU_K01-K04	F1- Evaluation of the implementation of the project and written report. F2 - Score from cards. P - Final evaluation from the laboratory

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] Heywood I., Cornelius S., Carver S., 2006: An Introduction to Geographical Information Systems, 3rd Edition, Pearson – Prentice Hall;

[2] Kennedy M., 2013: Introducing Geographic Information Systems with ArcGIS: A Workbook Approach to Learning GIS, Third Edition, John Wiley and Sons;

[3] Longley P. A., Goodchild M. F., Maguire D. J., Rhind D. 2011: Geographic Information Systems and Science, John Wiley & Sons

[4] Tomlin C.D., 2012, GIS and Cartographic Modeling, Esri Press, Book

SECONDARY LITERATURE:

[1] INSPIRE Forum, INSPIRE Network Services Tutorial @ http://inspire-forum.jrc.ec.europa.eu/pg/pages/view/87055/inspire-network-services-tutorial

[2] Open Geospatial Consortium, OGC Standards, @http://www.opengeospatial.org/standards

[3] ESRI TV @ https://www.youtube.com/user/esritv

[4] ESRI, 2020: ArcGIS Pro Help @ https://pro.arcgis.com/en/pro-app/help/main/welcome-to-the-arcgis-pro-app-help.htm

[5] ESRI, 2020: ESRI GIS Dictionary, @ https://support.esri.com/en/other-resources/gis-dictionary

[6] ESRI, ArcGIS Tutorial Data, ArcGIS Geostatistical Analyst; ESRI Polska, ArcGIS Geostatistical Analyst

[7] ArcGIS Pro documentation, https://pro.arcgis.com/en/pro-app/tool-reference/main/arcgis-pro-tool-reference.htm

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Zał. nr 5 do ZW 16/2020

FACULTY OF CHEMISTRY

SUBJECT CARD

Name of subject in Polish Praca magisterska
Name of subject in English Graduate laboratory
Main field of study (if applicable): Urban mining.
Specialization (if applicable): —
Profile: academic / practical*
Level and form of studies: 1st/ 2nd level, uniform magister studies*, full-time / part-time*
Kind of subject: obligatory / optional / university-wide*
Subject code …….
Group of courses YES / NO*

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)			20		
Number of hours of total student workload (CNPS)					
Form of crediting	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			25		
including number of ECTS points for practical classes (P)			25		
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)			17,5		

*delete as not necessary

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Theoretical and practical knowledge necessary for the studied field of science

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SUBJECT OBJECTIVES

C1 Gaining the skills of planning, carrying out and analyzing the results of scientific experiments

C2 Inspiring students to their further development and continuous self-education.

C3 Deepening the ability to create a written document presenting the current state of knowledge and their own achievements in the field of thesis topic.

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge:

PEU_W01 knows the types of sources of scientific and professional knowledge

PEU_W02 has in-depth knowledge of the subject of the diploma thesis.

relating to skills:

PEU_U01 – can form simple hypotheses and research problems, selects adequate methods, techniques and research tools,
can collect and verify information useful for learning a specific issue,

PEU_U02 - can combine and generalize information from various sources,

PEU_U03 - is able to synthetically and critically process the collected information, indicates directions for further research in the field of urban mining

PEU_U04 - can prepare a written study on a selected scientific or practical issue.

PEU_U05 - able to carry out experiments / perform project / build software and develop the results and draw conclusions from their achievements,

Relating to competence:

PEU_K01 Is ready for creative and entrepreneurial thinking and acting; is ready to properly prioritize the implementation of a specific task

PEU_K02 Is ready to learn throughout life and critically evaluate the knowledge and content received

PROGRAMME CONTENT		
Laboratory		**Number of hours**
La 1-15	Individual student work according to the schedule agreed with the thesis supervisor.	300
	Total hours	300

TEACHING TOOLS USED
N1. Consultations

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT

Evaluation (F – forming during semester), P – concluding (at semester end)	Learning outcomes code	Way of evaluating learning outcomes achievement
P	PEU_W01- PEU_W02 PEU_U01- PEU_U05 PEU_K01- PEU_K02	evaluation of the quantity and quality of the results of the student's work after submitting to the tutor the final, written version of the study entitled: Thesis

PRIMARY AND SECONDARY LITERATURE

Scientific and professional literature indicated by the Tutor and / or found by the student.
SUBJECT SUPERVISOR (NAME AND SURNAME, E-MAIL ADDRESS)
Tutors of individual courses: Diploma thesis

Zał. nr 5 do ZW 16/2020

FACULTY OF CHEMISTRY

SUBJECT CARD

Name of subject in Polish Seminarium dyplomowe
Name of subject in English Graduate seminar
Main field of study (if applicable): Urban mining.
Specialization (if applicable): —
Profile: academic / practical*
Level and form of studies: 1st/ 2nd level, uniform magister studies*, full-time / part-time*
Kind of subject: obligatory / optional / university-wide*
Subject code …….
Group of courses YES / NO*

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)					2
Number of hours of total student workload (CNPS)					
Form of crediting	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)					
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)					1,4

*delete as not necessary

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Theoretical and practical knowledge necessary for the studied field of science

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SUBJECT OBJECTIVES

C1 Skills of oral presentation of own work results
C2 Skills of written presentation own research results.
C3 Get to know the form of a public discussion with regard to defend own views and ideas.

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge:
PEU_W01 has in-depth knowledge of the subject of the diploma thesis.

relating to skills:
PEU_U01 – can prepare and present an oral presentation containing the results of the diploma

dissertation,
PEU_U02 – can justify a discussion the manner of its implementation and the results achieved
PEU_U03 – able to publicly present the results of own achievements and defend them during the public discussion.
PEU_U04 - can indicate alternative possibilities and directions for solving the analyzed problem

Relating to competence:
PEU_K01 - Is ready for creative and entrepreneurial thinking and acting; is ready to prioritize the implementation of a specific task properly
PEU_K02 - Is ready to learn throughout life and critically evaluate the knowledge and content received

PROGRAMME CONTENT		
Seminar		**Number of hours**
Sem 1-15	Presentation of multimedia presentation and participate in the discussion	30
	Total hours	30

TEACHING TOOLS USED
N1 consultations N2 multimedia presentation N3 oral presentation

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_U04 PEU_K01- PEU_K02	evaluation of oral presentation and activities in the discussions

PRIMARY AND SECONDARY LITERATURE
PRIMARY LITERATURE: none **SECONDARY LITERATURE:** none
SUBJECT SUPERVISOR (NAME AND SURNAME, E-MAIL ADDRESS)

Agnieszka Saeid, agnieszka.saeid@pwr.edu.pl

Załącznik nr 5 do ZW 16/2020

FACULTY OF CHEMISTRY

SUBJECT CARD

Name of subject in Polish Identyfikacja i ocena aspektów środowiskowych
Name of subject in English Identification and assessment of environmental aspects
Main field of study (if applicable): Urban mining
Specialization (if applicable): ……..
Profile: academic / ~~practical~~*
Level and form of studies: ~~1st~~/ 2nd level, ~~uniform magister studies*~~, full-time / ~~part-time~~*
Kind of subject: obligatory / ~~optional / university-wide~~*
Subject code …….
Group of courses ~~YES~~ / NO

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15				
Number of hours of total student workload (CNPS)	60				
Form of crediting	~~Examination /~~ crediting with grade	Examination / crediting with grade*	Crediting with grade	Examination / crediting with grade*	Examination / crediting with grade*
For group of courses mark (X) final course					
Number of ECTS points	1				
including number of ECTS points for practical classes (P)					
0,7	1.4				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Has a basic knowledge of environmental protection.

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SUBJECT OBJECTIVES

C1 Present and discuss the main principles of environmental management.
C2 LCA characteristics of waste management projects.
C3. Presentation of methods for identifying aspects of the environment.
C4. Characteristics of environmental aspects related to emissions to air, water and wastewater management, emissions to water and land.

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge:

PEU_W01 The student has knowledge of environmental management.
PEU_W02 The student has knowledge of identification and classification of environmental aspects.
PEU_W03 The student has knowledge in environmental monitoring.
PEU_W04 The student has knowledge about land management, air emissions, water and wastewater management and soil pollution.

PROGRAMME CONTENT		
Lecture		**Number of hours**
Lec 1	Introduction to environmental management. To define the LCA of waste management projects.	2
Lec 2	Methods of identifying environmental aspects. Classification of key environmental aspects (directs, indirect and induced)	2
Lec 3	Emissions to air, including biogas.	2
Lec 4	Water and waste water management with particular focus on leachate	2
Lec 5	Emissions to water – monitoring and mitigation.	2
Lec 6	Emissions to land – monitoring and mitigation.	2
Lec 7	Land management and sanitation methods.	2
Lec 8	Test.	2
	Total hours	**15**

TEACHING TOOLS USED
N1. Informative lecture. N2. Multimedia presentations. N3. A moderated discussion with the lecture N7. Consultations N8. Own work – individual studies and preparation for the test.

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT

Evaluation (F – forming during semester), P – concluding (at semester end)	Learning outcomes code	Way of evaluating learning outcomes achievement
P1	PEU_W01 PEU_W02 PEU_W03 PEU_W04	Final grade in lecture based on a test.

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] Hayscgukd N. Z., Rosenbaum R. K., Olsen S. I., 2017, Life Cycle Assessment – Theory and Practice, Springer.
[2] Schenck R., 2014, Environmental Life cycle Assessment: Measuring the Environmental Performance of Products, Lightning Source Inc.
[3] Horne R. E., Grant T., Verghese K., 2009, Life Cycle Assessment: Principles, Practice and Prospects, CSIRO Publishing
[4] Klöpffer W., Grahl B., 2014, Life Cycle Assessment (LCA), Wiley-VCH Verlag GmbH.
[5] Mustaq B., 2021, Environmental Management: Environmental Issues, Awareness and Abatement, Springer Nature.
[6] Belcham A., 2014, Environmental management, Taylor & Francis.
[7] Waters B., 2020, Introduction to Environmental Management, Taylor & Francis Ltd.

