Zał. Nr 1 do ZW 16/2020

PROGRAM OF STUDIES

FACULTY: Chemistry
MAIN FIELD OF STUDY: Sustainable Biomass and Bioproducts Engineering
BRANCH OF SCIENCE: Chemical Engineering
DISCIPLINES:D1 Chemical engineering (major discipline)

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 2023/2024

Zał. Nr 2 do ZW 16/2020
Attachment no. 1 to the Program of Studies

ASSUMED LEARNING OUTCOMES

FACULTY: **Chemistry**
MAIN FIELD OF STUDY: Sustainable Biomass and Bioproducts Engineering
EDUCATION LEVEL: second-level studies
PROFILE: general academic

Location of the main-field-of study:

Branch of science: Engineering-technical
Discipline: Chemical engineering

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

W - category "knowledge"
U - category "skills"
K - category "social competences"

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

_inż. – learning outcomes related to the engineer competences

Main field of study learning outcomes	**Description of learning outcomes for the main-field-of study** Sustainable Biomass and Bioproducts Engineering After completion of studies, the graduate:	Reference to PRK characteristics		
		Universal first degree characteristics (U)	Second degree characteristics typical for qualifications obtained in higher education (S)	
			Characteristics for qualifications on 6 / 7* levels of PRK	Characteristics for qualifications on 6 and 7 levels of PRK, enabling acquiring engineering competences
KNOWLEDGE (W)				
K2Asb_W01	Has the thorough knowledge of the principles of biomaterials composition and synthesis methodology	P7U_W	P7S_WG	P7S_WG_Inż
K2Asb_W02	Has thorough knowledge about instrumental analysis of biomaterials' structural and chemical properties	P7U_W	P7S_WG	P7S_WG_Inż
K2Asb_W03	Has horough knowledge of valorization of the biomass/biogenic fraction of waste into different valuable bioproducts	P7U_W	P7S_WG P7S_WK	P7S_WG_Inż
K2Asb_W04	Has thorough knowledge about chemical, mechanical, thermal biomass conversion processes, biomass treatment, purification and modification	P7U_W	P7S_WG	P7S_WG_Inż
K2Asb_W05	Has thorough knowledge of biochemical units operation	P7U_W	P7S_WG	P7S_WG_Inż
K2Asb_W06	Has thorough knowledge of modelling and processes simulation methods, process control and industrial measurements	P7U_W	P7S_WG P7S_WK	P7S_WG_Inż
K2Asb_W07	Has advanced knowledge on state-of-the-art lignocellulosic resources and biorefining processes	P7U_W	P7S_WG	P7S_WG_Inż

K2Asb_W08	Knows fundamentals of sustainable bio-economy related to sustainable economic development (climate warming and fossil resources, natural resource scarcity, biomass competition, biodiversity, waste streams, governance, social well-being)	P7U_W	P7S_WG P7S_WK	P7S_WG_Inż
K2Asb_W09	Knows fundamentals of circular economy and methodology of conversion of resources, residues, by-products and side streams into value added products	P7U_W	P7S_WG	P7S_WG_Inż
K2Asb_W10	Has thorough knowledge of Good Laboratory Practice approach and research methodology strategies.	P7U_W	P7S_WG P7S_WK	P7S_WG_Inż
K2Asb_W11	Has thorough knowledge of safety, consistency, high quality, and reliability of chemicals in laboratory and at industry	P7U_W	P7S_WG P7S_WK	P7S_WG_Inż
K2Asb_W12	Knows and understands the fundamental dilemmas of modern civilization and science.	P7U_W	P7S_WK	
K2Asb_W13	Knows and understands the basic concepts of project design and management, financial analysis and business plan.	P7U_W	P7S_WK	P7S_WK_Inż
K2Asb_W14	Knows and understands the conceptualization of engineering models, apply innovative methods in problem solving and appropriate software applications, for the design, simulation, optimization and control of processes and systems.	P7U_W	P7S_WG	P7S_WK_Inż
SKILLS (U)				
K2Asb_U01	Has practical skills in synthesis and analysis of bio-materials and analyses the obtained product by using advanced instrumental equipment.	P7U_U	P7S_UW	P7S_UW_Inż
K2Asb_U02	Has practical skills in biomass conversion, recovery of valuable bioproducts and their practical applications	P7U_U	P7S_UW	P7S_UW_Inż

K2Asb_U03	Has practical skills in design and optimization of the bioprocesses	P7U_U	P7S_UW	P7S_UW_Inż
K2Asb_U04	Has practical skills in carrying out selected chemical, thermal and mechanical conversion processes	P7U_U	P7S_UW	P7S_UW_Inż
K2Asb_U05	Conceive, prepare and use bioproducts in various professional contexts, integrating ethical environmental and societal challenges	P7U_U	P7S_UW	P7S_UW_Inż
K2Asb_U06	Is able to apply principles of work organization in a laboratory, preparation and implementation of documentation ensuring safety, high quality, and operations repeatability	P7U_U	P7S_UW	P7S_UW_Inż
K2Asb_U07	Is able to perform of Life Cycle Assessment, Environmental Management System, and waste valorization	P7U_U	P7S_UW	P7S_UW_Inż
K2Asb_U08	Can make a critical analysis of scientific information	P7U_U	P7S_UW	
K2Asb_U09	Is able to perform a development and technical and economic evaluation of a project of innovation and research	P7U_U	P7S_UW	P7S_UW_Inż
K2Asb_U10	Is able to deal with complex situations or those that require the development of new solutions in the academic, work or professional field of study of Chemical Engineering.	P7U_U	P7S_UW	P7S_UW_Inż
K2Asb_U11	Has practical skills in communication in a foreign language.	P7U_U	P7S_UK	
K2Asb_U12	Is able to work independently and in a team, assuming various roles, including managerial ones, as well as plan his own development and stimulate others to do so.	P7U_U	P7S_UU P7S_UO	
SOCIAL COMPETENCES (K)				
K2Asb_K01	Is ready to critically evaluate the knowledge and received content.	P7U_K	P7S_KK	

K2Asb_K02	Understands the need for entrepreneurial thinking and action.	P7U_K	P7S_KO	
K2Asb_K03	Is aware of the need to act in the public interest.	P7U_K	P7S_KO	
K2Asb_K04	Recognizes the importance of knowledge in solving cognitive and practical problems.	P7U_K	P7S_KK	
K2Asb_K05	Responsibly interacts in the group taking various roles in it, including managerial.	P7U_K	P7S_KO P7S_KR	
K2Asb_K06	Is ready to use the knowledge and experience of experts in case of difficulties with problem solving.	P7U_K	P7S_KK	
K2Asb_K07	Is ready to comply with the principles of professional ethics and respect for the law, including copyrights.	P7U_K	P7S_KR	
K2Asb_K08	Recognizes the importance and understands the non-technical aspects and effects of scientific and engineering activities, including its impact on the environment, as well as the associated responsibilities.	P7U_K	P7S_KR	
K2Asb_K09	Is aware of the social role of a technical university graduate and the need to uphold the ethos of the engineering profession.	P7U_K	P7S_KR	

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: **Sustainable Biomass and Bioproducts Engineering** Profile: **general academic**

Level of studies: **second-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: **1393 h** (for optional block A+C or B+C) **1383 h** (for optional block A+D or B+D)	*1.4 Prerequisites (particularly for second-level studies):* Defined by the Wroclaw University of Science and Technology regulation regarding the conditions and procedure of recruitment
1.5 Upon completion of studies graduate obtains ***magister inżynier***	*1.6 Graduate profile, employability:* The graduate gains fundamental knowledge of an advanced organic chemistry for biobased materials and their in-depth analysis; engineering knowledge about the design and operation of industrial facilities for the bioproducts processing at industrial scale; practical knowledge about green technologies involved in the production of the biobased vectors, utilization of biotechniques for green treatment and conversion of biomass; knowledge related to reduction of environmental impacts of bioprocesses and to increasing use of bio-based products in order to reduce the dependence on fossil-based ones; knowledge about cost optimization and energy consumption due to bio-processes industrial adoption. The graduate acquires transversal skills related to ethical issues, EU legislative framework, and intellectual property rights as well as gain skills in communication, decision taking and collective actions. Highly qualified and creative graduates are prepared for the labor market with a big capacity to adapt themselves and to find new solutions for technological development (problem

	solving). The received level of training allows the graduates to continue with PhD programs all over the world or to work as leaders in the developing bioprocesses industry.
1.7 Possibility of continuing studies: ***Eligibility to apply for admission to a doctoral school, non-degree postgraduate programmes***	The mission and strategy of the Wrocław University of Science and Technology is defined in the document: "Development Plan of Wrocław University of Science and Technology". The main aim is to develop creative, critical and tolerant personalities of students and to identify directions for the development of science and technology. The University's role is to maintain and develop competences related to experimental work. The study programs harmonize the proportions of knowledge directly useful for work and knowledge enabling later professional adaptations. The second-level program of study in the field of the Sustainable Biomass and Bioproducts Engineering is in line with the above goals through: – developing creative skills in the nature of scientific work through an increased number of classes related to the implementation of the diploma thesis, – a large extent (above 50%) of practical classes, such as laboratories, seminars and projects, – taking care of the balance between the general and specialist knowledge communicated, – various specialist education within the specializations offered, – providing students with knowledge and skills covering the state-of-the-art in science and technology achievements in the field, – provision of an interdisciplinary training in the field of green chemistry and green technology, desire to develop sustainable and competitive bio-based industries, – forming partially individual student profiles through the possibility of participating in elective courses, – developing the personality of students through participation in humanities courses, – partial preparation of students for future independent life through classes on management and business, – learning of local languages will improve their chances to look for a job in different countries and companies. – understanding of the foreign cultures and history will allow them for easier contact with people having different cultural background.

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

2. Detailed description

2.1 Total number of learning outcomes in the program of study: W (knowledge) = 14, U (skills) = 12, K (competences) = 9, W + U + K = 35

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

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

~~**D2 .....**~~

~~**D3 .....**~~

~~**D4 .....**~~

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

D1 100% ECTS points

~~**D2 .....% ECTS points**~~

~~**D3 .....% ECTS points**~~

~~**D4 .....% ECTS points**~~

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

102 ECTS

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

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[2]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

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

The programme is engineering oriented and focuses on analytical skills and practical knowledge. It also covers advanced technological and processing aspects necessary to develop sustainable and competitive bio-based industries in Europe. The "classical" academic disciplines in the field of chemical engineering & biotechnology are extended and focalized, to the changing academic, society and labor market needs.

The preparation of graduates mentioned therein reflect, inter alia, the following learning outcomes:

- practical skills in synthesis and analysis of bio-materials, preparation of samples, operation of advanced instrumental equipment and data analysis,
- wide knowledge about biomass conversion methods, biochemical units' operation involved in the production of biofuels; numerical design and optimization of the processes,
- advanced knowledge on present biorefining processes and capacity to modernize the present technologies and develop the new ones,
- basic knowledge about circular economy, the methodology of the valorisation of the biomass, and sustainable bio-economy.

The assumed learning outcomes fit into the current needs of the chemical and biorefinery industry, including companies and workplaces dealing with the design and development of chemical technologies for the fuel, energy, food, biotechnological, agrochemical industries, as well as technologies in environmental protection.

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)

Block A 62,77 ECTS
Block B 62,30 ECTS

[1]BU – number of ECTS points assigned to hours of classes requiring direct participation of academic teachers and other persons conducting classes
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[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	**12**
Number of ECTS points for optional subjects	**0**
Total number of ECTS points	**12**

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	**55,4**
Number of ECTS points for optional subjects	**37**
Total number of ECTS points	**92,4**

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)

8 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). As a rule, it is conducted by means of quizzes, tests and exams, during which the student is supposed to demonstrate the appropriate level of knowledge. Learning outcomes in the field of skills are verified during practical classes, as well as on the basis of prepared reports, projects and final works.

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

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

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.

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[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
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4. List of education blocks:

4.1. List of obligatory blocks:

4.1.1 List of general education blocks

4.1.1.1 *Liberal-managerial subjects* block *(min.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		Philosophy of science	15	-	-	-	-	K2Asb_W12 K2Asb_K04	15	30	1	0	0,65	T/Z	Z	O		-	KO
2		Knowledge management and communication skills (**GK)**	**11**	-	-	5	14	K2Asb_W13 K2Asb_U08 K2Asb_K02 K2Asb_K04 K2Asb_K05	30	90	3	0	1,38	T/Z	Z	-		P (1,9)	KO
3		Business models and market analysis LUT (**GK**)	-	15	-	**2**	-	K2Asb_U06 K2Asb_U09 K2Asb_K05 K2Asb_K06	17	60	2	0	0,8	T/Z	Z	-		P (2,0)	KO
4		Business models and market analysis UCLM	15	-	-	-	-	K2Asb_W13 K2Asb_K05 K2Asb_K06	15	30	1	0	0,65	T/Z	Z	-			KO
		Total	**41**	**15**	**-**	**7**	**14**		**77**	**210**	**7**	**0**	**3,48**					**P (3,9)**	

[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
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4.1.1.2 *Foreign languages* **block** *(min. 4. 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]
		Finish language and culture (**GK**)	-	**30**	-	10	-	K2Asb_U11	40	120	4	0	1,9	T/Z	Z	O		P (3.5)	KO
		Total	**0**	**30**	**0**	**10**	**0**		**40**	**120**	**4**	**0**	**1,9**					**P (3,5)**	

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																	

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																	

[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 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					
41	**45**	**-**	**17**	**14**	**117**	**210**	**11**	**0**	**5,38**

[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		Research methodology (**GK**)	6	-	-	**18**	-	K2Asb_W10 K2Asb_U08 K2Asb_U09 K2Asb_K04 K2Asb_K05 K2Asb_K06	24	60	2	2	1,16	T/Z	Z	-	DN	P (1,5)	PD
2		Design and optimization of experiments (**GK**)	15	15	-	**2**	-	K2Asb_W06 K2Asb_U03 K2Asb_U06 K2Asb_U09 K2Asb_K05 K2Asb_K06	32	120	4	4	1,45	T/Z	Z	-	DN	P (3,5)	PD
		Total	**21**	**15**	**-**	**20**	**-**		**56**	**180**	**6**	**6**	**2,61**					**P (5,0)**	