SECONDARY LITERATURE:

[1] Klöpffer W., Grahl B., 2014, Life Cycle Assessment (LCA): A Guide to Best Practise, Wiley-VCH Verlag GmbH.
[2] Gangawane L. V., 2014, Sustainable Environmental Management, Astral International.
[3] Tinsley S., 2016, Environmental management systems, Taylor & Fracis Ltd.

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Zał. nr 5 do ZW 16/2020

FACULTY OF CHEMISTRY

SUBJECT CARD

Name of subject in Polish: Metody instrumentalne w analizie produktów i biomonitoringu
Name of subject in English: Instrumental methods in biomonitoring and analysis of products
Main field of study: Urban mining
Specialization: —
Profile: academic
Level and form of studies: 2nd level, full-time
Kind of subject: obligatory
Subject code: …….
Group of courses: NO

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30		75		
Number of hours of total student workload (CNPS)	90		180		
Form of crediting	crediting with grade		crediting with grade		
For group of courses mark (X) final course					
Number of ECTS points	2		6		
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)	1,4		4,2		

*delete as not necessary

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge about analytical, inorganic and organic chemistry
2. Knowledge of basic analytical problems and techniques
3. Basic knowledge about environmental pollutants and environmental protection

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SUBJECT OBJECTIVES

C1. Acquiring knowledge of instrumental methods used for the determination of elements, organic and inorganic substances in various materials
C2. Learning about sample separation methods based on chromatography techniques
C3 Learning about thermal analysis techniques and applications
C4. To familiarize the student with the practical approach of selected analytical methods and techniques to determine ingredients in real samples
C5. To acquaint the student with the techniques of preparing complex samples of various origins for the multi-element analysis by spectrometric methods
C6. To familiarize the student with metrological problems in analytics
C7. To acquaint the student with validation of analytical methods and the aspects of accreditation
C8. Acquiring knowledge about environmental contamination analysis and modern techniques used in environmental analysis and biomonitoring
C9. Learning about modern technologies of environmental remediation

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge:

Student:

PEU_W01 has a knowledge about instrumental spectroscopic methods and their applications for the analysis of various materials

PEU_W02 has a knowledge about method validation and the validation parameters determined in the validation process

PEU_W03 knows the basic concepts and requirements of the PN-EN ISO/IEC 17025 standards in the field of quality assurance and control as well as ensuring consistency in experimental approaches

PEU_W04 knows what is the accreditation of laboratories and what is its importance for the quality of measurement results

PEU_W05 has a knowledge about sample preparation before analysis

PEU_W06 has a knowledge about applications of thermal analysis methods in identification of inclusions in recycled polyolefins

PEU_W07 has a knowledge about techniques in environmental analysis and biomonitoring

PEU_W08 knows the environmentally friendly technologies, regulations and legal aspects; knows terms such as sustainability development, green deal, circular economy

PEU_W09 knows sources of environmental pollution and has a knowledge about the modern technique of remediation

PEU_W10 knows general laboratory safety rules

relating to skills:

Student:

PEU_U01 can use instrumental methods of chemical analysis in the determination of inorganic and organic components of samples

PEU_U02 can perform (multi)-element analysis of the sample using atomic spectrometry methods

PEU_U03 is able to prepare samples before analysis by spectrometric methods

PEU_U04 is able to assess whether the method fits the assumed goal by calculating the basic parameters

PEU_U05 can apply chromatographic methods and the various spectroscopies, including IR, NMR and MS spectrometry for determining of organic compounds in environmental samples

PEU_U06 is able to perform DSC measurements, evaluate the DSC curve and identify the composition of recycled polyolefins

PEU_U07 The student is able to perform environmental pollution determinations using modern techniques

PEU_U08 is able to perform environmental pollution contamination assessment using biological and physicochemical methods

PEU_U09 can perform the determination of mercury content by atomic absorption spectrometry using an amalgamation technique; can prepare samples (using extraction methods) and perform analysis of ions concentration in environmental samples

PEU_U10 is able to prepare an adequate measuring station and perform nitrogen and carbon determination by elemental analysis as well as is able to perform the determination of nitrogen forms by the Kjeldahl and Devard methods in environmental and waste samples

relating to social competences:

Student:

PEU_K01 The student is able to work independently and collaborate in a group, taking various roles in it

PEK_K02 The student is aware of the importance of the quality and measurability of research results in environmental analysis and in company practice

PEK_K03 The student understands the need to develop modern pro-environmental technologies in line with global trends

PROGRAMME CONTENT		
Lecture		**Number of hours**
Lec 1	Application of spectrometric methods in elemental analysis of samples.	2
Lec 2	Samples preparation strategies in the multi-elemental analysis by spectrometric methods.	2
Lec 3	Selected aspects of verification and validation of analytical methods.	2
Lec 4	Confirming the validity of test results. Sources of error from sample collection to test result.	2
Lec 5	Management system in a laboratory based on PN-EN ISO/IEC 17025. Statement of conformity and decision-making principle in laboratory practice.	2
Lec 6	The use of chromatographic separation methods, NMR, IR spectroscopy, and MS spectrometry in the determination of organic compounds in environmental samples.	2
Lec 7	The use of chromatographic separation methods, NMR, IR spectroscopy, and MS spectrometry in the determination of organic compounds in environmental samples.	2
Lec 8	The use of chromatographic separation methods, NMR, IR spectroscopy, and MS spectrometry in the determination of organic compounds in environmental samples.	2
Lec 9	The use of chromatographic separation methods, NMR, IR spectroscopy, and MS spectrometry in the determination of organic compounds in environmental samples.	2
Lec 10	Methods for determination of inclusion in recycled polymers.	2
Lec 11	Environmentally friendly technologies. Regulations and legal aspects. Sustainability, green deal, circular economy.	2
Lec 12	Environmental contamination analysis. Environmental monitoring. Modern technologies of environmental remediation.	2
Lec 13	Modern research techniques in environmental analysis and biomonitoring.	2
Lec 14	Hazards in the work environment with measuring instruments.	2
Lec 15	Summary. Final test	2
	Total hours	**30**

Laboratory		**Number of hours**
Lab 1	Practical aspects of working in an accredited testing laboratory. Metrological supervision over equipment. Confirmation of the validity of results.	5
Lab 2	Analysis of environmental contamination. Determination of elemental composition of environmental samples by ICP-OES method.	5
Lab 3	Determination of contaminants (e.g. mercury, chlorides, phosphates) in water and wastewater (AAS method with amalgamation technique, ion chromatography).	5
Lab 4	Assessing the utility of chemical products made from renewable raw materials in in vitro testing.	5
Lab 5	Determination of nitrogen and carbon by elemental analysis and nitrogen forms by titration in environmental samples and wastes.	5
Lab 6	Biological methods of environmental contamination assessment - indicator plants - field classes.	5
Lab 7	Physicochemical methods of environmental pollution control - evaluation of soil parameters.	5

Lab 8	Biomonitoring and bioindication of selected environmental samples (e.g. soil, moss, pollen) - multielement analysis using ICP OES/MS methods -part 1.	5
Lab 9	Biomonitoring and bioindication of selected environmental samples (e.g. soil, moss, pollen) - multielement analysis using ICP OES/MS methods -part 2.	5
Lab 10	The use of chromatographic separation methods, NMR, IR spectroscopy, and MS spectrometry in the determination of organic compounds in environmental samples.	5
Lab 11	The use of chromatographic separation methods, NMR, IR spectroscopy, and MS spectrometry in the determination of organic compounds in environmental samples.	5
Lab 12	The use of chromatographic separation methods, NMR, IR spectroscopy, and MS spectrometry in the determination of organic compounds in environmental samples.	5
Lab 13	The use of chromatographic separation methods, NMR, IR spectroscopy, and MS spectrometry in the determination of organic compounds in environmental samples.	5
Lab 14	Determination of organochlorine pollutants in water.	5
Lab 15	Methods for determination of inclusion in recycled polymers.	5
	Total hours	**75**

TEACHING TOOLS USED

N1. Lecture: multimedia presentation
N2. Laboratory: experiment planning, performing chemical analysis, preparation of reports
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
P1 (lecture)	PEU_W01 - PEU_W10	Test
F1 (laboratory)	PEU_U01 - PEU_U10 PEU_K01 - PEU_K03	Assessment of preparation for laboratory class
F2 (laboratory)	PEU_U01 - PEU_U10 PEU_K01 - PEU_K03	Evaluation of the report from laboratory class
P2 (laboratory) final mark for laboratory classes (weighted average of F1 50% and F2 50%)		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] Handbook of Analytical Techniques, Editors: H.Gunzler, A.Williams, 2001 Wiley-VCH
[2] Handbook of Spectroscopy: Second, Enlarged Edition, G. Gauglitz, D.S. Moore, 2014 Wiley-VCH
[3] P. Konieczka, J. Namieńnik, Quality Assurance and Quality Control in the Analytical Chemical Laboratory: A Practical Approach, 1st ed.; CRC Press: Boca Raton, FL, USA; Taylor & Francis Group: Boca Raton, FL, USA, 2009

SECONDARY LITERATURE:

[1] J.F. Rubinson, K.A. Rubinson, Contemporary Chemical Analysis, Prentice Hall, New Jersey 1998

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Zał. nr 5 do ZW 16/2020

FACULTY OF CHEMISTRY

SUBJECT CARD

Name of subject in Polish Metody identyfikacji strumieni odpadów i ocena potencjału surowcowego

Name of subject in English Methods of waste streams identification and assessing the raw material potential

Main field of study (if applicable): Urban mining

Specialization (if applicable): —

Profile: academic / ~~practical~~*

Level and form of studies: ~~1st~~/ 2nd level, ~~uniform magister studies~~*, full-time / ~~part-time~~*

Kind of subject: obligatory / ~~optional / university-wide~~*

Subject code …….

Group of courses YES / ~~NO~~**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30			45	
Number of hours of total student workload (CNPS)	60			90	
Form of crediting	~~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			4	
including number of ECTS points for practical classes (P)				4	
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	2			4	

*delete as not necessary

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge of urban mining.
2. Basic knowledge of spatial data, coordinate systems and methods of making cartographic studies.
3. Can use computer tools for building databases and GIS systems

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SUBJECT OBJECTIVES

C1. Presentation of main assumptions of municipal waste management.
C2. Acquisition of knowledge and skills in the field of typing areas in municipal waste management.
C3. Learning modern methods and techniques of spatial data acquisition.
C4. Acquisition of the ability to assess the raw material potential in selected wastes.
C5. Understanding the principles of visualization of spatial data in the GIS environment.

C6. Acquisition knowledge and skills in the organization of waste management in line with the idea of urban mining.

SUBJECT EDUCATIONAL EFFECTS

Relating to knowledge:

PEU_W01 The student knows municipal waste management organization systems.
PEU_W02 The student knows about the raw materials available in the waste.
PEU_W03 The student knows the assessment of the raw material potential of municipal and landfill waste.
PEU_W04 Knows modern data acquisition methods.

Relating to skills:

PEU_U01 He can identify waste in a given geographical space.
PEU_U02 Has the ability to use GIS tools to analyze waste management in a given geographical space.
PEU_U03 Has the ability to solve selected problems in waste management with the use of spatial analyzes.
PEU_U04 Can assess the raw material potential in waste in a given geographical space.
PEU_U05 Can present graphically and interpret the results of spatial analyzes.

Relating to social competences:

PEU_K01 The student can cooperate in a project group.
PEU_K02 Can present the results of work.

PROGRAMME CONTENT		
Lecture		**Number of hours**
Lec 1	Municipal waste management. Main assumptions.	2
Lec 2	Typization of areas in waste management. Context and methodical approach.	2
Lec 3	Modern methods and techniques of acquiring spatial data (scanning, lidar, photogrammetric measurements).	2
Lec 4	Modern methods and techniques of spatial data acquisition (smartphones, GNSS receivers).	2
Lec 5	Quantitative and qualitative analysis of the municipal waste stream.	2
Lec 6	Organization of the municipal waste collection and transport system. Theoretical basics.	2
Lec 7	Organization of the municipal waste collection and transport system. Case study.	2

Lec 8	Segregation and recovery of municipal waste.	2
Lec 9	GIS systems in waste management. Usage.	2
Lec 10	Assessment of the raw material potential in municipal waste management.	2
Lec 11	Assessment of the raw material potential in waste deposited in landfills.	2
Lec 12	Critical metals in municipal waste.	2
Lec 13	Ashes after waste incineration as a source of metals.	2
Lec 14	Obtaining phosphorus from waste and sludge and their processing.	2
Lec 15	Summary. Final test.	2
	Total hours	30

PROGRAMME CONTENT		
Project		**Number of hours**
Proj 1	Organization of classes. Information on the principles of health and safety in the computer room. Discussion of the method of conducting classes and the conditions of passing. Typization of the area in waste management. Overview of the scope of the project. Selection of the geographic area for typing.	2
Proj 2	Identification of natural, demographic, structural, technical, economic, social, environmental and other conditions.	2
Proj 3 - Proj 4	Development of a database for the typification criteria for a selected geographical area with the use of spatial data (topographic data, aerial photos, satellite photos, NMT, NMPT, WMS, WMTS, WFS).	4
Proj 5	Typization of a selected geographical area with the use of tools available in GIS software.	2
Proj 6	Quantitative and qualitative identification of the waste stream in the analyzed geographical area. Visualization of results on maps.	2
Proj 7	Development of a map of waste density in the analyzed geographical area for selected time intervals (heat map). Change analysis.	2
Proj 8	Development of a map of waste concentrations in the analyzed geographical area for selected time periods (hot spot). Change analysis.	2

Proj 9-Proj 10	Organization of the waste collection and transport system in a given geographical space. The traveling salesman algorithm, planar topological graphs and geometric networks.	4
Proj 11	Development of an interactive map with results (5-9). Assessment and completion of the project.	2
Proj 12	Analysis of the raw material potential of the given waste. Overview of the scope of the project. Waste selection.	2
Proj 13	Analysis of the raw material potential of the given waste. Quantitative and qualitative characteristics of the given waste.	2
Proj 14	Analysis of the raw material potential of the given waste. Raw material analysis of given waste.	2
Proj 15	Analysis of the raw material potential of the given waste. Identification of the processing technology of components from the given waste.	2
Proj 16	Analysis of the raw material potential of the given waste. Initial economic assessment.	2
Proj 17	Presentation of the results. Assessment and credit.	2
Proj 18-Proj 19	Identification of the raw material potential from waste in the analyzed geographical area (1).	4
Proj 20	Development of a map of the density of raw materials from waste in the analyzed geographical area (heat map).	2
Proj 21	Development of a map of concentrations of raw materials from waste in the analyzed geographical area (hot spot).	2
Proj 22	Development of an interactive map with results (18-20). Assessment and completion of the project.	2
Proj 23	Summary, discussion of the results, assessment.	1
	Total hours	45

TEACHING TOOLS USED
N1. Information lecture.
N2. Multimedia presentation.
N3. Didactic discussion as part of the lecture and project.

N4. Design exercises and preparation of exercise reports.

N5. Use of a specialized software package for GIS.

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
F, P	PEU_W01-W04 PEU_U01-U05 PEU_K01-K02	F1- Evaluation of the implementation of the project and written report. F2 - Score from cards. P1 - Final evaluation of the project. P2 - Final grade in the lecture.

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] Best Practice Municipal Waste Management, http://www.umweltbundesamt.de/abfallwirtschaft-e/best-practice-mwm/html/index_en.html;

[2] Damodaran, Aswath. (2012). *Investment Valuation* (3. Aufl. ed., Vol. 666, Wiley finance). New York: Wiley.

[3] Townsend, Timothy G, et al. Sustainable Practices for Landfill Design and Operation. 2015th ed., Springer New York, 2015.

[4] Junghoon, K.I., GIS and big data visualization. In: Geographic Information Systems and Science. IntechOpen, 2018.

[5] Ahmad, Shabir, et al. Quantum GIS based descriptive and predictive data analysis for effective planning of waste management. Ieee Access, 2020, 8: 46193-46205.

[6] Dutta, Deblina; Goel, Sudha. Applications of remote sensing and GIS in solid waste management–A review. In: Advances in solid and hazardous waste management. Springer, Cham, 2017. p. 133-151.

[7] Chalkias, Christos; Lasaridi, Katia. Benefits from GIS based modelling for municipal solid waste management. INTECH Open Access Publisher, 2011.

[8] Longley P. A., Goodchild M. F., Maguire D. J., Rhind D. 2011: Geographic Information Systems and Science, John Wiley & Sons

[9] Mitchell A., 2005: The ESRI Guide to GIS Analysis, Volume 2: Spatial Measurements and Statistics

SECONDARY LITERATURE:

[1] Circular Economy and Sustaiable Strategies, artykuły o gospodarce odpadami dostępne na stronie internetowej czasopisma: https://www.mdpi.com/journal/sustainability/special_issues/Circular_Economy_and_Sustainable_Strategies

[2] Energy and Climate Change, artykuły o gospodarce odpadami dostępne na stronie internetowej czasopisma https://www.journals.elsevier.com/energy-and-climate-change

[3] Energy Policy Journal, artykuły o gospodarce odpadami dostępne na stronie internetowej czasopisma https://www.journals.elsevier.com/energy-policy

[4] Sustainable Production and Consumption, artykuły o gospodarce odpadami dostępne na dostępne na stronie internetowej czasopisma, https://www.journals.elsevier.com/sustainable-production-and-consumption

[5] ArcGIS Pro Documentation @ https://doc.arcgis.com/

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Zał. nr 5 do ZW 16/2020

FACULTY OF CHEMISTRY

SUBJECT CARD

Name of subject in Polish BHP przy gospodarce odpadami
Name of subject in English Occupational health and safety in waste management
Main field of study (if applicable): Urban mining
Specialization (if applicable): ……..
Profile: academic / ~~practical~~*
Level and form of studies: ~~1st~~/ 2nd level, ~~uniform magister studies~~*, full-time / ~~part-time~~*
Kind of subject: obligatory / ~~optional~~ / ~~university-wide~~*
Subject code …….
Group of courses ~~YES~~ / NO*

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15			15	15
Number of hours of total student workload (CNPS)	30			60	30
Form of crediting	~~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	1			2	1
including number of ECTS points for practical classes (P)				1,5	0,5
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	0,7			1,4	0,7

*delete as not necessary

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge of basic work-related concepts.

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SUBJECT OBJECTIVES

C1 Acquisition basic knowledge of health and safety in the waste processing industry.
C2 Acquisition of knowledge in the field of work environment factors, occupational risk and its assessment, accidents and occupational diseases and OSH management systems.
C3 Acquisition of skills in risk assessment and development of corrective actions.

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge:
PEU_W01 The student knows the terminology and procedures of occupational safety and health.

PEU_W02 The student knows the principles of safe work performance.
PEU_W03 The student has knowledge about threats in work environment in waste management.
PEU_W04 The student has general knowledge about the rules of occupational risk assessment.
PEU_W05 The student has knowledge on formal and legal conditions, methods and tools to study accidents at work.
PEU_W06 The student knows the ways of shaping the culture of safety and hygiene of work in workplaces.

relating to skills:
PEU_U01 The student is able to identify threats in the work environment in waste management industry
PEU_U02 The student is able to assess and determine the acceptability of occupational risk.
PEU_U03 The student is able to plan corrective and preventive actions for threats in the workplace.
PEU_U04 The student is able to analyze accidents at work using various methods

relating to social competences:
PEU_K01 The student should be ready to critically evaluate the received content and recognize the importance of knowledge in solving problems focused on OSH.
PEU_K02 The student is able to recognize the need for lifelong learning.