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																	

[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

4.1.2.3 *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		Nature of bio-materials (**GK)**	**12**	-	12	-	-	K2Asb_W01 K2Asb_U01 K2Asb_U06 K2Asb_K04 K2Asb_K05 K2Asb_K06	24	60	2	2	1,08	T/Z	Z	-	DN	P (1,0)	PD
2		Life cycle assessment UCLM	10	-	-	-	-	K2Asb_W09 K2Asb_U07 K2Asb_K04	10	30	1	1	0,43	T/Z	Z	-	DN		PD
3		Good laboratory practice (**GK)**	8	-	**16**	-	-	K2Asb_W10 K2Asb_U06 K2Asb_K04 K2Asb_K05 K2Asb_K06	24	60	2	2	1,09	T/T	Z	-	DN	P (1,5)	PD
4		Chemicals safety	12	-	-	-	-	K2Asb_W11 K2Asb_K04	12	30	1	1	0,52	T/Z	Z	-	DN		PD
		Total	**42**	**-**	**28**	**-**	**-**		**70**	**180**	**6**	**6**	**3,12**					**P (2,5)**	

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					
63	**15**	**28**	**20**	**0**	**126**	**360**	**12**	**12**	**5,73**

[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		Bio-components characterization (**GK)**	12	-	**24**	-	-	K2Asb_W02 K2Asb_U01 K2Asb_U06 K2Asb_K04 K2Asb_K05 K2Asb_K06	36	90	3	3	1,64	T/Z	Z	-	DN	P (2,0)	K
2		Modification of recovered bio-components (**GK**)	**12**	-	12	-	-	K2Asb_W03 K2Asb_U01 K2Asb_U06 K2Asb_K04 K2Asb_K05 K2Asb_K06	24	60	2	2	1,08	T/Z	Z	-	DN	P (1,0)	K
3		Recovery of bio-components (**GK**)	**12**	-	24	-	-	K2Asb_W03 K2Asb_U02 K2Asb_U06 K2Asb_K04 K2Asb_K05 K2Asb_K06	36	90	3	3	1,64	T/Z	**E (lec)**	-	DN	P (2,0)	K
4		Operations unit and reactors of biomass treatment I WUST (**GK**)	12	12	**36**	-	-	K2Asb_W05 K2Asb_U03 K2Asb_U06 K2Asb_U12 K2Asb_K04 K2Asb_K05 K2Asb_K06	60	150	5	5	2,76	T/Z	**E (lab)**	-	DN	P (5,0)	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

5		Operations unit and reactors of biomass treatment I UCLM	12	-	-	-	-	K2Asb_W05 K2Asb_U03 K2Asb_U06 K2Asb_K04 K2Asb_K05 K2Asb_K06	12	30	1	1	0,52	T/Z	Z		DN		K
6		Lignocellulosic resources LUT	16	-	-	-	-	K2Asb_W07	16	30	1	1	0,69	T/Z	Z	-	DN		K
7		Chemical-thermal biomass conversion (**GK**)	**7**	-	17	-	-	K2Asb_W04 K2Asb_U04 K2Asb_U06 K2Asb_K04 K2Asb_K05 K2Asb_K06	24	60	2	2	1,10	T/Z	**E (lec)**	-	DN	P (1,0)	K
8		Environmental impact	12	-	-	-	-	K2Asb_W08 K2Asb_U07 K2Asb_K04	12	30	1	1	0,52	T/Z	Z	-	DN		K
9		Bio-based materials fabrication WUST	**24**	-	-	-	-	K2Asb_W01 K2Asb_K05 K2Asb_K06	24	60	2	2	1,04	T/Z	Z	-	DN		K
10		Bio-based materials fabrication UCLM	-	-	15	-	-	K2Asb_U01 K2Asb_U06 K2Asb_U12 K2Asb_K05 K2Asb_K06	15	30	1	1	0,7	T/Z	Z	-	DN	P (1,0)	K
11		Operations unit and reactors of biomass treatment II (**GK**)	**25**	-	25	-	-	K2Asb_W05 K2Asb_U03 K2Asb_U06 K2Asb_K05 K2Asb_K06	50	150	5	5	2,25	T/Z	**E (lec)**	-	DN	P (3,0)	K
12		Design and optimization of bioprocesses by commercial simulators (**GK**)	-	**35**	-	5	-	K2Asb_U03 K2Asb_K05 K2Asb_K06	40	120	4	4	1,88	T/Z	Z	-	DN	P (4,0)	K
13		Dynamic and control of bioprocesses (**GK**)	7,5	-	-	**15**	7,5	K2Asb_W14 K2Asb_U01 K2Asb_K05 K2Asb_K06	30	90	3	3	1,42	T/Z	**E (lec)**	-	DN	P (2,0)	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

14		Chemical and mechanical fractionation LUT (**GK**)	**17**	-	-	5	-	K2Asb_W04 K2Asb_U04 K2Asb_U06 K2Asb_K05 K2Asb_K06	22	90	3	3	0,99	T/Z	Z	-	DN	P (2,0)	K
15		Chemical and mechanical fractionation UCLM (**GK**)	**-**	13	5	-	-	K2Asb_U04 K2Asb_U06 K2Asb_K05 K2Asb_K06	18	30	1	1	0,84	T/Z	Z	-	DN	P (1,0)	K
16		Bioproducts valorization and waste management (**GK**)	15	-	**18**	-	7	K2Asb_W08 K2Asb_U05 K2Asb_U06 K2Asb_K05 K2Asb_K06	40	120	4	4	1,82	T/Z	Z	-	DN	P (2,5)	K
17		Bio-based sorbents, fertilizers and food additives WUST	12	-	-	-	-	K2Asb_W03	12	30	1	1	0,52	T/Z	Z	-	DN	-	K
18		Bio-based chemicals and consumer products (**GK**)	**15**	15	-	2	-	K2Asb_W03 K2Asb_U02 K2Asb_U06 K2Asb_U09 K2Asb_K05 K2Asb_K06	32	120	3	3	1,45	T/Z	Z	-	DN	P (2,5)	K
19		Sustainable bio-products technologies UCLM (**GK**)	**17**	3	-	-	-	K2Asb_W03 K2Asb_W04 K2Asb_U02 K2Asb_U06	20	60	2	2	0,88	T/Z	Z	-	DN	P (1,0)	K
20		Lignocellulosic bio-refinery (**GK**)	**15**	15	-	30	-	K2Asb_W07 K2Asb_U02 K2Asb_U06 K2Asb_U09 K2Asb_K05 K2Asb_K06	60	150	5	5	2,85	T/Z	**E (lec)**	-	DN	P (4,5)	K
21		Separations by filtration in biorefining (**GK**)	15	15	**15**	2	-	K2Asb_W07 K2Asb_U02 K2Asb_U06 K2Asb_U09 K2Asb_K05	47	120	4	4	2,15	T/Z	Z	-	DN	P (3,5)	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

								K2Asb_K06											
22		Separations by adsorption in biorefining (**GK**)	15	15	-	**15**	-	K2Asb_W07 K2Asb_U02 K2Asb_U06 K2Asb_U09 K2Asb_K05 K2Asb_K06	45	90	3	3	2,1	T/Z	Z	-	DN	P (2,5)	K
		Total	**272,5**	**123**	**191**	**74**	**7,5**		**675**	**1800**	**60**	**60**	**30,84**					**P (40,5)**	

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					
272,5	**123**	**191**	**74**	**7,5**	**675**	**1800**	**60**	**60**	**30,84**

[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. ..... 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																	

4.2.1.2 ***Foreign languages*** **block** *(min. 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		**Blok A and Blok B to choose**		**30**		**15**			**45**	**90**	**3**		**2,15**	**T/Z**	**Z**	**O**		**P(3,0)**	**KO**
		Blok A: Polish language and local culture (optional to Spanish) (**GK**)	-	30	-	15	-	K2Asb_U11	45	90	3	0	2,15	T/Z	Z	O		P (3,0)	KO
		Blok B: Basic Spanish language and local culture (optional to Polish) (**GK**)	-	30	-	15	-	K2Asb_U11	45	90	3	0	2,15	T/Z	Z	O		P (3,0)	KO
2		**Blok C and D to choose**																	
		Block C: Spanish language and culture (**GK**)	-	**16**	22	-	2	K2Asb_U11	40	120	4	0	1,87	T/Z	Z	-		P (4,0)	KO
		Block D: Basic Finnish language	-	30	-	-	-	K2Asb_U11	30	120	4	0	1,4	T/Z	Z	-		P (4,0)	KO
		Total (A+C) or (B+C)	**0**	**46**	**22**	**15**	**2**		**85**	**210**	**7**	**0**	**4,02**					**P (7,0)**	
		Total (A+D) or (B+D)	**0**	**60**	**0**	**15**	**0**		**75**	**210**	**7**	**0**	**3,55**					**P (7,0)**	

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

4.2.1.3 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]
1		Sport	-	30	-	-	-	K2Asb_U12	30	0	0	0	0	T/Z	Z	O		-	KO
		Total	**-**	**30**	**-**	**-**	**-**		**30**	**0**	**0**	**0**	**0**						

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					
Block (A+C) or (B+C) with sport	**0**	**76**	**22**	**15**	**2**	**115**	**210**	**7**	**0**	**4,02**
Block (A+D) or (B+D) with sport	**0**	**90**	**0**	**15**	**0**	**105**	**210**	**7**	**0**	**3,55**

[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 basics 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					

[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 Optional main field of study blocks *(min. 30 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		Master thesis	-	-	360	-	-	K2Asb_W05 K2Asb_U06 K2Asb_U08 K2Asb_U12 K2Asb_K01 K2Asb_K04 K2Asb_K07 K2Asb_K09	360	900	30	30	21	T	Z	-	DN	P (30)	K
		Total	**-**	**-**	**360**	**-**	**-**		**360**	**900**	**30**	**30**	**16,8**					**P (30)**	

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					
-	**-**	**360**	**-**	**-**	**360**	**900**	**30**	**30**	**16,8**

[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.

does not apply

4.4 „Diploma dissertation" block

Type of diploma dissertation	~~Licencjat / inżynier / magister /~~ magister inżynier*	
Number of diploma dissertation semesters	**Number of ECTS points**	**Code**
1	**30 ECTS**	
Character of diploma dissertation		
The diploma thesis of the second-cycle (Master's) studies should have the characteristics of a scientific, experimental or theoretical work, of a basic or practical nature. The work should result in new outcomes of original research or technical and technological solutions, and its presentation in the form of a written work should contain the results obtained and present the author's knowledge and skills, including: (1) the ability to formulate research goals and problems; (2) the ability to use literature and other sources of knowledge; (3) the ability to plan and conduct research and other activities leading to the implementation of the set goals and problems; (4) the ability to correctly interpret the results; (5) the ability to use precise and clear language and to properly select graphic materials illustrating the presented issues.		
Number of BU[1] ECTS points	**16,8**	
Number of DN[5] ECTS points	**30**	

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	e.g. prepared diploma dissertation

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[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

6. Range of diploma examination
Thematic scope in line with the program of studies

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** The "remote" form is allowed with the consent of the Dean in exceptional situations, provided that it does not constitute more than 75% of ECTS. The T/Z entry applies only to classes in the following form: lecture, classes and seminar.

8. Plan of studies (attachment no. 4)

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

Approved by faculty student government legislative body:

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

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

PLAN OF STUDIES

FACULTY: **Chemistry**

MAIN FIELD OF STUDY: Sustainable Biomass and Bioproducts Engineering

EDUCATION LEVEL: second-level studies

FORM OF STUDIES: full-time studies

PROFILE: general academic

LANGUAGE OF STUDY: English

In effect since **2023/2024**

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

JOINT MASTER SECOND LEVEL STUDIES (4 semesters) MAIN FIELD OF STUDY: **SUSTAINBLE BIOMASS AND BIOPRODUCTS ENGINEERING**

SEMESTER 1	**SEMESTER 2**	**SEMESTER 3**	**SEMESTER 4**
Wrocław WUST (PL) 366h / 27 ECTS / 3E Ciudad Real UCLM (ES) 22h / 2 ECTS Lappeenranta LUT(FI) 16h / 1 ECTS	Wrocław WUST (PL) 24h / 2 ECTS Ciudad Real UCLM(ES) 263h (block A)/ 25 ECTS / 2E 253h (block B)/ 25 ECTS / 2E Lappeenranta LUT(FI) 22h / 3 ECTS	Wrocław WUST(PL) 12h / 1 ECTS Ciudad Real UCLM(ES) 35h/3ECTS Lappeenranta LUT(FI) 273h / 26 ECTS / 1E	360h / 30 ECTS
FUNDAMENTALS	ENGINEERING	APPLICATIONS	
MODULE 1 Nature of bio-materials (**GK**) 12w + 12**l** (1 + 1 ECTS)	**MODULE 1**	**MODULE 1**	
Bio-components characterization (**GK**) 12w + **24l** (1 + 2 ECTS)	Bio-based materials fabrication WUST 24w (2 ECTS)	Bio-based sorbents, fertilzers and food additives WUST 12w (1 ECTS)	
Modification of recovered bio-components (**GK**) **12w** + 12l (1 +1 ECTS)	Bio-based materials fabrication UCLM 15l (1 ECTS)	Bio-based chemicals and consumer products (**GK**) **15w** + 15c + 2p (1.5 + 0.5 + 2 ECTS)	
Recovery of bio-components (**GK**) **E** **12w** + 24l (1 + 2 ECTS)	**MODULE 2**		
MODULE 2 Operations unit and reactors of biomass treatment I WUST (**GK**) **E** 12w + 12c + 36**l** (1 + 1 + 3 ECTS) Operations unit and reactors of biomass treatment I UCLM 12w (1 ECTS)	Operations unit and reactors of biomass treatment II (**GK**) **E** **25w** + 25l (2 + 3 ECTS)	**MODULE 2** Sustainable bio-products technologies UCLM (**GK**) **17w** + 3c (1 + 1 ECTS)	
MODULE 3 Lignocellulosic resources LUT 16w (1 ECTS)	Design and optimization of bioprocesses by commercial simulators (**GK**) **35c** + 5p (3.5 + 0.5 ECTS)	**MODULE 3** Lignocellulosic bio-refinery (**GK**) **E** **15w** + 15c + 30p (1 + 1 + 3 ECTS)	
Chemical-thermal biomass conversion (**GK**) **E** **7w** + 17l (1 + 1 ECTS)	Dynamic and control of bioprocesses (**GK**) **E** 7.5w + **15p** + 7.5s (1 + 1.25 + 0.75 ECTS)	Separations by filtration in biorefining (**GK**) 15w + 15c + **15l** + 2p (0.5 + 0.5 + 1 + 2 ECTS)	Master thesis 360l (30 ECTS)
MODULE 4 Environmental impact 12w (1 ECTS)	**MODULE 3** Chemical and mechanical fractionation LUT (**GK**) **17w** + 5p (1 + 2 ECTS)	Separations by adsorption in biorefining (**GK**) 15w + 15c + **15p** (0.5 + 0.5 +2 ECTS)	
Life cycle assessment UCLM 10w (1 ECTS)	Chemical and mechanical fractionation UCLM (**GK**) **13c** + 5l (0.5 + 0.5 ECTS)	**MODULE 4**	
Good laboratory practice (**GK**) 8w + **16l** (0.5 + 1.5 ECTS)	**MODULE 4** Bioproducts valorization and waste management (**GK**) 15w + **18l** + 7s (1.5 + 1.8 + 0.7 ECTS)	Business models and market analysis LUT (**GK**) 15c + **2p** (1+1 ECTS)	
MODULE 5 Research methodology (**GK**) 6w + **18p** (0.5 + 1.5 ECTS)	**MODULE 5**	Business models and market analysis UCLM 15w (1 ECTS)	
Chemicals safety 12w (1 ECTS)	Knowledge management and communication skills (**GK**) **11w** + 5p + 14s (1.1 + 0.5 + 1.4 ECTS)	**MODULE 5**	
MODULE 6 Philosophy of science 15w (1 ECTS)	**MODULE 6**	Design and optimization of experiments (**GK**) 15w + 15c + **2p** (0.5 + 1.5 + 2 ECTS)	
Polish language and local culture (**GK**) **30c** + 15p (2 + 1 ECTS) / Basic Spanish language and local culture (**GK**) **30c** + 15p (2 + 1 ECTS)	Spanish language and culture (**GK**) **16c** + 22l +2s (1.6 + 2.2 + 0.2 ECTS) / Basic Finnish language 30c (4 ECTS)	**MODULE 6**	
Sport 30c (0 ECTS)		Finnish language and culture (**GK**) **30c** + 10p (3 + 1 ECTS)	
SEMESTER 1	**SEMESTER 2**	**SEMESTER 3**	**SEMESTER 4**

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 27

No.	Course/ group of courses code	Name of course/group of courses (denote group of courses with symbol **GK**)	Semester 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		Nature of bio-materials (**GK)**	**12**	-	12	-	-	K2Asb_W01 K2Asb_U01 K2Asb_U06 K2Asb_K04 K2Asb_K05 K2Asb_K06	24	60	2	2	1,08	T/Z	Z	-	DN	P (1,0)	PD
2		Bio-components characterization (**GK)**	12	-	**24**	-	-	K2Asb_W02 K2Asb_U01 K2Asb_U06 K2Asb_K04 K2Asb_K05 K2Asb_K06	36	90	3	3	1,64	T/Z	Z	-	DN	P (2,0)	K
3		Modification of recovered bio-components (**GK**)	**12**	-	12	-	-	K2Asb_W03 K2Asb_U01 K2Asb_U06 K2Asb_K04 K2Asb_K05 K2Asb_K06	24	60	2	2	1,08	T/Z	Z	-	DN	P (1,0)	K
4		Recovery of bio-components (**GK**)	**12**	-	24	-	-	K2Asb_W03 K2Asb_U02 K2Asb_U06 K2Asb_K04 K2Asb_K05 K2Asb_K06	36	90	3	3	1,64	T/Z	**E (lec)**	-	DN	P (2,0)	K
5		Operations unit and reactors of biomass treatment I WUST (**GK**)	12	12	**36**	-	-	K2Asb_W05 K2Asb_U03 K2Asb_U06 K2Asb_U12 K2Asb_K04	60	150	5	5	2,76	T/Z	**E (lab)**	-	DN	P (5,0)	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

								K2Asb_K05 K2Asb_K06											
6		Operations unit and reactors of biomass treatment I UCLM (**GK**)	12	-	**-**	-	-	K2Asb_W05 K2Asb_U03 K2Asb_U06 K2Asb_K04 K2Asb_K05 K2Asb_K06	12	30	1	1	0,52	T/Z	Z		DN		K
7		Lignocellulosic resources LUT	16	-	-	-	-	K2Asb_W07	16	30	1	1	0,69	T/Z	Z	-	DN		K
8		Chemical-thermal biomass conversion (**GK**)	**7**	-	17	-	-	K2Asb_W04 K2Asb_U04 K2Asb_U06 K2Asb_K04 K2Asb_K05 K2Asb_K06	24	60	2	2	1,1	T/Z	**E (lec)**	-	DN	P (1,0)	K
9		Environmental impact	12	-	-	-	-	K2Asb_W08 K2Asb_U07 K2Asb_K04	12	30	1	1	0,52	T/Z	Z	-	DN		K
10		Life cycle assessment UCLM	10	-	-	-	-	K2Asb_W09 K2Asb_U07 K2Asb_K04	10	30	1	1	0,43	T/Z	Z	-	DN		PD
11		Good laboratory practice (**GK)**	8	-	**16**	-	-	K2Asb_W10 K2Asb_U06 K2Asb_K04 K2Asb_K05 K2Asb_K06	24	60	2	2	1,09	T/T	Z	-	DN	P (1,5)	PD
12		Research methodology (**GK**)	6	-	-	**18**	-	K2Asb_W10 K2Asb_U08 K2Asb_U09 K2Asb_K04 K2Asb_K05 K2Asb_K06	24	60	2	2	1,16	T/Z	Z	-	DN	P (1,5)	PD
13		Chemicals safety	12	-	-	-	-	K2Asb_W11 K2Asb_K04	12	30	1	1	0,52	T/Z	Z	-	DN		PD
14		Philosophy of science	15	-	-	-	-	K2Asb_W12 K2Asb_K04	15	30	1	0	0,65	T/Z	Z	O			KO
		Total	**158**	**12**	**141**	**18**	**0**		**329**	**810**	**27**	**26**	**14,88**					**P (15)**	

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

Optional courses / groups of courses (3 ECTS points)

No.	Course/ group of courses code	Name of course/group of courses (denote group of courses with symbol **GK**)	Semester 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		Language blocks (optional A or B)		**30**		**15**			**45**	**90**	**3**	**0**	**2,1**	**T/Z**	**Z**	**O**		**P(3,0)**	**KO**
		Blok A: Polish language and local culture (optional to Spanish) (**GK**)	-	30	-	15	-	K2Asb_U11	45	90	3	0	2,1	T/Z	Z	O		P (3,0)	KO
		Blok B: Basic Spanish language and local culture (optional to Polish) (**GK**)	-	30	-	15	-	K2Asb_U11	45	90	3	0	2,1	T/Z	Z	O		P (3,0)	KO
2		Sport	-	30	-	-	-	K2Asb_U12	30	0	0	0	0	T/Z	Z	**O**		**P(0)**	**KO**
		Total	**0**	**60**	**0**	**15**	**0**		**75**	**90**	**3**	**0**	**2,15**					**P (3,0)**	

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					
158	**72**	**141**	**33**	**0**	**404**	**900**	**30**	**26**	**17,03**

[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 26

No.	Course/ group of courses code	Name of course/group of courses (denote group of courses with symbol **GK**)	Semester 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		Bio-based materials fabrication WUST	**24**	-	-	-	-	K2Asb_W01 K2Asb_K05 K2Asb_K06	24	60	2	2	1,04	T/Z	Z	-	DN		K
2		Bio-based materials fabrication UCLM	**-**	-	15	-	-	K2Asb_U01 K2Asb_U06 K2Asb_U12 K2Asb_K05 K2Asb_K06	15	30	1	1	0,7	T/Z	Z	-	DN	P (1,0)	K
3		Operations unit and reactors of biomass treatment II (**GK**)	**25**	-	25	-	-	K2Asb_W05 K2Asb_U03 K2Asb_U06 K2Asb_K05 K2Asb_K06	50	150	5	5	2,25	T/Z	**E (lec)**	-	DN	P (3,0)	K
4		Design and optimization of bioprocesses by commercial simulators (**GK**)	-	**35**	-	5	-	K2Asb_U03 K2Asb_K05 K2Asb_K06	40	120	4	4	1,88	T/Z	Z	-	DN	P (4,0)	K
5		Dynamic and control of bioprocesses (**GK**)	7,5	-	-	**15**	7,5	K2Asb_W14 K2Asb_U01 K2Asb_K05 K2Asb_K06	30	90	3	3	1,42	T/Z	**E (lec)**	-	DN	P (2,0)	K
6		Chemical and mechanical fractionation LUT (**GK**)	**17**	-	-	5	-	K2Asb_W04 K2Asb_U04 K2Asb_U06 K2Asb_K05 K2Asb_K06	22	90	3	3	0,99	T/Z	Z	-	DN	P (2,0)	K
7		Chemical and mechanical fractionation UCLM (**GK**)	**-**	13	5	-	-	K2Asb_U04 K2Asb_U06 K2Asb_K05 K2Asb_K06	18	30	1	1	0,84	T/Z	Z	-	DN	P (1,0)	K
8		Bioproducts valorization and waste management (**GK**)	15	-	**18**	-	7	K2Asb_W08 K2Asb_U05 K2Asb_U06 K2Asb_K05 K2Asb_K06	40	120	4	4	1,82	T/Z	Z	-	DN	P (2,5)	K
9		Knowledge management and communication skills (**GK**)	**11**	-	-	5	14	K2Asb_W13 K2Asb_U08 K2Asb_K02 K2Asb_K04 K2Asb_K05	30	90	3	0	1,38	T/Z	Z	-		P (1,9)	KO
		Total	**99,5**	**48**	**63**	**30**	**28,5**		**269**	**780**	**26**	**23**	**12,32**					**P (17,4)**	

Optional courses / groups of courses (4 ECTS points)

No.	Course/ group of courses code	Name of course/group of courses (denote group of courses with symbol **GK**)	Semester 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		Language blocks (optional C or D)																	
		Block C: Spanish language and culture (**GK**)	-	**16**	22	-	2	K2Asb_U11	40	120	4	0	1,87	T/Z	Z	-		P (4,0)	KO
		Block D: Basic Finnish language	-	30	-	-	-	K2Asb_U11	30	120	4	0	1,4	T/Z	Z	-		P (4,0)	KO
		Total A		**16**	**22**		**2**		**40**	**120**	**4**		**1,87**						
		Total B		**30**					**30**	**120**	**4**		**1,4**						

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					
Block A	**99,5**	**64**	**85**	**30**	**30,5**	**309**	**900**	**30**	**23**	**14,19**
Block B	**99,5**	**78**	**63**	**30**	**28,5**	**299**	**900**	**30**	**23**	**13,72**

[1]BU – number of ECTS points assigned to hours of classes requiring direct participation of academic teachers and other persons conducting classes
[2]Traditional – enter T, remote – enter Z
[3]Exam – enter E, crediting – enter Z. For the group of 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**)	Semester 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		Bio-based sorbents, fertilizers and food additives WUST	12	-	-	-	-	K2Asb_W03	12	30	1	1	0,52	T/Z	Z	-	DN	-	K
2		Bio-based chemicals and consumer products (**GK**)	**15**	15	-	2	-	K2Asb_W03 K2Asb_U02 K2Asb_U06 K2Asb_U09 K2Asb_K05 K2Asb_K06	32	120	4	4	1,45	T/Z	Z	-	DN	P (2,5)	K
3		Sustainable bio-products technologies UCLM (**GK**)	**17**	3	-	-	-	K2Asb_W03 K2Asb_W04 K2Asb_U02 K2Asb_U06	20	60	2	2	0,88	T/Z	Z	-	DN	P (1,0)	K
4		Lignocellulosic bio-refinery (**GK**)	**15**	15	-	30	-	K2Asb_W07 K2Asb_U02 K2Asb_U06 K2Asb_U09 K2Asb_K05 K2Asb_K06	60	150	5	5	2,85	T/Z	**E (lec)**	-	DN	P (4,5)	K
5		Separations by filtration in biorefining (**GK**)	15	15	**15**	2	-	K2Asb_W07 K2Asb_U02 K2Asb_U06 K2Asb_U09 K2Asb_K05 K2Asb_K06	47	120	4	4	2,15	T/Z	Z	-	DN	P (3,5)	K
6		Separations by adsorption in biorefining (**GK**)	15	15	-	**15**	-	K2Asb_W07 K2Asb_U02 K2Asb_U06 K2Asb_U09 K2Asb_K05 K2Asb_K06	45	90	3	3	2,1	T/Z	Z	-	DN	P (2,5)	K
7		Business models and market analysis LUT (**GK**)	-	15	-	**2**	-	K2Asb_U06 K2Asb_U09 K2Asb_K05 K2Asb_K06	17	60	2	0	0,8	T/Z	Z	-		P (2,0)	KO
8		Business models and market analysis UCLM	15	-	-	-	-	K2Asb_W13 K2Asb_K05 K2Asb_K06	15	30	1	0	0,65	T/Z	Z	-			KO

9		Design and optimization of experiments (**GK**)	15	15	-	**2**	-	K2Asb_W06 K2Asb_U03 K2Asb_U06 K2Asb_U09 K2Asb_K05 K2Asb_K06	32	120	4	4	1,45	T/Z	Z	-	DN	P (3,5)	PD
10		Finish language and culture (**GK**)	-	**30**	-	10	-	K2Asb_U11	40	120	4	0	1,9	T/Z	Z	O		P (3.5)	KO
		Total	**119**	**123**	**15**	**63**	**0**		**320**	**900**	**30**	**23**	**14,75**					**P (23,0)**	