PROGRAMME CONTENT		
Lecture		**Number of hours**
Lec 1	Introduction to the lecture, didactic aim, program, requirements and credit conditions, literature. Documentation, terminology and procedures in the field of OSH.	2
Lec 2	Hazards in the work environment in urban mining - part I.	2
Lec 3	Hazards in the working environment in urban mining - part II. Measurement of working environment factors.	2
Lec 4	Definition of occupational risk. Legal basis of occupational risk assessment Risk assessment methods Risk assessment process.	2
Lec 5	Accidents and occupational diseases in urban mining industry.	2
Lec 6	OSH management systems.	2
Lec 7	Formation of safety and health culture at workplaces.	2
Lec 8	Test	1
	Total hours	**15**

Project		**Number of hours**
Proj 1	Introduction to exercises, learning goal, requirements and conditions for passing. Introduction to project 1: Occupational risk assessment of selected workplaces in the urban mining industry.	2
Proj 2	Hazard analysis for selected workplaces in urban mining industry.	2

Proj 3	Occupational risk assessment for selected positions using various methods.	2
Proj 4	Developing corrective and preventive actions for workplace hazards.	2
Proj 5	Credit for project 1 Introduction to project 2: Analysis of accidents at work.	2
Proj 6	Analysis of accidents at work using different methods	2
Proj 7	Corrective and preventive actions. Motivating and reinforcing safe behaviour.	2
Proj 8	Credit of the project 2. Credit of the course.	1
	Total hours	**15**

Seminar		**Number of hours**
Semin 1	Introduction to the seminar, didactic aim, requirements and credit conditions. Assignment of the seminar participants to prepare and present the topics of safety and health at work in waste management.	2
Semin 2-5	Analysis of dangerous, harmful and arduous factors on selected positions in urban mining industry.	8
Semin 6-8	Specific formal and legal conditions of OSH in waste management.	5
	Total hours	**15**

TEACHING TOOLS USED
N1. Multimedia presentation N2. Case study N3. Working in groups N4. Discussion N5. Consultation N6. E-learing N7. Own 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
P1 - Lecture	PEU_W01-06 PEU_U01 PEU_K01-02	Final evaluation of the lecture on the basis of a written or oral test
F1, F2, P – Project	PEU_W03-06 PEU_U01-04	F1: evaluation for the development of the assigned tasks, F2: evaluation for activity during the project

	PEU_K01-02	classes/project defense, P: final evaluation of the exercises (arithmetic mean of F1 and F2) ."
F1, F2, P - Seminar	PEU_W01-06 PEU_K01-02	F1: evaluation for preparation and presentation of a paper, F2: evaluation for activity and participation in discussions during classes, P: final evaluation from the seminar (the arithmetic mean of F1 and F2)

PRIMARY AND SECONDARY LITERATURE
PRIMARY LITERATURE: [1] Standard ISO 45001:2018 [2] S. Z. Mansdorf, Handbook of Occupational Safety and Health, Third Edition, Wiley, 2019 [3] D. Koradecka (Ed.), Handbook of Occupational Safety and Health, Taylor & Francis Group, 2010 [4] B. O. Alli, Fundamental Principles of Occupational Health and Safety, Second Edition, International Labour Office, 2008 [5] M. A. Friend, J.P. Kohn, Fundamentals of Occupational Safety and Health, Seventh Edition, Bernan Press, 2018 **SECONDARY LITERATURE:** [1] International and national regulations on occupational safety and health [2] Scientific journals in the field of occupational safety and health [3]
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Załącznik nr 5 do ZW 16/2020

FACULTY OF CHEMISTRY

SUBJECT CARD

Name of subject in Polish Fizyczne i fizykochemiczne metody przerobu odpadów
Name of subject in English Physical and physicochemical methods of waste processing
Main field of study (if applicable): Urban mining
Specialization (if applicable): ……..
Profile: academic / ~~practical~~*
Level and form of studies: ~~1st~~/ 2nd level, ~~uniform magister studies*~~, full-time / ~~part-time~~*
Kind of subject: obligatory / ~~optional / university-wide~~*
Subject code …….
Group of courses ~~YES~~ / NO

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30		45		15
Number of hours of total student workload (CNPS)					
Form of crediting	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		4		2
including number of ECTS points for practical classes (P)	2		3		1
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	1.4		2.8		1.4

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Student has a basic knowledge of chemistry, physics and environmental protection
2. Has basic knowledge in the field of waste treatment and urban mining

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SUBJECT OBJECTIVES

C1 The aim of the course is to make students familiar with methods of waste management
C2 To familiarize students with circular economy principles
C3 To acquaint the student with the physicochemical basis of solid and liquid waste separation methods
C4 To teach students the differences in handling polymer waste with different physicochemical properties

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge:

PEU_W01 The student knows the physico-chemical basis and methods of solid and liquid waste separation
PEU_W02 The student is familiar with circular economy and methodology to recover value-added products
PEU_W03 Has knowledge in the field of obtaining raw materials from the waste stream resulting from human activity
PEU_W04 Has knowledge covering properties of useful raw materials, characteristics of physical and physicochemical processes, research methods, technologies and systems of waste materials processing
PEU_W05 Has knowledge about polymeric materials in municipal waste.
PEU_W06 Has knowledge about differences in properties in polymeric materials of municipal wastes

relating to skills:

PEU_U01 The student is able to select the separation method of solid waste and wastewater
PEU_U02 The student is able to carry out the separation of solid waste and wastewater
PEU_U03 The student gets practical skills in designing and optimization of the separation
PEU_U04 Can search for information and identify and apply physical, physicochemical and chemical processes in technologies of waste materials processing and subject the information to critical evaluation and analysis
PEU_U05 Can determine basic qualitative and quantitative parameters in technologies and processing systems and analyze and evaluate results of conducted processing
PEU_U06 Can separate polyesters from polyolefins
PEU_U07 Can process polymeric wastes using basic equipments
PEU_U08 Is able to use raw material, chemical and biological processing methods and technologies to valorise waste for fertiliser and feeding purposes

relating to social competences:

PEU_K01 Student can prepare a presentation on his/her knowledge
PEU_K02 Student is able to prepare a critical review of the scientific literature on a specific topic
PEU_K03 Student is able to work in a group and take on different roles
PEU_K04 He/she should be ready to critically evaluate the received contents and recognize the importance of knowledge in solving problems focused on the properties and possibilities of use of man-made wastes and technologies of their processing.

PEU_K05 Can freely communicate and discuss in the field of physical and physicochemical methods of waste treatment

PEU_K06 Knows the ecological risks resulting from incorrect waste management

PROGRAMME CONTENT		
Lecture		**Number of hours**
Lec 1	Introduction, aim and scope of lectures. Classification of waste materials. Basic terms and definitions. Criteria of effectiveness of recovery processes	2
Lec 2	Sorting and comminution technologies	2
Lec 3	Mechanical and hydraulic classification technologies	2
Lec 4	Basics and practice of gravity separation	2
Lec 5	Magnetic, electrical and optical separation technologies and practice	2
Lec 6-7	Physicochemical basis of solid waste and wastewater separation methods (flotation, coagulation, flocculation, agglomeration)	4
Lec 8	Flotation practice and technologies	2
Lec 9	Waste dewatering technologies and practice. Technologies of selected waste treatment	2
Lec 10	Membrane technologies in water recovery - micro and ultrafiltration	2
Lec 11	Membrane technologies in water recovery - nanofiltration, reverse osmosis, electrodialysis	2
Lec 12	Sorption technologies for cleaning of water	2
Lec 13	Sorption technologies in recovery of valuable compounds	2
Lec 14-15	Polymer recycling line - from waste to new material	4
	Total hours	30

Laboratory	**Number of hours**

Lab 1	Introduction to the laboratory, health and safety rules. Mining and processing waste treatment methods (comminution, sorting, classification, separation)	3
Lab 2	Electronic waste treatment methods (comminution, sorting, classification, separation)	3
Lab 3	Construction waste treatment methods (comminution, sorting, classification, separation)	3
Lab 4	Membrane systems in water recovery - UF/MF	3
Lab 5	Membrane systems in water recovery - NF/ED	3
Lab 6	Sorption filtration hybrid for removal of harmful components	3
Lab 7	Sorption systems for removal of endocrine disruptors	3
Lab 8	Recovery of valuable components from sewage (metal and metal oxides)	3
Lab 9	Recovery of valuable components from sewage (low molecular organics)	3
Lab 10	Solid waste suspension coagulation and flocculation	3
Lab 11	Plastics flotation	3
Lab 12	Precipitate and carrier flotation	3
Lab 13	Polymer waste processing - separation, shredding, extrusion, injection molding	3
Lab 14	Polymer waste processing - casting extrusion and/or blow film extrusion	3
Lab 15	Mechanical properties of recycled polymers (tensile strength, compression strength, impact strength, melt mass flow rate)	3
	Total hours	**45**

Seminar		**Number of hours**
Semin 1-2	Examples of anthropogenic waste recycling. Technological problems and challenges of waste recycling	2
Semin 3	Technologies for recovery of ferrous metals. Technologies for recovery of non-ferrous metals	1
Semin 4-5	Examples of municipal, industrial and construction wastes recycling	2
Semin 6-7	Examples of mining and processing wastes recycling. Life cycle of selected product	2
Semin 8-9	Physicochemical basis of solid waste and wastewater separation methods	2
Semin 10-13	Design of plant for recovery of water from sewage	4
Semin 14-15	Polymer recycling line - from waste to new material	2
	Total hours	**15**

TEACHING TOOLS USED

N1. Lecture with multimedia presentation
N2. Preparing of presentation
N3. Solving conceptual problems
N4. Performing laboratory exercises
N5. Preparing of laboratory report
N6. Consultation

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT

Evaluation (F – forming during semester), P – concluding (at semester end)	Learning outcomes code	Way of evaluating learning outcomes achievement
P (lecture)	PEU_W01-PEU_W06	Written examination
F1 (seminar)	PEU_U01-PEU_U08 PEU_K01-PEU_K06	Presentation on a chosen aspec
F2 (seminar)	PEU_U01-PEU_U08 PEU_K01-PEU_K06	Activity in classes
P (seminar) final mark for seminar classes (weighted average of F1 60% and F2 40%)		
F1 (laboratory)	PEU_U01-PEU_U08 PEU_K01-PEU_K06	Assessment of preparation for laboratory classes
F2 (laboratory)	PEU_U01-PEU_U08 PEU_K01-PEU_K06	Evaluation of the report of the laboratory tests carried out
P (laboratory) final mark for laboratory classes (weighted average of F1 50% and F2 50%)		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] M.Bryjak, N.Kabay, B.Rivas, J.Bundschuh, Innovative materials and methods for water treatment, CRC Press 2015
[2] J.S.Laskowski, J.Ralston, Colloid chemistry in mineral processing, Elsevier 1992
[3] J.Drzymała, Mineral processing: foundations of theory and practice of minerallurgy, Oficyna Wydawnicza Politechniki Wrocławskiej 2007
[4] J.Bratby, Coagulation and flocculation in water and wastewater treatment, IWA Publishing 2016
[5] N.Rudolph, R.Kiesel, C.Aumnate, Understanding Plastic Recycling: economic, ecological and technical aspects of plastic waste handling, HANSER 2017
[6] R.Francis, Recycling of Polymers: methods, Characterization and Applications, Wiley-VCH 2020
[7] B.A.Wills, Mineral processing technology. Pergamon Press, 1983 (3rd edition) and all subsequent editions (7th edition, Elsevier & BH 2006)
[8] A.Gupta, D.S.Yan, Mineral Processing Design and Operations. An introduction. Elsevier 2006