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**)	Semester 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									0								

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					
119	**123**	**15**	**63**	**0**	**320**	**900**	**30**	**23**	**14,75**

[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 0

No.	Course/ group of courses code	Name of course/group of courses (denote group of courses with symbol **GK**)	Semester 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																	

Optional courses / groups of courses (30 ECTS points)

No.	Course/ group of courses code	Name of course/group of courses (denote group of courses with symbol **GK**)	Semester 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		Master thesis	-	-	360	-	-	K2Asb_W05 K2Asb_U06 K2Asb_U08 K2Asb_U12 K2Asb_K01 K2Asb_K04 K2Asb_K07 K2Asb_K09	360	900	30	30	21	T	Z	-	DN	P (30)	K
		Total	**-**	**-**	**360**	**-**	**-**		**360**	**900**	**30**	**30**	**16,8**					**P (30)**	

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					
-	-	**360**	-	-	**360**	**900**	**30**	**30**	**16,8**

2. Set of examinations in semestral arrangement

Course / group of courses code	Names of courses / groups of courses ending with examination	Semester
	1. Recovery of bio-components 2. Operations unit and reactors of biomass treatment I WUST 3. Chemical-thermal biomass conversion	1
	4. Operations unit and reactors of biomass treatment II 5. Dynamic and control of bioprocesses	2
	6. Lignocellulosic bio-refinery	3
	----	4

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

Semester	Allowable deficit of ECTS points after semester
1	-
2	-
3	-
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

Opinion of student government legislative body

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

.....	.....
Date	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

FACULTY OF CHEMISTRY

SUBJECT CARD

Name of subject in Polish	Charakterystka bio-komponentów
Name of subject in English	Bio-components characterization
Main field of study (if applicable)	Sustainable Biomass and Bioproducts Engineering
Specialization (if applicable)	----
Profile:	academic
Level and form of studies:	2nd level, full-time
Kind of subject:	obligatory
Subject code	…….
Group of courses	YES (leading course – LABORATORY)

	Lecture	Classes (excercises)	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	12		**24**		
Number of hours of total student workload (CNPS)	30		60		
Form of crediting	crediting with grade*		crediting with grade*		
For group of courses mark (X) final course			X		
Number of ECTS points	1		2		
including number of ECTS points for practical classes (P)	0		2		
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	0.52		1.12		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Completed the first grade of high education curriculum

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SUBJECT OBJECTIVES

C1 To gain knowledge how to assess the valuable components in biomaterials .
C2 To recognize methods for analysis of bio-components.

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge:
PEU_W01 to get knowledge on methods used in analyses of bio-mass
PEU_W02 to know the basics of analytical methods

relating to skills:
PEU_U01 to be able to determine valuable bioproducts
PEU_U02 to be able to calculate the amount of valuable components

relating to social competences:
PEU_K01 to work effectively in a sub-group during performing the experiments

PROGRAMME CONTENT

Lecture		Number of hours
Lec 1	Sample collection and preparation,	2
Lec 2	UV-VIS spectroscopy and sample preparation	2
Lec 3	IR and FTIR and sample preparation	2
Lec 4	Fundamentals of electro-membrane evaluation	2
Lec 5	Methods of molecular weight determination	2
Lec 6	Fundamentals of NMR analysis	2
	Total hours	12

Laboratory		Number of hours
Lab 1	Chemical analysis, sampling and data analysis	2
Lab 2	Titration, sample collection and preparation	2
Lab 3	UV-VIS spectroscopy, sample preparation, calibration	4
Lab 4	IR and FTIR analyses, sample preparation, calibration	4
Lab 5	Electrochemical characterization of bio-components	4
Lab 6	Surface analysis: contact angle and microscopy	2
Lab 7	NMR characterization of bio-components	4
Lab 8	Molecular weight determination, viscometry	2
	Total hours	24

TEACHING TOOLS USED

N1. Lecture with multimedia presentation
N2. Practical laboratory classes

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT

Evaluation (F – forming during semester), P – concluding (at semester end)	Learning outcomes code (from subject educational effects)	Way of evaluating learning outcomes achievement
P1	PEU_W01-W02	Test *(minimum examination pass mark is 50 %)*
F2	PEU_U01-U02	Reports
P2 (laboratory) average grade from reports		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] A. Nzihou, „Handbook on Characterization of Biomass, Biowaste and Related By-products", Springer International Publishing, 2021.
[2] A. Bandyopadhyay, S. Bose, „Characterization of Biomaterials", Elsevier 2013.
[3] M. Masuelli, D. Renard (Eds.), „Advances in Physicochemical Properties of Biopolymers (Part 1)", Bentham Science Publishers 2017.

SECONDARY LITERATURE:

[1] N. P. Cheremisinoff, „Polymer Characterization. Laboratory Techniques and Analysis", William Andrew Inc.1996
[2] D. Campbell, R. A. Pethrick, J. R. White, „Polymer Characterization: Physical Techniques", CRC Press 2000
[3] „Characterization and Analysis of Polymers", Wiley 2008

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

Prof. Marek Bryjak, marek.bryjak@pwr.edu.pl

FACULTY OF CHEMISTRY

SUBJECT CARD

Name of subject in Polish	Modyfikacja odzyskiwanych biokomponentów
Name of subject in English	Modification of recovered bio-components
Main field of study (if applicable)	Sustainable Biomass and Bioproducts Engineering
Specialization (if applicable)	----
Profile:	academic
Level and form of studies:	2nd level, full-time
Kind of subject:	obligatory
Subject code	…….
Group of courses	YES (leading course – LECTURE)

	Lecture	Classes (excercises)	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	12		12		
Number of hours of total student workload (CNPS)	30		30		
Form of crediting	crediting with grade*		crediting with grade*		
For group of courses mark (X) final course	X				
Number of ECTS points	1		1		
including number of ECTS points for practical classes (P)			1		
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	0.52		0.56		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. completed the first grade of high education curriculum

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SUBJECT OBJECTIVES

C1 To gain knowledge on the valuable components in biomaterials.
C2 To recognize methods for recovery of bio-components.

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge:
PEU_W01 to get knowledge on methods used in treatment of bio-mass.
PEU_W02 to know how to change the properties of the recovered bio-components
PEU_W03 to know the basics of chemical engineering processes

relating to skills:
PEU_U01 to be able to run recovery of valuable bioproducts.
PEU_U02 to be able to calculate the effect of biomass treatment
…
relating to social competences:
PEU_K01 to work effectively in a sub-group during performing the experiments

PROGRAMME CONTENT		
Lecture		**Number of hours**
Lec 1	Enzymatic modification of bio-components	4
Lec 2	Physical modification of bio-components	2
Lec 3	Chemical modification of bio-components	3
Lec 4	Mixed methods for bio-components modification	3
	Total hours	12
Laboratory		**Number of hours**
Lab 1	Enzymatic modification of bio-components	3
Lab 2	Physical modification of bio-components	3
Lab 3	Chemical modification of bio-components	3
Lab 4	Mixed methods for bio-components modification	3
	Total hours	12

TEACHING TOOLS USED

N1. Lecture with multimedia presentation
N2. Practical laboratory classes

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT

Evaluation (F – forming during semester), P – concluding (at semester end)	Learning outcomes code (from subject educational effects)	Way of evaluating learning outcomes achievement
F1	PEU_W01-W03	Test *(minimum examination pass mark is 50 %)*
F2	PEU_U01-U02	Reports
P2 (laboratory) average grade from reports		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] S. Thomas, N. Ninan, S. Mohan, E. Francis, „Natural Polymers, Biopolymers, Biomaterials, and Their Composites, Blends, and IPNs", Apple Academic Press Inc. 2012, CRC Press Taylor & Francis.
[2] Y. Imanishi (Ed.), „Synthesis of Biocomposite Materials: Chemical and Biological Modifications of Natural Polymers", CRC Press Taylor & Francis 2017.
[3] V. C. Kalia, A. K. Saini (Eds.), "Metabolic Engineering for Bioactive Compounds", Springer Nature Singapore Pte Ltd. 2017.
[4] S. Saravanamurugan, A. Pandey, H. Li, A. Riisager, „Recent Advances in Development of Platform Chemicals" volume in Biomass, Biofuels, Biochemicals, Elsevier 2020.

SECONDARY LITERATURE:

[1] V. K. Gupta, M. G. Tuohy, „Biotechnology of Bioactive Compounds: Sources and applications", John Wiley & Sons, Ltd 2015.

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

Dr hab. inż. Joanna Wolska joanna.wolska@pwr.edu.pl

FACULTY OF CHEMISTRY

SUBJECT CARD

Name of subject in Polish	Natura bio-materiałów
Name of subject in English	Nature of bio-materials
Main field of study (if applicable)	Sustainable Biomass and Bioproducts Engineering
Specialization (if applicable)	----
Profile:	academic
Level and form of studies:	2nd level, full-time
Kind of subject:	obligatory
Subject code	…….
Group of courses	YES (leading course – LECTURE)

	Lecture	Classes (excercises)	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	12		12		
Number of hours of total student workload (CNPS)	30		30		
Form of crediting	crediting with grade*		crediting with grade*		
For group of courses mark (X) final course	X				
Number of ECTS points	1		1		
including number of ECTS points for practical classes (P)			1		
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	0.52		0.56		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Finished the first grade of higher education curriculum.
2. Basic knowledge of organic and inorganic chemistry.

SUBJECT OBJECTIVES

C1 To provide students with a general knowledge of the basic components of bio-materials.
C2 To familiarize students with main techniques of biomass components characterization.

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge:
PEU_W01 to gain the knowledge on bio-materials and their main components.
PEU_W02 to know the basics of chemistry in bio-based materials.
PEU_W03 to recognize the quality and quantity of bio-materials coming from various sources.

relating to skills:
PEU_U01 to get knowledge about methods used for classification of bio-materials.
PEU_U02 to evaluate, develop and present the results of measurements used in biomass analysis.

relating to social competences:
PEU_K01 to work consciously and effectively in a sub-group during performing the experiments and results processing

PEU_K02 to understand the need for systematic knowledge replenishment

PROGRAMME CONTENT		
Lecture		**Number of hours**
Lec 1	Nature of plants and animals materials	4
Lec 2	Chemical character of protein	2
Lec 3	Chemistry of carbohydrates	2
Lec 4	Chemistry of other biopolymers	2
Lec 5	Characterization of bio-materials	2
	Total hours	12
Laboratory		**Number of hours**
Lab 1	Basic analyses of biomass: water, ash, volatiles	3
Lab 2	Characterization of protein in biomass	3
Lab 3	Characterization of carbohydrates in biomass	3
Lab 4	Content of hydrophobic components in biomass	3
	Total hours	12

TEACHING TOOLS USED
N1. Lecture with multimedia presentation N2. Practical laboratory classes (work with different laboratory equipment and instruments)

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT

Evaluation (F – forming during semester), P – concluding (at semester end)	Learning outcomes code (from subject educational effects)	Way of evaluating learning outcomes achievement
P1	PEU_W01-W03	Final test *(minimum examination pass mark is 50 %)*
F2	PEU_U01-U02	Students' reports
P2 (laboratory) average grade from reports		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] O. Olatunji, „Natural Polymers: Industry Techniques and Applications", Springer International Publishing Switzerland 2016.
[2] S. Thomas, N. Ninan, S. Mohan, E. Francis, „Natural Polymers, Biopolymers, Biomaterials, and Their Composites, Blends, and IPNs", Apple Academic Press Inc. 2012, CRC Press Taylor & Francis.
[3] J. Jacob, F. Gomes, J. T. Haponiuk, N. Kalarikkal, S. Thomas, „Natural Polymers: Perspectives and Applications for a Green Approach", Apple Academic Press Inc. NY 2022, CRC Press Taylor & Francis.
[4] C. Tang; C. Y. Ryu, „Sustainable Polymers from Biomass", John Wiley & Sons VCH 2017.

SECONDARY LITERATURE:

[1] D. C. Dayton, T. D. Foust, „Analytical Methods for Biomass Characterization and Conversion" Emerging Issues in Analytical Chemistry, Elsevier Science Publishing Co Inc. 2020.
[2] A. Nzihou, „Handbook on Characterization of Biomass, Biowaste and Related By-products", Springer International Publishing, 2021.

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

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FACULTY OF CHEMISTRY

SUBJECT CARD

Name of subject in Polish	Odzysk bio-komponentów
Name of subject in English	Recovery of bio-components
Main field of study (if applicable)	Sustainable Biomass and Bioproducts Engineering
Specialization (if applicable)	----
Profile:	academic
Level and form of studies:	2nd level, full-time
Kind of subject:	obligatory
Subject code	…….
Group of courses	YES (leading course – LECTURE)

	Lecture	Classes (excercises)	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	12		24		
Number of hours of total student workload (CNPS)	30		60		
Form of crediting	Examination		crediting with grade*		
For group of courses mark (X) final course	X				
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)	0.52		1.12		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Completed the first grade of high education curriculum

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SUBJECT OBJECTIVES

C1 To gain knowledge on the valuable components in biomaterials.
C2 To recognize methods for recovery of bio-components.

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge:
PEU_W01 to get knowledge on methods used in treatment of bio-mass
PEU_W02 to know the basics of chemical engineering processes

relating to skills:
PEU_U01 to be able to run recovery of valuable bioproducts
PEU_U02 to be able to calculate the effect of biomass treatment

relating to social competences:
PEU_K01 to work effectively in a sub-group during performing the experiments

PROGRAMME CONTENT

Lecture		Number of hours
Lec 1	Extraction processes	2
Lec 2	Adsorption processes	2
Lec 3	Membrane enhanced separation	2
Lec 4	Recovery of bioactive components	2
Lec 5	Bio-transformational recovery	2
Lec 6.	Microwaves in the recovery of bio-active components	2
	Total hours	12
Laboratory		**Number of hours**
Lab 1	Extraction processes: LL and SL	4
Lab 2	Adsorption processes: Phys and chem	4
Lab 3	Membrane enhanced separation: MEUF, PEUF and/or AEUF	4
Lab 4	Recovery bioactive components: sorption on MIP materials	4
Lab 5	Enzyme enhanced recovery	4
Lab 6	Ultrasounds in recovery of bio-active components	4
Lab 7	Extraction processes: LL and SL	4
	Total hours	24

TEACHING TOOLS USED
N1. Lecture with multimedia presentation N2. Practical laboratory classes

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT

Evaluation (F – forming during semester), P – concluding (at semester end)	Learning outcomes code (from subject educational effects)	Way of evaluating learning outcomes achievement
P1	PEU_W01-W02	Exam *(minimum examination pass mark is 50 %)*
F2	PEU_U01-U02	Reports
P2 (laboratory) average grade from reports		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] A. Nzihou, „Handbook on Characterization of Biomass, Biowaste and Related By-products", Springer International Publishing, 2021.
[2] D. C. Dayton, T. D. Foust, „Analytical Methods for Biomass Characterization and Conversion" Emerging Issues in Analytical Chemistry, Elsevier Science Publishing Co Inc. 2020.
[3] L. J. R. Nunes (Ed.), „Recycling and Recovery of Biomass Materials", MDPI Books 2021.
[4] H. D. González, M. J. González Muñoz (Eds.), „Water Extraction of Bioactive Compounds: From Plants to Drug Development", Elsevier 2018.

SECONDARY LITERATURE:

[1] M. Komiyama, T. Takeuchi, T. Mukawa, H. Asanuma, „Molecular Imprinting: From Fundamentals to Applications", Weinheim, Wiley-VCH 2003.
[2] R. W. Baker, „Membrane Technology and Applications", John Wiley & Sons Inc NY 2021.
[3] V. T. Nguyen (Ed.), „Recovering Bioactive Compounds from Agricultural Wastes", Wiley 2017.

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

Prof. Marek Bryjak, marek.bryjak@pwr.edu.pl

FACULTY OF CHEMISTRY

SUBJECT CARD

Name of subject in Polish	Wytwarzanie bio-materiałów
Name of subject in English	Bio-based materials fabrication
Main field of study (if applicable)	Sustainable Biomass and Bioproducts Engineering
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 (excercises)	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)			15		
Number of hours of total student workload (CNPS)			30		
Form of crediting			crediting with grade*		
For group of courses mark (X) final course					
Number of ECTS points			1		
including number of ECTS points for practical classes (P)			1		
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)			0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Completed the first grade of higher education curriculum .
2. Basic knowledge of biopolymers and bio-based materials.

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SUBJECT OBJECTIVES

C1 To gain knowledge on the valuable components in biomaterials.
C2 To recognize methods for transformation of bio-components.

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge:
PEU_W01 to get knowledge on methods used in treatment of bio-mass.
PEU_W02 to know the basics of technology processes used in bio-mass treatment.

relating to skills:
PEU_U01 to be able to run transformation of bioproducts.
PEU_U02 to be able to calculate the effect of biomass transformation.

relating to social competences:

PEU_K01 to work effectively in a sub-group during performing the experiments.

PROGRAMME CONTENT

Laboratory		Number of hours
Lab 1	Biodegradable polymers: synthesis of polylactide polymers	3
Lab 2	Modification of cellulose	3
Lab 3	Bio-based polymers: synthesis of bio-based polyurethanes	3
Lab 4	Bio-based polymers: synthesis of bio-based polyesters	3
Lab 5	Modification of activated carbon	3
	Total hours	15

TEACHING TOOLS USED

N1. Lecture with multimedia presentation
N2. Practical laboratory classes (work with different laboratory equipment and instruments)

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT

Evaluation (F – forming during semester), P – concluding (at semester end)	Learning outcomes code (from subject educational effects)	Way of evaluating learning outcomes achievement
P1	PEU_W01-W02	Final test *(minimum examination pass mark is 50 %)*
F	PEU_U01-U02	Reports
P2 (laboratory) average grade from reports		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] M. Niaounakis, „Biopolymers: Processing and Products", PDL Handbook Series, William Andrew Publishing 2015, Elsevier.
[2] S. Ebnesajjad (Eds.), „Handbook of Biopolymers and Biodegradable Plastics: Properties, Processing and Applications", PDL Handbook Series, William Andrew Publishing 2013, Elsevier.
[3] S. A. Ashter, „Introduction to Bioplastics Engineering", PDL Handbook Series, William Andrew Publishing 2016, Elsevier.
[4] S. Kabasci (Ed.), C.V. Stevens (Series Ed.), „Bio-Based Plastics: Materials and Applications", Wiley 2013.
[5] M. Komiyama, T. Takeuchi, T. Mukawa, H. Asanuma, „Molecular Imprinting: From Fundamentals to Applications", Weinheim, Wiley-VCH 2003.

SECONDARY LITERATURE:

[1] R. P. Wool, X. S. Sun, „Bio-Based Polymers and Composites", Academic Press 2005, Elsevier.
[2] S. K. Sharma, A. Mudhoo (Eds.), „A Handbook of Applied Biopolymer Technology: Synthesis, Degradation and Applications", RSC Publishing 2011.
[3] Journal series Bioresource Technology, ScienceDirect

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

Dr inż. Anna Jakubiak-Marcinkowska anna.jakubiak-marcinkowska@pwr.edu.pl

FACULTY OF CHEMISTRY

SUBJECT CARD

Name of subject in Polish	Wytwarzanie bio-materiałów
Name of subject in English	Bio-based materials fabrication
Main field of study (if applicable)	Sustainable Biomass and Bioproducts Engineering
Specialization (if applicable)	----
Profile:	academic
Level and form of studies:	2nd level, full-time
Kind of subject:	obligatory
Subject code	…….
Group of courses	YES – leading course - LECTURE

	Lecture	Classes (excercises)	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	24				
Number of hours of total student workload (CNPS)	60				
Form of crediting	crediting with grade*				
For group of courses mark (X) final course					
Number of ECTS points	2				
including number of ECTS points for practical classes (P)					
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	1.04				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Completed the first grade of higher education curriculum .
2. Basic knowledge of biopolymers and bio-based materials.

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SUBJECT OBJECTIVES

C1 To gain knowledge on the valuable components in biomaterials.
C2 To recognize methods for transformation of bio-components.

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge:
PEU_W01 to get knowledge on methods used in treatment of bio-mass.
PEU_W02 to know the basics of technology processes used in bio-mass treatment.

relating to skills:
PEU_U01 to be able to run transformation of bioproducts.
PEU_U02 to be able to calculate the effect of biomass transformation.

relating to social competences:

PEU_K01 to work effectively in a sub-group during performing the experiments.

PROGRAMME CONTENT

Lecture		Number of hours
Lec 1	Bio-based composites for improvement of material properties	5
Lec 2	Biopolymer-based nanocomposites for processing of liquid wastes	5
Lec 3	Functionalization of activated carbon	2
Lec 4	Stabilized nanomaterials for chemical processes	5
Lec 5	Techniques of bio-based polymers processing	2
Lec 6	Preparation of bio-inspired materials	5
	Total hours	24

TEACHING TOOLS USED

N1. Lecture with multimedia presentation
N2. Practical laboratory classes (work with different laboratory equipment and instruments)

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT

Evaluation (F – forming during semester), P – concluding (at semester end)	Learning outcomes code (from subject educational effects)	Way of evaluating learning outcomes achievement
P1	PEU_W01-W02	Final test *(minimum examination pass mark is 50 %)*

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] M. Niaounakis, „Biopolymers: Processing and Products”, PDL Handbook Series, William Andrew Publishing 2015, Elsevier.
[2] S. Ebnesajjad (Eds.), „Handbook of Biopolymers and Biodegradable Plastics: Properties, Processing and Applications”, PDL Handbook Series, William Andrew Publishing 2013, Elsevier.
[3] S. A. Ashter, „Introduction to Bioplastics Engineering”, PDL Handbook Series, William Andrew Publishing 2016, Elsevier.
[4] S. Kabasci (Ed.), C.V. Stevens (Series Ed.), „Bio-Based Plastics: Materials and Applications”, Wiley 2013.
[5] M. Komiyama, T. Takeuchi, T. Mukawa, H. Asanuma, „Molecular Imprinting: From Fundamentals to Applications”, Weinheim, Wiley-VCH 2003.

SECONDARY LITERATURE:

[1] R. P. Wool, X. S. Sun, „Bio-Based Polymers and Composites”, Academic Press 2005, Elsevier.
[2] S. K. Sharma, A. Mudhoo (Eds.), „A Handbook of Applied Biopolymer Technology: Synthesis, Degradation and Applications”, RSC Publishing 2011.
[3] Journal series Bioresource Technology, ScienceDirect

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

Dr inż. Anna Jakubiak-Marcinkowska anna.jakubiak-marcinkowska@pwr.edu.pl

FACULTY OF CHEMISTRY

SUBJECT CARD

Name of subject in Polish	Biochemikalia i produkty konsumenckie
Name of subject in English	Bio-based chemicals and consumer products
Main field of study (if applicable)	Sustainable Biomass and Bioproducts Engineering
Specialization (if applicable)	----
Profile:	academic
Level and form of studies:	2nd level, full-time
Kind of subject:	obligatory / optional / university-wide
Subject code	…….
Group of courses	YES – leading course - LECTURE

Tuomo Sainio <Tuomo.Sainio@lut.fi>

	Lecture	Classes (excercises)	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15	15		2	
Number of hours of total student workload (CNPS)	45	15		60	
Form of crediting	Crediting with grade	Crediting with grade		Report	
For group of courses mark (X) final course	X				
Number of ECTS points	1.5	0.5		2	
including number of ECTS points for practical classes (P)		0.5		2	
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	0.65	0.7		0.1	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. completed the first grade of high education curriculum

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SUBJECT OBJECTIVES

C1 to gain knowledge on the valuable components in biomaterials
C2 to recognize methods for transformation of bio-components

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge:

PEU_W01 students are familiar with commercially viable use of fibers, cellulose derivatives, and lignin in various non-paper applications

PEU_W02 students have adequate knowledge for tailoring the functionalities of bio-based polymers to meet functionality needed for specific application such as barriers in packaging and hygiene products.

PEU_W03 are familiar with production of biochemicals from secondary sources such as tall oil.

relating to skills:

PEU_U01 to be able to calculate the effect of biomass transformation relating to social competences: PEU_K01 to work effectively in a small group

PROGRAMME CONTENT		
Lecture		**Number of hours**
Lec 1	Biobased barrier technologies in packaging applications	3
Lec 2	Biobased hygiene products	3
Lec 3	Biobased components in paints, inks, adhesives, and glues	3
Lec 4	Biofuels from wastes and side streams	3
Lec 5	Biomaterials in food application	3
	Total	15

Classes (a personal and a group assignment)		**Number of hours**
Cl 1	Barrier technologies in packaging industry	3
Cl 2	Hygiene products	3
Cl 3	Components of paints, inks, adhesives, and glues	3
Cl 4	Biofuels	3
Cl 5	Biomaterials in food industry	3
	Total hours	15

Project		**Number of hours**
Proj 1	Product development project - biobased consumer products	2

TEACHING TOOLS USED
N1. Lecture with multimedia presentation N2. Practical classes (brain storming)

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT

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

F1	PEU_W01, PEU_W02, PEU_W03.	Test
F2	PEU_U01	Supervisor's evaluation
P = 0.5(F1+ F2)		

PRIMARY AND SECONDARY LITERATURE
PRIMARY LITERATURE: [1] Wool & Sun, Bio-based polymers and composites, Academic Press, 2005 [2] Pandey et al., Biomass, Biofuels, Biochemicals, Elsevier, 2021 **SECONDARY LITERATURE:** [1] papers in journals selected by the supervisor [2] lecture notes and demonstration videos
SUBJECT SUPERVISOR (NAME AND SURNAME, E-MAIL ADDRESS)
Assist. prof. Rama Layek, rama.layek@lut.fi

FACULTY OF CHEMISTRY

SUBJECT CARD

Name of subject in Polish	Nawozy i dodatki spożywcze pochodzenia biologicznego
Name of subject in English	Bio-based fertilizers and food additives
Main field of study (if applicable)	Sustainable Biomass and Bioproducts Engineering
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 (excercises)	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	12				
Number of hours of total student workload (CNPS)	30				
Form of crediting	Crediting with grade				
For group of courses mark (X) final course					
Number of ECTS points	1				
including number of ECTS points for practical classes (P)					
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	0.65				

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PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge of the basics of chemical technology
2. Knowledge of the basics of the chemical and natural sciences

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SUBJECT OBJECTIVES

C1 To familiarize students with the basics of Bio-based materials applications
C2 Obtain basic knowledge of the different Bio-based materials production methods
C3 Obtain basic knowledge of the organization of the research and development of Bio-based materials
C4 To introduce the student to practical Bio-based materials examples in the chemical industry
C5 To introduce the student to new trends in Bio-based materials applications
C6 To acquaint students with the mission of chemical and biological sciences in the development of modern sustainable agriculture
C7 To acquaint the students with the organization of the research and development cycle and its role in implementing process and product innovations in the production of agrochemicals
C8 To acquaint the students with new civilization challenges related to sustainable development, raw materials and energy problems in the chemical industry

C9 To acquaint the students with the principles and problems of the development of the innovative fertilizer industry in the EU and Poland

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge:
PEU_W01 Student knows the characteristic and production methods of bio-based sorbents, polymers, fertilizers, biostimulats, bioregulators and food additives,
PEU_W02 Student knows the basics of bio-based materials applications
PEU_W03 Student knows organizational, market, technological, raw materials and basic legal regulations concerning functioning of chemical industry in knowledge-based economy.
PEU_W04 Student knows trends and development directions of bio-based materials applications
relating to skills:
PEU_U01 Student is able to gain knowledge (available literature databases, industry websites etc.) about the state of technology and about innovations and trends in bio-based materials applications
relating to social competences:
PEU_K01 Student is ready to look for innovative solutions for a given issue.
PEU_K02 Student understands the need to apply innovations in chemical and process engineering.