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[1] B.Lottermoser, Mine Wastes: Characterization, Treatment and Environmental Impacts. Springer 2007
[2] M.J.Rogoff, Solid Waste Recycling and Processing. Planning of Solid Waste Recycling Facilities and Programs, Elsevier 2013
[3] A.Khan, Inamuddin, A.M.Asiri, E-waste Recycling and Management. Present Scenarios and Environmental Issues, Springer 2020
[4] T.Nakamura, K.Halada, Urban Mining Systems, Springer 2015
[5] N.Kayay, M.Bryjak, N.Hilal, Boron separation processes, Elsevier 2015
[6] L.K.Wang, N.K.Shammas, Y.-T.Hung, Waste treatment in the metal manufacturing, forming, coating, and finishing industries, CRC Press 2009
[7] T.F.Tadros, Dispersion of powders in liquids and stabilization of Suspensions, Wiley-VCH 2012

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Zał. nr 5 do ZW 16/2020

FACULTY OF CHEMISTRY

SUBJECT CARD

Name of subject in Polish: Inżynieria procesowa
Name of subject in English: *Process engineering*
Main field of study (if applicable): Urban mining
Specialization (if applicable): —
Profile: academic / ~~practical~~*
Level and form of studies: ~~1st/~~ 2nd level, ~~uniform magister studies~~*, full-time / ~~part-time*~~
Kind of subject: obligatory **/** ~~optional / university-wide~~**
Subject code:
Group of courses ~~YES~~ / NO**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30			60	
Number of hours of total student workload (CNPS)	60			150	
Form of crediting	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			5	
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)	1.4			3.5	

*delete as not necessary

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge of unit operations in chemical and process engineering and in chemical technology.
2. Basics of technological process design, technological project.
3. Knowledge of process equipment.

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SUBJECT OBJECTIVES

C1. To acquaint students with the possibilities of developing practical technological processes.
C2. To acquaint students with the tasks of designing an industrial installation, the principles of developing a process design of an industrial installation.
C3. Obtaining by students of basic knowledge about the raw material and energy supply system, the requirements for the quality of raw materials (including waste materials) and obtained products, optimization and intensification of the technological process.
C4. To familiarize students with the principles of developing the course of the production process, including the principles of drawing up a schematic diagram as well as a technological and apparatus diagram of the designed industrial installation.

C5. To acquaint students with the principles of the selection of process apparatus, devices, construction materials, as well as the method and selection of control, measuring and regulating apparatus of the designed installation.
C6. Implementation of a simplified design of a technological process by a group of students.

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge:
PEU_W01 - Knows the possibilities of developing the technological processes used in practice.
PEU_W02 - Knows the rules of developing a process design.
PEU_W03 - Knows the basics of designing unit operations.
PEU_W04 - Knows the supply systems for raw materials and energy, is able to analyze and prepare process data for design, has knowledge about the requirements for the quality of raw materials and the products obtained, and about the requirements for their storage.
PEU_W05 - Has in-depth knowledge of the selection of apparatus and devices used in process engineering.
PEU_W06 - Knows the rules of process intensification.

relating to skills:
PEU_U01 - Can make design calculations of selected unit operations in process engineering.
PEU_U02 - Is able to select the sequence of unit processes to the technological process.
PEU_U03 - Is able to select individual parameters of processes and unit operations of a given design task, according to a developed schematic diagram.
PEU_U04 - Can prepare a material and energy balance of a technological process.
PEU_U05 - Can select and/or design process installation apparatus.
PEU_U06 - Is able to make a simplified process design of an industrial installation.

relating to social competences:
PEU_K01 - Is aware of the importance and connections of process design with environmental, economic and product quality aspects.
PEU_K02 - Understands the importance of design for the social and economic development of the country.
PEU_K03 - Can cooperate in a project group.
PEU_K04 - Can present the results of own and / or group work.

PROGRAMME CONTENT

	Lecture	**Number of hours**
Lec1	From idea to implementation - where do ideas for new investments come from? Directions of development of practical technological processes.	2
Lec2	Sustainable process design - sustainable development. Designing production processes in line with the resource-efficient economy.	2
Lec3	Integration of chemical processes. Industrial installation. Principles of designing an industrial installation.	2
Lec4	Formulation of the design problem. Principles of developing a process design.	2
Lec5	Raw material and energy supply system. Products, waste. Environmental Protection.	2
Lec6	Process data. Selection of process parameters.	2
Lec7	Quality of raw materials and products, guidelines for their storage.	2

Lec8	The course of the production process. Schematic diagram of an industrial installation.	2
Lec9	Principles of process balancing.	2
Lec10	Process apparatus, industrial installation devices. Selection of construction materials.	2
Lec11	Control and regulation of the designed process - industrial installation. Control and measurement equipment, automatic control systems.	2
Lec12	Technological and apparatus diagrams in process engineering.	2
Lec13	Circular economy and waste - recovery of critical raw materials from wastewater (case study)	2
Lec14	Design of an installation for waste processing in a continuous system (case study)	2
Lec15	Design of an installation for waste processing in a periodic system (case study)	2
	Total hours	**30**

Project		**Number of hours**
Pr1	Organizational classes. Discussion of the method of conducting classes and the conditions of passing. Overview of the scope of the project. Organization of project teams.	4
Pr2	Task 1. Research and market analysis. Formulation of the design problem.	4
Pr3	Task 2. Development of a chemical and technological concept for a design task - an example of an industrial installation. Presentation of the concept by design teams. Discussion.	4
Pr4	Task 3. Selection of individual parameters of processes and unit operations for a specific design task according to the developed schematic diagram of the designed installation.	4
Pr5-6	Material and energy balance, calculation of raw material consumption rates. Calculation of the composition of the product / products, waste composition and preparation of proposals for their storage / disposal on the example of real industrial installations.	8
Pr7	Task 4. Preparation of a material and energy balance for a selected technological concept (work in project teams).	4
Pr8-9	Selection and / or design of process apparatus, selection of devices, selection of construction materials on the basis of real industrial installations.	8
Pr10	Task 5. Selection and / or design of selected process apparatuses, equipment selection, selection of construction materials for a selected technological concept (work in project teams).	4
Pr11	Development of a measurement, control and regulation system for the designed industrial installation. Selection of control and measurement equipment. Selection of automatic control systems (on the example of real industrial installations).	4
Pr12	Task 6. Development of a measurement, control and regulation system for the designed industrial installation. Selection of control and measurement equipment. Selection of automatic control systems for a selected technological concept (work in project teams).	4

Pr13	Development of the technological and apparatus scheme of the designed installation. Spatial distribution of apparatuses and devices on the example of real industrial installations.	4
Pr14	Task 7. Development of a technological and apparatus scheme for a selected technological concept (work in project teams).	4
Pr15	Presentation of simplified process projects made by students and passing the course.	4
	Total hours	**60**

TEACHING TOOLS USED

N1. Lecture with multimedia presentation.
N2. Project exercises.
N3. Didactic discussion as part of the lecture and project.
N4. Implementation of a simplified process design of the given task - elements of independent work and in teams.
N5. Project 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, P2	PEU_W01-W06 PEU_U01-U06 PEU_K01-K04	P1 - Final exam of the lecture. P2 - Credit with grade - project evaluation.

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] A.C. Dimian, C. S. Bildea: *Chemical Process Design*, WILEY-VCH, 2008.
[2] D.W. Green, R.H. Perry (red.): *Perry's chemical engineer's handbook*, 8th ed., McGraw-Hill, 2007.
[3] G.H. Vogel, *Process Development. From the initial idea to the chemical production plant*, Wiley, 2005.
[4] M. Zlokarnik, *Scale–up in chemical engineering*, Wiley, 2002.
[5] G.I. Wells, L.M. Rose, *The art of chemical process design*, Elsevier, 1986.

SECONDARY LITERATURE:

[1] W.D. Seider: *Process design principles*, J.W.&S., 1999.
[2] U. Brockel, W. Meier, G. Wagner (red.): *Product design and engineering*. Vol. 1: *Basics and technologies*, Vol. 2: *Raw materials, additives and application*, Wiley, 2007.

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Zał. nr 5 do ZW 16/2020

FACULTY OF CHEMISTRY

SUBJECT CARD

Name of subject in Polish: Studium wykonalności projektu
Name of subject in English: *Project feasibility study*
Main field of study (if applicable): Urban mining
Specialization (if applicable): —
Profile: academic / ~~practical~~*
Level and form of studies: ~~1st/~~ 2nd level, ~~uniform magister studies~~*, full-time / ~~part-time*~~
Kind of subject: obligatory **/** ~~optional / university-wide~~**
Subject code:
Group of courses ~~YES~~ / NO**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15			30	
Number of hours of total student workload (CNPS)	30			90	
Form of crediting	~~Examination /~~ crediting with grade*	Examination / crediting with grade*	Examination / crediting with grade*	~~Examination~~ / crediting with grade*	Examination / crediting with grade*
For group of courses mark (X) final course					
Number of ECTS points	1			2	
including number of ECTS points for practical classes (P)				2	
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	0.7			1.4	

*delete as not necessary

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge of unit operations in chemical and process engineering and in chemical technology.
2. Basics of technological process design, technological project.
3. Knowledge of process equipment.