PROGRAMME CONTENT

	Lecture	**Number of hours**
Lec 1	Raw materials – available sources and processing	2
Lec 2	Bio-based fertilizer products - classification, methods of production, environmental impact	2
Lec 3	Food additives – classification, methods of production, biofortification, environmental impact	2
Lec 4	Sorption materials applied for environmental protection	2
Lec 5	Phytoremediation and Bioimmobilization	2
Lec 6	Sustainable Use of Biochar in Environmental Management	2
	Total hours	12

TEACHING TOOLS USED

N1. Lecture with multimedia presentation
N2. Scientific discussion
N3. Consultation

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT

Evaluation (F – forming during semester), P – concluding (at semester end)	Learning outcomes code (from subject educational effects)	Way of evaluating learning outcomes achievement
F	W01-W04, U01	oral answers, evaluation of partial tasks during the semester.
P=F		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] Bergmann, C. P., & Machado, F. M. (Eds.). (2015). *Carbon nanomaterials as adsorbents for environmental and biological applications* (pp. 1-105). New York: Springer International Publishing.
[2] European Fertilizer Manufactures Association, Forecast 2012-2022 of food, farming and fertilizer use I European Union, EFMA Brussels,2013
[3] Regulation (EU) 2019/1009 of the European Parliament and of the Council of 5 June 2019
[4] K.Chojancka,"Biosorption and bioacumulation" wed. Nova, New York 2010
[5] Samoraj, M., Tuhy, Ł., Chojnacka, K. (2016) Innovative Bio-Products for Agriculture: Innovative Bio-Based Micronutrient Fertilizers, Nova science.

SECONDARY LITERATURE:

[1] Scientific and technical journals: Chemical Industry, Chemical, Apparatus and Chemical Engineering.
[2] Scientific journals: Springer base, Elsevier, John Wiley & Sons
[3] Fertilizer Europe.com

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

Dr inż. Mateusz Samoraj mateusz.samoraj@pwr.edu.pl
Dr hab. inż. Jolanta Warchoł jolanta.warchol@pwr.edu.pl

FACULTY OF CHEMISTRY

SUBJECT CARD

Name of subject in Polish: Procesy jednostkowe i reaktory do obróbki Biomasy I - UCLM
Name of subject in English: **Operation unit and reactors of biomass treatment I - UCLM**
Main field of study (if applicable): Sustainable Biomass and Bioproducts Engineering
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 (excercises)	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	12				
Number of hours of total student workload (CNPS)	30				
Form of crediting	Crediting with grade				
For group of courses mark (X) final course					
Number of ECTS points	1				
including number of ECTS points for practical classes (P)					
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	0.52				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. completed all courses of the 1st semester

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SUBJECT OBJECTIVES

C1 to get familiar with the unit operations in bio-mass treatment
C2 to know how to recover some valuable components from the bio-mass

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge:
PEU_W01 student gains knowledge in the field of chemical engineering unit operations
PEU_W02 student knows the basics of running the unit operations

relating to skills:
PEU_U01 student is able to interpret, develop and present the results of measurements
PEU_U02 student can run selected unit operations

relating to social competences:
PEU_K01 student can work collectively in a group

PROGRAMME CONTENT

Lecture		Number of hours
Lec 1	Fundamentals of ion exchange	2
Lec 2	Fundamentals of distillation	2
Lec 3	Fundamentals of membrane processes	4
Lec 4	Fundamentals of biochemical reactors	4
	Total	12

TEACHING TOOLS USED
N1. Lecture with multimedia presentation N2. Presentation of industrial installation elements

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT

Evaluation (F – forming during semester), P – concluding (at semester end)	Learning outcomes code (from subject educational effects)	Way of evaluating learning outcomes achievement
F1	W01, W02….	Final test
P= F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] W.L McCabe, J.Smith, Unit Operations of Chemical Engineering, McGraw-Hill Ed. 2004
[2] P.Kee-Yoeup, *Production of Biomass and Bioactive Compounds Using Bioreactor Technology, Springer 2014*

SECONDARY LITERATURE:

[1] publications in journals related to chemical engineering

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

Prof. Marek Bryjak marek.bryjak@pwr.edu.pl

FACULTY OF CHEMISTRY

SUBJECT CARD

Name of subject in Polish Procesy jednostkowe i reaktory do obróbki Biomasy I - WUST
Name of subject in English **Operation unit and reactors of biomass treatment I - WUST**
Main field of study (if applicable) Sustainable Biomass and Bioproducts Engineering
Specialization (if applicable) ----
Profile: academic
Level and form of studies: 2nd level, full-time
Kind of subject: obligatory
Subject code …….
Group of courses YES – leading course - LABORATORY

	Lecture	Classes (excercises)	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	12	12	**36**		
Number of hours of total student workload (CNPS)	30	30	120		
Form of crediting	Examination	crediting with grade*	Examination		
For group of courses mark (X) final course			X		
Number of ECTS points	1	1	4		
including number of ECTS points for practical classes (P)		1	4		
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	0.52	0.56	1.68		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. completed all courses of the 1st semester

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SUBJECT OBJECTIVES

C1 to get familiar with the unit operations in bio-mass treatment
C2 to know how to recover some valuable components from the bio-mass

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge:
PEU_W01 student gains knowledge in the field of chemical engineering unit operations
PEU_W02 student knows the basics of running the unit operations

relating to skills:
PEU_U01 student is able to interpret, develop and present the results of measurements
PEU_U02 student can run selected unit operations

relating to social competences:
PEU_K01 student can work collectively in a group

PROGRAMME CONTENT

Lecture		Number of hours
Lec 1	Fundamentals of ion exchange	2
Lec 2	Fundamentals of distillation	2
Lec 3	Supercritical Fluids –Fundamentals of Biomass Treatment; Supercritical Fluid Extraction	2
Lec 4	Fundamentals of membrane processes	3
Lec 5	Fundamentals of biochemical reactors	3
	Total	12
Classes		**Number of hours**
Cl 1	Practical classes in industry (visiting chosen companies or institutions)	12
	Total hours	12
Laboratory		**Number of hours**
Lab 1	Purification of glycerol/water solutions from biodiesel synthesis by ion exchange	4
Lab 2	Distillation and rectification of water ethanol mixture	4
Lab 3	Demineralization by electrodialysis and capacitive deionization	4
Lab 4	High-pressure laboratory: supercritical fluid extraction	4
Lab 5	Filtration with membrane regeneration (CIP method)	4
Lab 6	Carbonization of biomass	4
Lab 7	Glucose fermentation (batch and continuous process)	4
Lab 8	Transesterification of vegetable oil (biodiesel production)	4
Lab 9	Hydrolysis of starch (enzymatical process)	4
	Total hours	36

TEACHING TOOLS USED

N1. Lecture with multimedia presentation
N2. Presentation of industrial installation elements
N3. Practical laboratory classes

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT

Evaluation (F – forming during semester), P – concluding (at semester end)	Learning outcomes code (from subject educational effects)	Way of evaluating learning outcomes achievement
F1	W01, W02….	Exam
F2	U02	report
F3	U01,U02	report
P= 0.5 [F1+0.5(F2+F3)]		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] W.L McCabe, J.Smith, Unit Operations of Chemical Engineering, McGraw-Hill Ed. 2004
[2] P.Kee-Yoeup, *Production of Biomass and Bioactive Compounds Using Bioreactor Technology, Springer 2014*

SECONDARY LITERATURE:

[1] publications in journals related to chemical engineering

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

Prof. Marek Bryjak marek.bryjak@pwr.edu.pl

FACULTY OF CHEMISTRY

SUBJECT CARD

Name of subject in Polish	Projektowanie i optymalizacja bioprocesów z wykorzystaniem komercyjnych symulatorów
Name of subject in English	Design and optimization of bioprocesses using commercial simulators
Main field of study (if applicable)	Sustainable Biomass and Bioproducts Engineering
Specialization (if applicable)	----
Profile:	academic
Level and form of studies:	2nd level, full-time
Kind of subject:	obligatory
Subject code	…….
Group of courses	YES – leading course - CLASSES

	Lecture	Classes (excercises)	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)		35		5	
Number of hours of total student workload (CNPS)		105		15	
Form of crediting		crediting with grade		crediting with grade	
For group of courses mark (X) final course		X			
Number of ECTS points		3.5		0.5	
including number of ECTS points for practical classes (P)		3.5		0.5	
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)		1.63		0.25	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Not established

SUBJECT OBJECTIVES

C1 Be able to improve your simulation capabilities with HYSYS tools.
C2 Be able to use the Aspen simulator in the simulation of basic fluid operations, heat and material transfer and in the calculation of reactors.
C3 Be able to simulate known chemical and environmental processes with the two simulators listed above and comparison of results.

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge:
PEU_W01 Knowledge and capacity of management and specification of the main industrial equipment in the area of knowledge of chemical engineering
PEU_W02 Ability to write, sign and develop projects in the field of chemical engineering
…

relating to skills:
PEU_U01 Ability to solve problems with initiative, decision making, creativity, critical reasoning and to communicate and transmit knowledge, skills and abilities in the field of Chemical Engineering
PEU_U02 Capacity for critical thinking and decision making
PEU_U03 Synthesis capacity
PEU_U04 Ability to analyze and solve problems
PEU_U05 Ability to learn and work autonomously
PEU_U06 Ability to apply theoretical knowledge to practice
…
relating to social competences:
PEU_K01 Proper oral and written communication
PEU_K02 Capacity for teamwork
PEU_K03 Leadership

PROGRAMME CONTENT

Classes		**Number of hours**
Cl 1	Simulation Basic Concepts	5
Cl 2	Simulation of Separation Operations	2.5
Cl 3	Special Calculation Operations and Equipment Sizing for Separation Operations	2.5
Cl 4	Simulation of chemical reactors	2.5
Cl 5	Introduction to the use of ASPEN	2.5
Cl 6	Simulation of Unit Operations	2.5
Cl 7	Advanced Simulation of Separation Operations	2.5
Cl 8	Simulation of Chemical Reactors	2.5
Cl 9	Tools for Conceptual Analysis of Chemical Processes	2.5
Cl 10	Simulation of Chemical Processes with Aspen HYSYS and ASPEN PLUS	10
	Total hours	35
Project		**Number of hours**
Group or individual project		5

TEACHING TOOLS USED

N1. Computational classes
N2. Implementation of the project

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT

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

F1 P	PEU_W01, PEU_U01, PEU_U02, PEU_U04, PEU_U05, PEU_U06,	Test
F2 P	PEU_W02, PEU_U03, PEU_K01, PEU_K02, PEU_K03	Project report and presentation
F3		
P		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] Biegler, L. T. Systematic methods of chemical process design. Prentice Hall, 1997. ISBN: 0-13-492422-3
[2] Douglas, James M. Conceptual design of chemical procesesses. McGraw-Hill, 1988. ISBN: 0-07-017762-7
[3] Luyben, William L. Distillation design and control using AspenTM simulation. John Wiley & Sons, 2006. ISBN: 0-471-77888-5
[4] Luyben, William L. Process Modelling, Simulation and Control for Chemical Engineers. McGraw-Hill, 1990. ISBN: 0-07-039159-9

SECONDARY LITERATURE:

[1] Luyben, William L. Plantwide Dynamic Simulators in Chemical Processing and Control. Marcel Dekker, 2002. ISBN: 0-8247-0801-6
[2]
[3]

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

Maria Luz Sánchez Silva (marialuz.sanchez@uclm.es); Jesús Manuel García Vargas (jesusmanuel.garcia@uclm.es)

FACULTY OF CHEMICAL SCIENCE AND TECHNOLOGY

SUBJECT CARD

Name of subject in Polish	Dynamika i kontrola bioprocesów
Name of subject in English	Dynamic and control of Bioprocesses
Main field of study (if applicable)	Sustainable Biomass and Bioproducts Engineering
Specialization (if applicable)	----
Profile:	academic
Level and form of studies:	2nd level, full-time
Kind of subject:	obligatory
Subject code	…….
Group of courses	YES – leading course - PROJECT

	Lecture	Classes (exercises)	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	7.5	-	-	15	7.5
Number of hours of total student workload (CNPS)	30	-		37.5	22.5
Form of crediting	Exam	-	-	Exam	Crediting with grade
For group of courses mark (X) final course			-	X	
Number of ECTS points	1.0		-	1.25	0.75
including number of ECTS points for practical classes (P)	-	-	-	1.25	0.75
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	0.325			0.75	0.35

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. To have passed the subject: Design and optimization of bioprocesses by Commercial Simulators
2. Previous knowledge in Chemical Processing and Control and Instrumentation

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SUBJECT OBJECTIVES

C1 To be proficient in the use of commercial simulators for dynamic process simulation.
C2 To achieve the skills to instrument and operate chemical processes at scale.
C3 To have the ability for designing the automation of a complex industrial process.

SUBJECT EDUCATIONAL EFFECTS

Relating to knowledge:

PEU_W01.- To design products, processes, systems and services of the chemical industry, as well as the optimization of others already developed, taking as technological base the diverse areas related to chemical engineering.

PEU_W02.- To conceptualize engineering models, apply innovative methods in problem solving and appropriate software applications, for the design, simulation, optimization and control of processes and systems.

PEU_W03- To adapt to changes, being able to apply new and advanced technologies and other relevant developments, with initiative and entrepreneurial spirit.
Relating to skills:
PEU_U01 To be able to identify their own training needs in the field of study of Chemical Engineering and work or professional environment and to organize their own learning with a high degree of autonomy in all kinds of contexts (structured or unstructured).
PEU_U02.- To possess the skills of autonomous learning in order to maintain and improve the competences of chemical engineering that allow the continuous development of the profession.
PEU_U03- To have acquired advanced knowledge and demonstrated an understanding of the theoretical and practical aspects and of the working methodology in the field of Chemical Engineering with a depth that reaches the forefront of knowledge.
PEU_U04.- To be able to deal with complex situations or those that require the development of new solutions in the academic, work or professional field of study of Chemical Engineering.
PEU_U05.- To adapt to changes, being able to apply new and advanced technologies and other relevant developments, with initiative and entrepreneurial spirit.

Relating to social competences:
PEU_K01.- To be able, through arguments or procedures developed and supported by themselves, to apply their knowledge, understanding and problem-solving skills in complex or professional and specialized work environments that require the use of creative or innovative ideas.
PEU_K02- To have the ability to collect and interpret data and information on which to base their conclusions including, where necessary and relevant, reflection on social, scientific or ethical issues in the field of chemical engineering.
PEU_K03.- To know how to communicate to all types of audiences (specialized or not) in a clear and precise way, knowledge, methodologies, ideas, problems and solutions in the field of the study of Chemical Engineering.

PROGRAMME CONTENT		
Lecture		**Number of hours**
Lec 1	Topic 1.1. Dynamic simulation of chemical processes. Fundamentals.	1
Lec 2	Topic 1.2. Simulation of controlled processes with PID controllers.	1.25
Lec 3	Topic 1.3. Effect of dead time and capacitance.	1.25
Lec 4	Topic 2.1. Advanced process control. PID tunning.	1
Lec 5	Topic 2.2. Controller tuning using ASPENTECH HYSYS	1
Lec 6	Topic 3.1. Dynamic simulation of automatically controlled chemical processes. Single units.	1
Lec 7	Topic 3.2. Dynamic simulation of automatically controlled chemical processes. Industrial processes	1
	Total hours	7.5

Project	**Number of hours**

Cl 1	Topic 1.1. Case studies.	2.5
Cl 2	Topic 1.2. Case studies.	2.5
Cl 3	Topic 3.1. Case studies.	5.5
Cl 4	Topic 3.2. Case studies.	4.5
..		
	Total hours	15

Seminar		**Number of hours**
Semin 1	Development of a project simulation	7.5
Semin 2		
Semin 3		
…		
	Total hours	7.5

TEACHING TOOLS USED
N1. Lecture with multimedia presentation N2. Computational projects N3. Implementation of the project

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT

Evaluation (F – forming during semester), P – concluding (at semester end)	Learning outcomes code (from subject educational effects)	Way of evaluating learning outcomes achievement
F1	PEU_W01, PEU_W02, PEU_W03 PEU_U01, PEU_U02, PEU_U03, PEU_U04, _PEU_U05, PEU_K01, PEU_K02, _PEU_K03	Assessment of problem solving and/or case studies done in class (0-10)
F2	PEU_W01, PEU_W02, PEU_W03, PEU_U01, PEU_U02, PEU_U03, PEU_U04, PEU_U05, PEU_K01, PEU_K02, PEU_K03	Practical activities/Project report (0-10)
F3	PEU_W01, PEU_W02, PEU_W03 PEU_U01, PEU_U02, PEU_U03, PEU_U04, PEU_U05, PEU_K01, PEU_K02, PEU_K03	Final test including Practical Case Studies similar to those ones done in class (0-10)
P Final test at the end of the classes (40%), Practical activities/Project report (30%) and Assessment of problem solving and/or case studies (30%)		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] Ogunnaike, Babatunde A. Process dynamics, modeling, and control. Oxford University Press. 0-19-509119-1 (1994).
[2] Luyben, William L. Process modeling, simulation, and control for chemical engineers. McGraw-Hill. 0-07-039159-9 (1990).
[3] Luyben, William L. Plantwide dynamic simulators in chemical processing and control. Marcel Dekker. 0-8247-0801-6 (2002).
[4] Smith, C. and Corripio, A. Principles and Practices of Automatic Process Control. (3rd Edition). John Wiley and Sons Inc. 978-0471431909 (2005).

SECONDARY LITERATURE:

[1] Doran, P. M. Bioprocess Engineering Principles. Academic Press (2nd edition). 978-0-12-220851-5 (2013).
[2] Niazi, S.K. and Brown, J.L. Fundamentals of Modern Bioprocessing. CRC Press, Taylor and Francis Group (1st Edition). 9781138893290 (2015)

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

Ana Raquel de la Osa (AnaRaquel.Osa@uclm.es) and Francisco Javier Ramos (Javier.Ramos@uclm.es)

FACULTY OF CHEMISTRY

SUBJECT CARD

Name of subject in Polish	Procesy jednostkowe i reaktory do obróbki Biomasy II
Name of subject in English	Operation unit and reactors of biomass treatment II
Main field of study (if applicable)	Sustainable Biomass and Bioproducts Engineering
Specialization (if applicable)	Environmental and chemical engineering processes
Profile:	academic
Level and form of studies:	2nd level, full-time
Kind of subject:	obligatory
Subject code	…….
Group of courses	YES – leading course - LECTURE

	Lecture	Classes (excercises)	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	25		25		
Number of hours of total student workload (CNPS)	60		90		
Form of crediting	Examination		crediting with grade		
For group of courses mark (X) final course	X				
Number of ECTS points	2		3.0		
including number of ECTS points for practical classes (P)			3.0		
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	1.08		1.67		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge on mathematic tools and chemistry
2. Basic knowledge obtained in subject: Operation unit and reactors of biomass treatment I

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SUBJECT OBJECTIVES

C1 Understanding the fundamentals of the design and operation of bioreactors
C2 Acquiring the skills for designing advanced separation processes
C3 Understanding the current trends in the application of separation processes
C4 Acquiring abilities on the practical operation of separation processes and bioreactors

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge:
PEU_W01 student knows the fundamentals of the design of biochemical reactors
PEU_W02 student knows the fundamentals of aeration and agitation in bioreactors
PEU_W03 student knows the fundamentals of drying and lyophilization
PEU_W04 student knows the advanced design of ion exchange.
PEU_W05 student knows the fundamentals of the design of membrane separation processes
PEU_W06 student knows the fundamentals of distillation

PEU_W07 student knows the fundamentals of adsorption
PEU_W08 student acquires the fundamental abilities on the practical operation of separation processes and bioreactors

relating to skills:
PEU_U01 Improving science communication skills

relating to social competences:
PEU_K01 Improving the ability for working in groups
PEU_K02 Improving the capability for getting common objetives

PROGRAMME CONTENT		
Lecture		**Number of hours**
Lec 1	Design of biochemical reactors	2
Lec 2	Aeration in Bioreactors	3
Lec 3	Agitation in bioreactors	3
Lec 4	Drying and Lyophilization	3
Lec 5	Advanced design of Ion Exchange	3
Lec 6	Membrane Separation Processes	4
Lec 7	Distillation	2,5
Lec 8	Adsorption	2,5
Lec 9	Exam	2
	Total hours	25

Laboratory		**Number of hours**
Lab 1	Aeration in Bioreactors	5
Lab 2	Agitation in bioreactors	5
Lab 3	Biomass Drying	5
Lab 4	Distillation	5
Lab 5	Ultrafiltración	5
	Total hours	25

TEACHING TOOLS USED
N1. Lecture with multimedia presentation N2. Practical laboratory classes N3. Problems solving in class

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT

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

concluding (at semester end)		
F1	PEU_W01-PEU_W07, PEU_U01, PEU_K01, PEU_K02	Individual or group work (max 1 per lesson): 25 % .
P1	PEU_W01 -PEU_W08	Written exam from lecture and laboratory: 50 %
F2	PEU_W08, PEU_U01, PEU_K01, PEU_K02	Laboratory group report: 25 %

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] Friedrich Helfferich. Ion Exchange, Dover publications; 1962
[2] Don Green, Robert Perry, Marylee Z. Southard. Perry's chemical engineer's handbook. 9th Edition. McGraw-Hill Education. 2019
[3] Ruthven, D.M. Principles of Adsorption and Adsorption Processes. John Wiley & Sons. 1984
[4] Seader, J.D.; Henley, E.J. Separation process principles. John Wiley & Sons. 2006
[5] Baker, R. W. Membrane Technology and applications. Wiley. 2004
[6] Dutta, Rajiv. Fundamentals of biochemical engineering. Ane Books India Springer. 2008

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

Javier Llanos (javier.llanos@uclm.es)

FACULTY OF CHEMISTRY

SUBJECT CARD

Name of subject in Polish	Zrównoważone technologie bioproduktów UCLM
Name of subject in English	Sustainable Bio-products technologies UCLM
Main field of study (if applicable)	Sustainable Biomass and Bioproducts Engineering
Specialization (if applicable)	----
Profile:	academic
Level and form of studies:	2nd level, full-time
Kind of subject:	obligatory
Subject code	…….
Group of courses	YES – leading course lecture

	Lecture	Classes (excercises)	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	17	3			
Number of hours of total student workload (CNPS)	30	30			
Form of crediting	crediting with grade*	crediting with grade*			
For group of courses mark (X) final course	X				
Number of ECTS points	1	1			
including number of ECTS points for practical classes (P)		1			
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	0.737	0.14			

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge of unit processes and apparatus solutions in chemical engineering
2. Basic knowledge of environmental protection

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SUBJECT OBJECTIVES

C1 Understanding the fundamentals and technology needed for the application of electrochemically and biologically assisted soil remediation processes
C2 Understanding the current trends in the electro-bioremediation processes
C3 Understanding the fundamentals and technology needed for the application of bioremediation of industrial effluents
C4 Understanding the current trends in bioremediation processes to treat industrial effluents

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge:
PEU_W01student knows how pollutants contained in soil can be transported under the application of electric fields

PEU_W02 student knows how pollutants contained in soil can be degraded by different types of microorganisms and how their action can be promoted.
PEU_W03 student knows the basic apparatus and devices for electrochemical and biologically assisted soil remediation and how technologies can be efficiently combined
PEU_W04 student has in-depth knowledge of development trends and new achievements in the field of soil remediation using electrochemical and biological technology
PEU_W05 student knows the actual challenges and future prospects of industrial wastewater treatment
PEU_W06 student knows how pollutants contained in different types of industrial wastewater can be degraded by biological treatments.
PEU_W07 student knows the fundamentals of different wastewater treatment procedures and factors affecting technology selection depending on the characteristics of the industrial effluent.

relating to skills:
PEU_U01; student is able to propose a simple electrobioremediation treatment for a polluted soil
PEU_U02 student is able to propose a management and treatment strategy for the treatment of a given industrial effluent
…
relating to social competences:
PEU_K01 students is aware of the importance of the acquired theoretical and practical knowledge and is ready to putting your skills into practice
PEU_K02 students are aware of the importance of soil remediation and industrial effluents to preserve the environment

PROGRAMME CONTENT		
Lecture		**Number of hours**
Lec 1	Soil as a high value product: keys for characterization and transforming a polluted soil into a valuable product	1.0
Lec 2	Electrokinetics for soil remediation: fundamentals & technology	1.0
Lec 3	Bioremediation of soils: fundamentals & technology. Valorization of sludge using EK technology	2.0
Lec 4	Remediation based on soil washing: towards circular economy throught valorization	1.0
Lec 5	Biological permeable reactive barriers and phytoremediation	1.0
Lec 6	Enhacing bioproceses throught electrokinetics: flushing fluid and operation conditions choice	1.0
Lec 7	Enhacing bioprocesses throught electric heating: promoting thermophilic and soil vapor extractions	1.0
Lec 8	Industrial wastewater management: challenges and future prospects	1.0
Lec 9	Fundamentals on aerobic and anaercobic biotreatments	1.0
Lec 10	Treatments of tannery effluents	1.0
Lec 11	Treatment of effluents from textile industry	1.0
Lec 12	Treatment of effluents from sugar and distillery industries	1.0

Lec 13	Treatment of wastewater from paper and pulp industries	1.0
Lec 14	Treatment of effluents from food and dairy industries	1.0
Lec 15	Treatment of effluents from chemical and pharmaceutical industries	1.0
	Final tests	1.0
	Total hours	17 h

Classes		**Number of hours**
Cl 1	Case study about testing, design and scale up in electro-bioremediation	1.5
Cl 2	Case study about management and treatment of effluents generated in pharmaceutical industry	1.5
Cl 3		
Cl 4		
..		
	Total hours	3h

TEACHING TOOLS USED
N1. Lecture with multimedia presentation N2. Discussion & Report with a practical case study

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT

Evaluation (F – forming during semester), P – concluding (at semester end)	Learning outcomes code (from subject educational effects)	Way of evaluating learning outcomes achievement
F1	PEU_W01 – PEU_W04,PEU_ U01, PEU_K01	Report (max. 10 points)
F2	PEU_W01 – PEU_W04	Final test (max. 20 points)
F3	PEU_W07, PEU_U02	Report (max. 10 points)
F4	PEU_W05- PEU_W07	Final test (max. 10 points)

P
P = 3.0 if the sum of points in the range 50-60%
3.5 if the sum of points in the range 61-72%
4.0 if the sum of points in the range 73-82%
4.5 if the sum of points in the range 83-92%
5.0 if the sum of points in the range 93-100%
5.5 if the sum of points is 100%, and the student demonstrates the knowledge above the regular material scope

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] Electrochemically Assisted Remediation of Contaminated Soils: Fundamentals, Technologies, Combined Processes and Pre-Pilot and Scale-Up Applications (Environmental Pollution, 30) 1st ed. 2021 Edición. Springer. M. A. Rodrigo & E. V. Dos Santos (Editors) ISBN-13: 978-3030681395 ISBN-10: 3030681394

[2] Electrochemical Water and Wastewater Treatment Carlos Alberto Martínez-Huitle, Onofrio Scialdone & Manuel A. Rodrigo (Editors). ELSEVIER Butterworth-Heinemann, 2018, ISBN: 978-0128131602

[3] Aplicaciones medioambientales y energéticas de la tecnología electroquímica. A. J. Fernández Romero J. García Anton, M. A. Rodrigo, I. Sirés (Eds). Editorial Reverté. ISBN 978-84-291-7075-7

[4] Bioremediation : processes, challenges, and future prospects, Velazquez-Fernandez, Jesus Bernardino and Muñiz-Hernandez, Sae (Universidad Autsnoma de Nayarit, Mexico, and others). Nova Science Publishers, Inc. † New York. ISBN: 978-1-62948-515-7 (eBook).

[5] Biotreatment of Industrial Effluents. Mukesh Doble , Anil Kumar. Butterworth-Heinemann. Elsevier eBook ISBN: 9780080456218.