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SUBJECT OBJECTIVES

C1 Introducing students to investment project cycle from the stage of the initial idea until the plant is in operation.
C2 Presentation of issues relating to fundamental aspects of the pre-investment studies which allow to examining the project idea step by step and presentation of alternative solutions.
C3 To gain knowledge on the identification of investment opportunities include general and specific opportunities studies ready to present for potential investors.
C4 Understanding the nature and role of the preliminary assessment of the investment idea in the form of a pre-feasibility study.
C5 Presentation of the different stages of a feasibility study needed to make investment decisions and formulate the final version of the technical and economic project.

C6 To gain knowledge of product marketing, providing the necessary material inputs, locating the plant at the optimal site and human resource, technical and organizational planning.
C7 Knowledge of the financial viability of the project, planning the structure of overhead costs and the planning and balancing of project realization.

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge:

PEK_W01 – knows the investment project cycle from the stage of the initial idea until the plant is in operation and understands the interrelationship between three distinct phases: the pre-investment, the investment and the operational phase.

PEK_W02 – has knowledge and is able to describe the stages of pre-investment phase includes identification of investment opportunities (opportunity studies), analysis of project alternatives and preliminary project selection as well as project preparation (prefeasibility and feasibility studies).

PEK_W03 – has knowledge about identifying investment opportunities based on area, industrial sector and resource-based studies and specific project opportunity studies which should follow the initial identification of general investment opportunities.

PEK_W04 – knows the key concepts and issues related to the pre-feasibility study taking into account a detailed analysis of variants in the following main fields (components) of the study: project or corporate strategies, market and marketing concept, raw materials and factory supplies, location, site and environment, engineering and technology, organization and overhead costs, human resources, labour costs, project implementation schedule and budgeting.

PEK_W05 – has knowledge of the individual stages of a feasibility study taking into account the market analysis, outline of marketing concept, identification and description of the location, including ecological and environmental impact, a description of the socio-economic and cultural environment, characteristics of raw materials and other inputs needed for operating the plant.

PEK_W06 – is able to develop the functional and physical layout for the industrial plant, production program, is able to determine the production capacity of the plant and corresponding investment expenditures as well as the costs arising during the operational phase.

PEK_W07 – knows how and is able to plan the organization needed to manage and direct all activities of the plant and create a structure of overhead costs.

PEK_W08 – knows how and is able to specify implementation schedule and budget of project as well as describe the characteristics of the main implementation work tasks as well as the major constraints that normally have a particular impact on project implementation.

PEK_W09 – knows the basic aspects of financial analysis of industrial project investment and has knowledge of evaluation concept.

relating to skills:

PEU_U01 - can indicate the stages of the investment process

PEU_U02 - can perform an economic analysis

PEU_U03 - is able to perform an analysis of the legality of a technological solution

PEU_U04 - can make the project schedule

PEU_U05 - can choose a technology based on the available knowledge in the field of the project

PEU_U06 - is able to determine the degree of project progress

relating to social competences:

PEU_K01 - Is aware of the importance and connections of process design with environmental, economic and product quality aspects.

PEU_K02 - Understands the importance of design for the social and economic development of the country.

PEU_K03 - Can cooperate in a project group.

PEU_K04 - Can present the results of own and / or group work.

PROGRAMME CONTENT		
Lecture		**Number of hours**
Lec1	Introduction, aim and scope of lectures. Basic aspects of pre-investment studies	1
Lec2	General and specific project opportunity studies	2
Lec3	Project background and basic idea	2
Lec4	Market analysis and marketing concept	2
Lec5	Intellectual property law - know-how license and patent license	2
Lec6	Engineering and technology	2
Lec7	financial analysis and investment appraisal	2
Lec8	Exam Test	2
	Total hours	**15**

Project		**Number of hours**
Pr1	The investment project cycle: the pre-investment, the investment and the operational chase and promotion of industrial investment projects	2
Pr2	Basic aspects of pre-investment studies	2
Pr3	General and specific project opportunity studies	2
Pr4	Pre-feasibility studies	2
Pr5	The feasibility study - project background and basic idea	2
Pr6	The feasibility study – market analysis and marketing concept	
Pr7	The feasibility study – raw materials and supplies, location, site and environment	2
Pr8	The feasibility study – engineering and technology	2
Pr9	The feasibility study – organization and overhead costs	2
Pr10	The feasibility study – human resources	2
Pr11	The feasibility study – implementation planning and budgeting	2
Pr12	The feasibility study – financial analysis and investment appraisal	2
Pr13	Presentation of the feasibility study for selected industrial process	2
Pr14	Presentation of the feasibility study for selected industrial process	2
Pr15	Presentation of the feasibility study for selected industrial process	2
	Total hours	**30**

TEACHING TOOLS USED
N1. Lecture with multimedia presentation. N2. Project exercises. N3. Didactic discussion as part of the lecture and project. N4. Implementation of a simplified process design of the given task - elements of independent work and in teams. N5. Project consultations.

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT

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

concluding (at semester end)		
P1, P2	PEU_W01-W09 PEU_U01-U06 PEU_K01-K04	P1 - Final exam of the lecture. P2 - Credit with grade - project evaluation.

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] Behrens W., Hawranek P.M., Manual for the preparation of industrial feasibility studies, UNIDO, Warszawa 2003.
[2] Overton R., Feasibility Studies Made Simple, Martin Books, Australia, 2007.
[3] M. Zlokarnik, *Scale–up in chemical engineering*, Wiley, 2002.
[4] A.C. Dimian, C. S. Bildea: *Chemical Process Design*, WILEY-VCH, 2008.

SECONDARY LITERATURE:

[1] Stevens R.E., Sherwood P.K., How to prepare a feasibility study: a step-by-step guide including 3 model studies, Prentice-Hall, 1982

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Załącznik nr 5 do ZW 16/2020

FACULTY OF CHEMISTRY

SUBJECT CARD

Name of subject in Polish *Metody statystyczne w gospodarce odpadami*
Name of subject in English *Statistical methods in waste management*
Main field of study (if applicable): Urban mining
Specialization (if applicable): ……..
Profile: academic / ~~practical~~*
Level and form of studies: ~~1st~~/ 2nd level, ~~uniform magister studies*~~, full-time / ~~part-time~~*
Kind of subject: obligatory / ~~optional / university-wide~~*
Subject code …….
Group of courses ~~YES~~ / NO

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge of mathematical operations
2. Basic computer skills
3. Knowledge of the English language
4. Basic knowledge of computer programs: Matlab, MS Excel .

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SUBJECT OBJECTIVES

C1: Acquainting students with the problems of basic descriptive statistics
C2: Acquainting students with data representation methods
C3: Familiarizing students with the issues of basic mathematical statistics
C4: Introducing students to regression models
C5: Familiarizing students with parametric and non-parametric tests
C6: Familiarizing students with the methods of scaling and data transformation
C7: Familiarizing students with selected methods of multivariate data analysis
C8: Introducing students to scientific literature and literature examples

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge:

PEU_W01 The student knows the terminology and procedures used in data analysis.
PEU_W02 The student knows the rules of making decisions based on the results of statistical analyzes
PEU_W03 The student has knowledge of the methods of mathematical statistics
PEU_W04 The student has a general knowledge of the methods of multivariate analysis

relating to skills:

PEU_U01 The student is able to use the known computer tools for the purposes of statistical analysis

PROGRAMME CONTENT

	Lecture	**Number of hours**
Lec1	Basic nomenclature and terms used in statistics - part I	2
Lec2	Basic nomenclature and terms used in statistics - part II	2
Lec3	Basic concepts of descriptive statistics - part I	2
Lec4	Basic concepts of descriptive statistics - part II	2
Lec5	Data representation methods - part I	2
Lec6	Data representation methods - part II	2
Lec7	Mathematical Statistics - Basic Concepts - Part I	2
Lec8	Mathematical Statistics - Basic Concepts - Part II	2
Lec9	Mathematical Statistics - Basic Concepts - Part III	2
Lec10	Selected regression methods - part I	2
Lec11	Selected regression methods - part II	2
Lec12	Common methods of scaling and transforming data	2
Lec13	Selected methods of multivariate data analysis - part I	2

Lec14	Selected methods of multivariate data analysis - part II	2
Lec15	Exam	2
	Total hours	**30**

Laboratory		**Number of hours**
Lab1	Basic nomenclature and terms used in statistics - part I	2
Lab2	Basic concepts of descriptive statistics - part I	2
Lab3	Basic concepts of descriptive statistics - part II	2
Lab4	Data representation methods - part I	2
Lab5	Data representation methods - part II	2
Lab6	Mid test	2
Lab7	Mathematical Statistics - Basic Concepts - Part I	2
Lab8	Mathematical Statistics - Basic Concepts - Part II	2
Lab9	Mathematical Statistics - Basic Concepts - Part III	2
Lab10	Selected regression methods - part I	2
Lab11	Selected regression methods - part II	2
Lab12	Common methods of scaling and transforming data	2
Lab13	Selected methods of multivariate data analysis - part I	2
Lab14	Selected methods of multivariate data analysis - part II	2
Lab15	End test	2
	Total hours	**30**

TEACHING TOOLS USED
N1. Lecture - informative lecture, contents illustrated by multimedia presentations N2. Laboratory exercises – test of the knowledge from the preparation to exercise N3. Laboratory exercises – discussion on the scope and methodology of research N4. Laboratory exercises – carrying out research based on the instruction N5. Own work – preparation for laboratory exercises N6. Own work – preparation of report from conducted laboratory test N7. Own work – individual studies and preparation for the exam N8. 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 - Lecture	PEU_W01, PEU_W02, PEU_W03, PEU_W04	P1 - Written examination
F1, F2, P2 - Laboratory	PEU_U01 PEU_U02	F1 - Mid test and End test F2 - Activity and work during laboratory P2 - final mark (F1*8/10 i F2*2/10)

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] Statistics and Chemometrics for Analytical Chemistry, Miller, James N.; Miller, Jane C., Pearson FT Prentice Hall (2010)
[2] Numerical Methods for Engineers, Chapra, S., Canale, R., Sixth Edition, McGraw-Hill Science/Engineering/Math, (2009)
[3] Introduction to the Practice of Statistics, D. Moore, G. McCabe, IV edition, Freeman (2003)

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Załącznik nr 5 do ZW 16/2020

FACULTY OF CHEMISTRY

SUBJECT CARD

Name of subject in Polish: Grafika inżynierska
Name of subject in English: Technical drawing
Main field of study (if applicable): all fields
Specialization (if applicable):
Profile: academic
Level and form of studies: 1st level, 2nd level – supplementary semester, full-time
Kind of subject: obligatory
Subject code: GFC011001, GFC024002
Group of courses: NO

	Lecture	**Classes**	**Laboratory**	**Project**	**Seminar**
Number of hours of organized classes in University (ZZU)			30		
Number of hours of total student workload (CNPS)			60		
Form of crediting	Crediting with grade*	crediting with grade	crediting with grade	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 (P) classes			2		
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)			1.4		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge of computers

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SUBJECT OBJECTIVES

C1 Familiarisation with the technical drawing conventions.
C2 Learning to read and making a design drawing.
C3 Working knowledge of using the computer aided design software in making and modifying the technical documentation.

SUBJECT EDUCATIONAL EFFECTS

Related to skills:

PEU_U01 – understands the conventions of technical drawing and the role of standardisation on technical drafting.
PEU_U02 – can project the planar and three-dimensional objects in views.

PEU_U03 – possesses skills at representation and dimensioning of existing and proposing objects according to technical drawing conventions. PEU_U04 – has the sufficient knowledge of reading the design drawings and chemical plant diagrams. PEU_U05 – has the working knowledge of using computer aided design applications in making the technical documentation.

PROGRAMME CONTENT		
Laboratory		**Number of hours**
Proj 1	Organising class. Familiarisation with the safety rules in the computer room. Teaching tools and conditions of course completion. Introduction to CAD application – user interface, workspace, drawing area, creating and modifying of objects in AutoCAD.	2
Proj 2	Conventions of technical drawing (types of drawing, drawing sizes, scales, title blocks, line styles and types, technical lettering). Settings of parameters in AutoCAD (layer management, setting of attributes, coordinate systems).	2
Proj 3	Standardisation of technical drawing. Polish Committee for Standardization and it's normalisation activity. Searching for standard exercises. Drawing objects in AutoCAD: line, polyline, arc, circle, ellipse, rectangle, poligon.	2
Proj 4	Representation of 2D and 3D objects (axonometric, orthographic and perspective projections). Selection and modifications of objects in AutoCAD: move, copy, rotate, mirror, scale, trim, extend, break, fillet, chamfer, explode, offset.	2
Proj 5	Representation of the internal structural details of the object. Sections types: one and more cutting planes, revolved, removed, local, developing. Basic conventions of sections and cuts. Long objects - interrupted views. Symmetrical and revolving objects – representation conventions.	2
Proj 6	Dimensioning on technical drawing (indications, graphic form, rules). Printing of technical documentation in AutoCAD.	2
Proj 7	Repetition and test I.	2
Proj 8	Sectioning of 3D objects. Representation of interpenetrating solids. Curve of interpenetration.	2
Proj 9	Representations and dimensioning of tapers and slopes.	2
Proj 10	Types of joints in engineering constructions. Representation, designation and dimensioning of assembled threaded parts and selected inseparable joints. Simplified representation and dimensioning on technical drawing.	2
Proj 11	Tolerance of dimensions, fitting of elements, deviations of shape, position and surface finish specifications.	2
Proj 12	Design drawing (assembly and production drawings).	2
Proj 13	Diagram drawing. Graphical symbols for diagrams. Chemical equipment representation on diagram. Process flow diagrams for the chemical industry.	2

Proj 14	Test II	2
Proj 15	Correction test. Course acceptance.	2
	Total hours	30

TEACHING TOOLS USED
N1. Multimedia presentations N2. Using of AutoCAD software

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEU_U01-PEU_U02	test I
F2	PEU_U03-PEU_U05	test II
F3-F8	PEU_U02-PEU_U05	drawings made in AutoCAD

P=[(F1+F2)/2+(F3+F4+...+F8)/6]/2

3,0 if 3,00 < **P** < 3,25
3,5 if 3,25 ≤ **P** < 3,75
4,0 if 3,75 ≤ **P** < 4,25
4,5 if 4,25 ≤ **P** < 4,75
5,0 if 4,75 ≤ **P** < 5,00
5,5 if 5,00 ≤ **P**

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] B.Bielefeld, I.Skiba, Basics Technical Drawing, Birkhäuser 2013
[2] K.Rathnam, A First Course in Engineering Drawing, Springer Singapore Pte. Limited 2017
[3] C.Simmons, N.Phelps, Essential Guide to Technical Product Specification - Engineering Drawing, BSI Standards Ltd. 2009
[4] J.Pandey, Y.Shoukry, Practical Autodesk AutoCAD 2021 and AutoCAD LT 2021, Packt Publishing 2020

SECONDARY LITERATURE:

[1] C.Simmons, N.Phelps, Manual of Engineering Drawing: Technical Product Specification and Documentation to British and International Standards, Oxford: Elsevier Science & Technology 2012
[2] J.T.Dygdon et al., Technical Drawing with Engineering Graphics, 15th Edition, Peachpit Press 2016
[3] R.Hanifan, Perfecting Engineering and Technical Drawing: Reducing Errors and Misinterpretations, Springer International Publishing AG 2014
[4] A.Bhatt, AutoCAD 2022 Beginners Guide, CADFolks 2021

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Zał. nr 5 do ZW 16/2020

FACULTY OF CHEMISTRY

SUBJECT CARD

Name of subject in Polish Techniki i technologie zagospodarowania złóż antropogenicznych

Name of subject in English Techniques and methods of exploitation anthropogenic deposits,

Main field of study (if applicable): Urban mining.

Specialization (if applicable): —

Profile: academic / ~~practical~~*

Level and form of studies: ~~1st~~/ 2nd level, ~~uniform magister studies~~*, full-time / ~~part-time~~*

Kind of subject: obligatory ~~/ optional / university-wide~~*

Subject code …….

Group of courses ~~YES~~ / NO*

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15			30	
Number of hours of total student workload (CNPS)	30			90	
Form of crediting	Examination / ~~crediting with grade~~*	Examination / crediting with grade*	Examination / crediting with grade*	~~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)	0,7			2,1	

*delete as not necessary

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge of urban mining.
2. Knowledge of mathematics and data analysis on bachelor level.
3. Knowledge of using the CAD software.

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SUBJECT OBJECTIVES

C1. Learning about the technological, economic and environmental aspects of development an anthropogenic urban deposits

C2. Understanding the importance of the use of secondary raw materials in the economy

C3. Learning about the methods of optimizing the processes of exploitation raw materials from anthropogenic urban deposits

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge:

PEU_W01 Understands the importance of the use of secondary raw materials in the economy.

PEU_W02 Knows the methods and technologies of obtaining raw materials from anthropogenic urban deposits.

PEU_W03 Knows the basic methods of assessing the impact of selected techniques and technologies on the environment.

PEU_W04 Knows the method of simulation and optimization of production processes.

relating to skills:

PEU_U01 Can prepare a project of obtaining valuable raw materials the anthropogenic urban deposits

PEU_U02 Can apply good practices in the selection of methods and technologies for processing raw materials from anthropogenic urban deposits

PEU_U03 Can build a discrete simulation model in dedicated software and select the method and technical equipment for designed operation process.

relating to social competencies

PEU_K01 Can present and justify the solution of decision problem

PROGRAMME CONTENT		
Lecture		**Number of hours**
Lec 1	Recovering and reusing a city's materials - introduction	1
Lec 2	Reduce, reuse, recycle and rebuy cities anthropogenic deposits	2
Lec 3	Methods and technologies of processing individual groups of raw materials	3
Lec 4	Benefits of Reducing the Disposal of C&D Materials	2
Lec 5	Urban mining in practice - case studys	2
Lec 6	Future trends and perspectives of urban mining	1
Lec 7	Optimization of raw material exploitation processes	2
Lec 8	Simulation methods in technical and economic analysis of deposit exploitation	2
	Total hours	15

PROGRAMME CONTENT		
Project		**Number of hours**
Pr 1	Scope of the course, teaching purpose, crediting conditions, literature, data. Overview of the scope of the project no.1 : Pre-Construction and Demolition Recycling Plan for selected urban object	2
Pr 2	Selection of the research object. Object characteristics in terms of the possibility of obtaining valuable raw materials	2
Pr 3	Identifying obtainable raw materials. Selection of methods of their estimation.	2
Pr 4	Development of the local vision checklist	2
Pr 5	Field study - site inspection, geometric measurements	2

Pr 6	Calculating the amount of each raw materials for recovery.	2
Pr 7	Selection of methods and technologies for the processing of individual groups of raw materials	2
Pr 8	Selection of methods and technologies for the processing of individual groups of raw materials	2
Pr 9	Assessment of the environmental impact of the selected method and technology of raw material processing	2
Pr 10	Estimation of costs and benefits of the developed raw material processing plan	2
Pr 11	Presentation of projects. Final evaluation of the project.	2
Pr 12	Overview of the scope of the project no.2. Identification of technological processes in the exploitation of an anthropogenic deposit. Raw material transportation and technological model	2
Pr 13	Parametrization of key technical objects, means of transport and basic raw material processing methods	2
Pr 14	Assessment of the impact of selected factor on system performance. Creating scenarios and technical and economical analysis for raw material exploitation	2
Pr 15	Presentation of the simulator at the forum of the project group. Discussion about the solution	2
	Total hours	30

TEACHING TOOLS USED
N1. Type of lectures - traditional, illustrated with multimedia presentations with the usage of audio- visual equipment. N2. Discussion concerning lectures and project. N3. Solving optimizing issues with the use of dedicated software N4. Projects defense - oral and written form. N5. Duty hours.

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 (lecture)	PEU_W01-W04	Final exam
P2 (project)	PEU_U01- U03 PEU_K01	F1.1 Grade from project no 1 (work's performance and its merits - 60%; projects work's oral or written defense - 40%) F.1.2 Grade from project no 2 (work's performance and its merits - 60%; projects work's oral or written defense - 40%)

		P1.Final grade (weighted average of F1.1 - 50% and F1.2 - 50%).
P		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] Hartman, H.L. and Mutmansky, J.M.: Introductory Mining Engineering. John Wiley &
[2] Development of a guidance document on best practices in the extractive waste management

[3] Plans. CE Action ECOEFFICENCY.2019.

[4] Rosendal R.M, : Landfill Mining. Process, Feasibility, Economy, Benefits and Limitaions.Reno San. 2009.

[5] Environmental Guidelines Solid Waste Landfills. Second edition 2016. www.epa.nsw.gov.au

[6] Lopez G.C, Clausen A.,Pretz T.: Landfill Mining:

[7] Determination of the potential Landfill and need for remediation of landfill in Flandres. Final Report 2013.

[8] Urban mining and sustainable Waste Management pod red Ghosh B.K. Springer.A case study on sampling, processing and characterization of excavated waste from an Austrian landfill. RWTH Aachen . Sardinia. 2017.Sixteenth International Waste Management and Landfill Symposium.

[9] Frandegard P.F.,Krook J., Svenson N., Eklund M.:A novel approach for environmental evaluation of landfill mining. Linkoeping University Post Print 2013. Journal of Cleaner Production no 55.

[10] Patre G, Griffits Z, Val J, Tasiu A.M, Camacho-Dominguez E.V, Wagland S, Coulon F,: A decision support tool Enhanced landfill mining. Detritus Multidisciplinary Journal for Waste Resources & Residues. Vol 01. 2018.

[11] Hartman, H.L. and Mutmansky, J.M.: Introductory Mining Engineering. John Wiley & Sons. 2002

[12] European Commission EU Construction and Demolition Waste Protocol and Guidelines. 2018

[13] European Environment Agency: Construction and Demolition Waste: Challenges and Opportunities in a Circular Economy. 2020

[14] Department of Agriculture, Water and the Environment: Construction And Demolition Waste Guide - Recycling And Re-Use Across The Supply Chain.Australia. 2011

[15] Voet, Ester van der et al.: Prospecting the Urban Mine of Amsterdam; 2017

[16] Sturgul J., Discrete Simulation and Animation for Mining Engineers, CRC Press, 2016

[17] Banks J., Carson J. S., Nelson B. L., Nicol D: Discrete-Event System Simulation, 5 ed. Prentice Hall, 2010

SECONDARY LITERATURE:

[1] Reports of companies operating in the area of Landfill and Urban Mining

[2] Reports of non-profit organizations, government and scientific institutions in the field of Landfill Urban Mining

[3] Open Access Journals

[4] Books and manuals (Caterpillar, Komatsu, Volvo, Hyundai, Hitachi)

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FACULTY OF CHEMISTRY

SUBJECT CARD

Name of subject in Polish: Podstawy projektowania procesów technologicznych
Name of subject in English: Technological Design Process
Main field of study (if applicable): Urban mining
Specialization (if applicable): ……..
Profile: academic / ~~practical~~*
Level and form of studies: ~~1st~~/ 2nd level, ~~uniform magister studies*~~, full-time / ~~part-time~~*
Kind of subject: ~~obligatory~~ / optional /~~ university-wide*~~
Subject code …….
Group of courses ~~ YES /~~ NO

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)				45	
Number of hours of total student workload (CNPS)				90	
Form of crediting	Examination / crediting with grade*	Examination / crediting with grade*	Examination / crediting with grade*	crediting with grade*	Examination / crediting with grade*
For group of courses mark (X) final course					
Number of ECTS points				3	
including number of ECTS points for practical classes (P)				3	
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)				2,1	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge of the basic issues of chemistry, physics, biology and mathematics at the bachelor / engineer level.

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SUBJECT OBJECTIVES

C1 Understanding the process of technological design
C2 Understanding the course of action in creating new technologies of the production process
C3 Teaching students the correct way to create a schematic diagram, PFD diagram (process flow diagram), vertical projection.
C4 Understanding the importance of commercial, patent and marketing analysis in creating a new technology

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge:

PEU_W01 - Knows and can use the chemical and physical basis of selected engineering operations and processes to technology design
PEU_W02 - Knows the principles of scale-up
PEU_W03 - Can define technology problems

relating to skills:

PEU_U01 - can describe the operation of apparatus and devices occurring in industrial installations using the laws of physics and chemistry.
PEU_U02 - can create a schematic diagram of a technological concept.
PEU_U03 - can integrate unit processes and operations.
PEU_U04 - can choose the appropriate apparatus and devices for the implementation of processes and unit operations,
PEU_U05 - can present the location of devices and units in space,
PEU_U06 - knows how to use data sources about the properties of raw materials, products, etc.
PEU_U07 - knows how to describe the dependencies and actions between individual operations and unit processes used to implement a specific technological action.

relating to social competences:

PEU_K01 - The student is able to cooperate in a project group
PEK_K02 - The student is able to present the results of work

PROGRAMME CONTENT

Project		Number of hours
Proj 1	Introduction to the project: aim, requirements and conditions for passing. Introduction to the project 1: Conceptualization of the Technological Design Process - Idea Diagram	3
Proj 2	Analysis, optimization, discussion in project teams - project 1	6
Proj 3	Completion of the project 1. Introduction to the project 2: Conceptualization of the Technological Design Process - PFD diagram	3
Proj 4	Analysis, optimization, discussion in project teams - project 2	6
Proj 5	Completion of the project 2. Introduction to the project 3: Conceptualization of the Technological Design Process - Scheme of the vertical projection + specification of devices and apparatus	3
Proj 6	Analysis, optimization, discussion in project teams - project 3	6
Proj 7	Completion of the project 3. Introduction to the project 4: Conceptualization of the Technological Design Process - Market and technology analysis - SWOT analysis	3
Proj 8	Analysis, optimization, discussion in project teams - project 4	6
Proj 9	Completion of the project 4. Introduction to the project summary	6
Proj 10	Completion of the project 1-4 in the form of a summary. Completion of the course.	3
	Total hours	45

TEACHING TOOLS USED
N1. Multimedia presentation. N2. Discusion N3. Problem solving N4. Use of Microsoft VISIO, Draw.io to perform engineering diagrams N5. Solving engineering, design tasks and case study N6. Use of Excel to perform more labour-intensive calculations

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 (projects)	PEU_W01-W03 PEU_U01-U07	Crediting with grade - project evaluation.

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] **W.D. Seider:** Process design principles, J.W.&S., 1999.

[2] **U. Bröckel, W. Meier, G. Wagner (red.)**: Product design and engineering. Vol.1: Basics and technologies, Vol. 2: Rawmaterials, additives and application, Wiley, 2007.

[3] **G. Towler, R. Sinnott**, Chemical Engineering Design, Elsevier LTD, Oxford 2021

[4] **D.W. Green, R.H. Perry** (red.), Perry's chemical engineers' handbook, 8th ed., McGraw-Hill, 2007

SECONDARY LITERATURE:

[1] **D. Suman,** Optimization in Chemical Engineering, Cambridge University Press 2016

[2] **D.M. Himmelblau**, Basic principles and calculation in chemical engineering, New York 1986

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

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Zał. nr 5 do ZW 16/2020

FACULTY OF CHEMISTRY

SUBJECT CARD

Name of subject in Polish Urban mining-użyteczność odpadów
Name of subject in English Urban mining-utility of waste
Main field of study (if applicable): Urban mining.
Specialization (if applicable): —
Profile: academic / practical*
Level and form of studies: 1st/ 2nd level, uniform magister studies*, full-time / part-time*
Kind of subject: obligatory / optional / university-wide*
Subject code …….
Group of courses YES / **NO***

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	45				
Number of hours of total student workload (CNPS)	120				
Form of crediting	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	4				
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)	2,8				

*delete as not necessary

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge of the basic issues of chemistry, biology and mathematics at the bachelor / engineer level.

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SUBJECT OBJECTIVES

C1. Learning about the assumptions of urban mining
C2. Understanding the assumptions of the circular economy and explaining how it differs from the rope economy.
C3. Understanding the assumptions of the life cycle analysis as a tool used in the circular economy.
C4. Cognition of biological, chemical and physical methods of valorization of secondary raw materials.
C5. Understanding the stages necessary to develop new technologies
C6 Acquiring knowledge of instrumental methods used for the determination of elements, organic and inorganic substances in various materials

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge:

PEU_W01 Knows and understands the assumptions of urban mining and has knowledge about the processing processes.

PEU_W02 Knows the assumptions of the circular economy and knows how it differs from the rope economy.

PEU_W03 Knows the assumptions of the life cycle analysis as a tool used in the circular economy

PEU_W04 Knows examples of the use of secondary / renewable materials in industry.

PEU_W05 Has the knowledge about instrumental spectroscopic methods of analysis

PEU_W06 Knows basic occupational health and safety issues.

PROGRAMME CONTENT		
Lecture		**Number of hours**
Lec 1	Urban mining - introduction	3
Lec 2	Formal, legal and economic aspects of providing access to the exploitation of anthropogenic deposits	3
Lec 3	Methods of identifying waste streams and assessing the raw material potential	3
Lec 4	Identification and assessment of environmental aspects	3
Lec 5	Circularity assessment tools	3
Lec 6	Techniques and technologies of obtaining raw materials	3
Lec 7	ESG reporting of the exploitation and processing of anthropic deposits	3
Lec 8	Analysis of circular economy in processing processes	3
Lec 9	Physical and physicochemical methods of waste processing	3
Lec 10	Chemical and biological methods of waste processing	3
Lec 11	Instrumental methods in biomonitoring and analysis of products	3
Lec 12	Occupational health and safety in waste management	3
Lec 13	Technological Design Process	3
Lec 14	Project feasibility study	3
Lec 15	Urban mining - summary	3
	Total hours	45

TEACHING TOOLS USED

N1. Lecture with a multimedia presentation.

N2. Discussion

N3. Problem solving

N4. Case study

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 (lectrue)	PEU_W01-PEU_W06	Final exam – test multiple choice
	P	
P		

PRIMARY AND SECONDARY LITERATURE
PRIMARY LITERATURE:
[1] Urban Mining and Sustainable Waste Management, Ghosh, Sadhan Kumar, Springer Singapore, ISBN: 9811505314, 2020.
SECONDARY LITERATURE:
[1] Urban Mining for Waste Management and Resource Recovery, Pankaj Pathak, Prangya Ranjan Rout, Taylor & Francis Ltd, ISBN: 1032061790, 2021
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