[6] Industrial Waste: Management, Assessment and Environmental Issues. Stanley N. Barton. Nova Science Publisher. ISBN: 978-1-63485-600-3

[7] Bioremediation of Industrial Waste for Environmental Safety. Volume I: Industrial Waste and Its Management. Gaurav SaxenaRam Naresh Bharagava. Springer. ISBN: 978-981-13-1891-7

SECONDARY LITERATURE:

[1]
[2]
[3]

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

Manuel Andrés Rodrigo Rodrigo. Manuel.Rodrigo@uclm.es
Cristina Sáez Jiménez. Cristina.saez@uclm.es

FACULTY OF CHEMISTRY

SUBJECT CARD

Name of subject in Polish	Chemiczno-termiczna konwersja biomasy
Name of subject in English	Chemical-thermal biomass conversion
Main field of study (if applicable)	Sustainable Biomass and Bioproducts Engineering
Specialization (if applicable)	----
Profile:	academic
Level and form of studies:	2nd level, full-time
Kind of subject:	obligatory / optional / university-wide
Subject code	…….
Group of courses	YES – leading course - LECTURE

	Lecture	Classes (excercises)	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	7		17		
Number of hours of total student workload (CNPS)	30		30		
Form of crediting	examination		crediting with grade		
For group of courses mark (X) final course	X				
Number of ECTS points	1		1		
including number of ECTS points for practical classes (P)			1		
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	0,303		0,793		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

Knowledge and skills in:
1. Fundamentals of chemistry;
2. Fundamentals of physics;
3. Fundamentals of chemical and process engineering.

SUBJECT OBJECTIVES - CELE PRZEDMIOTU

C1 – Familiarising students with various thermochemical conversion processes of biomass;
C2 – Familiarising students with the basics of thermochemical conversion processes modelling and reactors design;
C3 – Developing skills in thermochemical reactors operation;
C4 – Developing skills to analyse and diagnose the quality of thermoschemical processes.

SUBJECT EDUCATIONAL EFFECTS - PRZEDMIOTOWE EFEKTY UCZENIA SIĘ

relating to knowledge:
PEU_W01 – knows thermochemical conversion processes of biomass;
PEU_W02 – knows the basics of thermochemical conversion processes modelling and reactors design;
relating to skills:
PEU_U01 – is able to design and carry out selected thermochemical conversion processes;

PEU_U02 – is able to process research findings, critically analyse them and formulate conclusions;
relating to social competences:
PEU_K01 – is ready to critically evaluate his knowledge and perceived content;
PEU_K02 – interacts responsibly in a group, taking various roles within it, including leadership;

PROGRAMME CONTENT

Lecture		**Number of hours**
Lec 1	Introduction to the course (organisation of work, grading policy, etc.).	1
Lec 2	Fundamentals of thermochemical (pyrolysis, torrefaction, gasification, combustion) and fermentation processes	3
Lec 3	Properties and applications of bio-oils, biogas and bio-chars	2
Lec 4	Lecture evaluation	1
	Total hours	7

Laboratory		**Number of hours**
Lab 1	Introduction to laboratories (grading policy, safety rules, etc.). Methane production by anaerobic digestion of biowaste	2
Lab 2	Valorisation of biomass by torrefaction and pyrolysis	2
Lab 3	Gasification for production of biosyngas	2
Lab 4	Characterization of gaseous, liquid and solid products of thermochemical processes	6
Lab 5	Combustion of biomass for energy purposes	2
Lab 6	Safety aspects of solid biomass storage, transportation and feeding	2
Lab 7	Biomethane reforming to green hydrogen	1
Lab 8	Introduction to laboratories (grading policy, safety rules, etc.). Methane production by anaerobic digestion of biowaste	2
Lab 9	Valorisation of biomass by torrefaction and pyrolysis	2
	Total hours	17

TEACHING TOOLS USED

N1. Lecture with multimedia presentation.
N2. Practical laboratory classes.
N3. Computational classes.
N4. Preparation and discussion of laboratory reports.
N5. Consultations.

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT

Evaluation (F – forming during semester), P – concluding (at semester end)	Learning outcomes code (from subject educational effects)	Way of evaluating learning outcomes achievement
P1	PEU_W01 – PEU_W02	test at the end of the classes,
F1	PEU_U01 – PEU_U02	reports from the laboratory classes and activity in the laboratory classes
P		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] Brown, R.C. (2019). Thermochemical Processing of Biomass: Conversion into Fuels, Chemicals and Power. John Wiley & Sons.
[2] Demirbas, A. (2009). Biofuels: Securing the Planet's Future Energy Needs. Springer.
[3] Dahlquist, E. (2013). Technologies for converting biomass to useful energy : combustion, gasification, pyrolysis, torrefaction and fermentation, CRC Press/Taylor & Francis Group.
[4] Kumar, S., Sani, K.R. (2018). Biorefining of Biomass to Biofuels: Opportunities and Perception. Springer.
[5] Bastidas-Oyanedel, J.-R. Schmidt, J.E. (2019). Biorefinery: Integrated Sustainable Processes for Biomass Conversion to Biomaterials, Biofuels, and Fertilizers. Springer.
[6] Aresta, M., Dibenedetto, A., Dumeignil, F. (2012). Biorefinery: From Biomass to Chemicals and Fuels. De Gruyter.
[7] Stuart, P. R., El-Halwagi, M.M. (2013). Integrated Biorefineries: Design, Analysis, and Optimization. CRC Press.

SECONDARY LITERATURE:

[1] Chen, H. (2015). Lignocellulose Biorefinery Engineering: Principles and Applications. Woodhead Publishing.
[2] Sadhukhan, J., Ng, K.S., Hernandez, E. M. (2014). Biorefineries and Chemical Processes: Design, Integration and Sustainability Analysis. John Wiley & Sons.
[3] Cooney, C.L. (1983). Bioreactors: Design and Operation. Science.

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

Halina Pawlak-Kruczek, halina.pawlak@pwr.edu.pl

FACULTY CHEMISTRY

SUBJECT CARD

Name of subject in Polish:	Surowce lignocelulozowe
Name of subject in English:	Lignocellulosic resources
Main field of study (if applicable):	**CHEMICAL AND PROCESS ENGINEERING**
Specialization (if applicable):	**Engineering chemical processes**
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)	16	-			
Number of hours of total student workload (CNPS)	30				
Form of crediting	Crediting with grade (test)				
For group of courses mark (X) final course					
Number of ECTS points	1				
including number of ECTS points for practical (P) classes	0				
including number of ECTS points for direct teacher-student contact (BU) classes	0.693				

*delete as applicable

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basics of organic chemistry

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SUBJECT OBJECTIVES

C1 Most common lignocellulosic raw materials
C2 Structure and properties of lignocellulosic raw materials

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge:
PEU_W01 to know the globally most common lignocellulosic raw materials for production of biobased materials, chemicals, and fuels in biorefineries
PEU_W02 to be familiar with the structure and properties of lignocellulosic raw materials.
PEU_W03 tp have an overview of the issues and opportunities regarding the availability and logistics of lignocellulosic raw materials

PROGRAMME CONTENT		
Lectures		**Number of hours**
Lec 1	Lignocellulosic raw materials	2
Lec 2	Structure and chemical composition of lignocellulose	2
Lec 3	Heating value of lignocellulose	1
Lec 4	Global and local perspectives to availability and logistics of lignocellulose	3
	Lignocellulosic raw materials	2
	Structure and chemical composition of lignocellulose	2
	Heating value of lignocellulose	1
	Global and local perspectives to availability and logistics of lignocellulose	3
		16h

TEACHING TOOLS USED
N1. Lecture with multimedia presentation N2. Group assignment

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
P1	PEU_W01 – PEU_W03	Final test (max. 10 points)
P = 3.0 if the sum of points in the range 50-60% 3.5 if the sum of points in the range 61-72% 4.0 if the sum of points in the range 73-82% 4.5 if the sum of points in the range 83-92% 5.0 if the sum of points in the range 93-100% 5.5 if the sum of points is 100%, and the student demonstrates the knowledge above the regular material scope		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] Filpponen et al., Lignocellulosics : Renewable Feedstock for (Tailored) Functional Materials and Nanotechnology, Elsevier 2020

SECONDARY LITERATURE:

[1] Lecture notes and other material from the lecture

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

Assist. Prof. Kristian Melin, kristian.melin@lut.fi

FACULTY CHEMISTRY

SUBJECT CARD

Name of subject in Polish:	Chemiczne i mechaniczne frakcjonowanie biomasy LUT
Name of subject in English:	Chemical and mechanical fractionation of biomass LUT
Main field of study (if applicable):	**CHEMICAL AND PROCESS ENGINEERING**
Specialization (if applicable):	**Engineering chemical processes**
Profile:	**academic**
Level and form of studies:	**2nd level, full-time**
Kind of subject:	**obligatory**
Subject code:	…….
Group of courses:	YES - leading course - LECTURE

	Lecture	**Classes**	**Laboratory**	**Project**	**Seminar**
Number of hours of organized classes in University (ZZU)	**17**			5	
Number of hours of total student workload (CNPS)	30			60	
Form of crediting	crediting with grade			report graded	
For group of courses mark (X) final course	X				
Number of ECTS points	1			2	
including number of ECTS points for practical (P) classes				2	
including number of ECTS points for direct teacher-student contact (BK) classes	0.737			0,25	

*delete as applicable

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basics of organic chemistry and structure of lignocellulosic biomass

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SUBJECT OBJECTIVES

C1 Biomass particle size modification
C2 Understanding the methods for releasing the desired structures from biomass

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge:
PEU_W01 to be familiar with methods to modify particle size and release desired structures from biomass.
PEU_02W to know common equipment for grinding and classification of fibrous particles.
PEU_03W to know chemical engineering principles in dissolution of biomass using acids, bases, and novel solvents

PROGRAMME CONTENT		
Lectures		**Number of hours**
Lec 1	Grinding or fibrous material and classification of fibers	4
Lec 2	Steam explosion	2
Lec 3	Fractionation of lignocellulose with acids and bases	4
Lec 4	Organosolv fractionation of lignocellulose	2
Lec 5	Ionic liquids and deep eutectic solvents in lignocellulose fractionation	5
	Total	**17**

Project		**Number of hours**
Proj 1	Biorefinery visit	3
Proj 2	Group assignment on fractionation technologies	2

TEACHING TOOLS USED
N1. Lecture with multimedia presentation N2. Lab equipment

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
P1	PEU_W01 – PEU_W03	Final test (max. 10 points)
P = 3.0 if the sum of points in the range 50-60% 3.5 if the sum of points in the range 61-72% 4.0 if the sum of points in the range 73-82% 4.5 if the sum of points in the range 83-92%		

5.0 if the sum of points in the range 93-100%
5.5 if the sum of points is 100%, and the student demonstrates the knowledge above the regular material scope

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] Mussatto, Biomass Fractionation Technologies for a Lignocellulosic Feedstock Based Biorefinery, Elsevier 2016

[2]

SECONDARY LITERATURE:

[1] Lecture material distributed during classes

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

Dr. Jari Heinonen, jari.heinonen@lut.fi

FACULTY CHEMISTRY

SUBJECT CARD

Name of subject in Polish:	Chemiczne i mechaniczne frakcjonowanie biomasy UCLM
Name of subject in English:	Chemical and mechanical fractionation of biomass UCLM
Main field of study (if applicable):	**CHEMICAL AND PROCESS ENGINEERING**
Specialization (if applicable):	**Engineering chemical processes**
Profile:	**academic**
Level and form of studies:	**2nd level, full-time**
Kind of subject:	**obligatory**
Subject code:	…….
Group of courses:	YES - leading course

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)		13	5		
Number of hours of total student workload (CNPS)		15	15		
Form of crediting		crediting with grade	crediting with grade		
For group of courses mark (X) final course		X			
Number of ECTS points		0.5	0.5		
including number of ECTS points for practical (P) classes		0.5	0.5		
including number of ECTS points for direct teacher-student contact (BK) classes		0.607	0.233		

*delete as applicable

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basics of organic chemistry and structure of lignocellulosic biomass

\

SUBJECT OBJECTIVES

C1 Biomass particle size modification
C2 Understanding the methods for releasing the desired structures from biomass

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge:
PEU_W01 to be familiar with methods to modify particle size and release desired structures from biomass.
PEU_02W to know common equipment for grinding and classification of fibrous particles.
PEU_03W to know chemical engineering principles in dissolution of biomass using acids, bases, and novel solvents

PROGRAMME CONTENT

Classes		**Number of hours**
Cl 1	Grinding or fibrous material and classification of fibers	2
Cl 3	Fractionation of lignocellulose with acids and bases	4
Cl 4	Organosolv fractionation of lignocellulose	3
Cl 5	Ionic liquids and deep eutectic solvents in lignocellulose fractionation	4
	Total	**13**

Laboratory		**Number of hours**
Proj 1	Steam explosion	5

TEACHING TOOLS USED
N1.multimedia presentation N2. Lab equipment

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
P1	PEU_W01 – PEU_W03	Final test (max. 10 points)
P = 3.0 if the sum of points in the range 50-60% 3.5 if the sum of points in the range 61-72% 4.0 if the sum of points in the range 73-82% 4.5 if the sum of points in the range 83-92% 5.0 if the sum of points in the range 93-100% 5.5 if the sum of points is 100%, and the student demonstrates the knowledge above the regular material scope		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] Mussatto, Biomass Fractionation Technologies for a Lignocellulosic Feedstock Based Biorefinery, Elsevier 2016

[2]

SECONDARY LITERATURE:

[1] Lecture material distributed during classes

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

Dr. Jari Heinonen, jari.heinonen@lut.fi

FACULTY CHEMISTRY

SUBJECT CARD

Name of subject in Polish:	Lignocelulozowe biorafinerie
Name of subject in English:	Lignocellulosic biorefinery
Main field of study (if applicable):	**CHEMICAL AND PROCESS ENGINEERING**
Specialization (if applicable):	**Engineering chemical processes**
Profile:	**academic**
Level and form of studies:	**2nd level, full-time**
Kind of subject:	**obligatory**
Subject code:	…….
Group of courses:	YES – leading course - LECTURE

	Lecture	**Classes**	**Laboratory**	**Project**	**Seminar**
Number of hours of organized classes in University (ZZU)	15	15		30	
Number of hours of total student workload (CNPS)	30	30		90	
Form of crediting	Exam	Exam		Report	
For group of courses mark (X) final course	X				
Number of ECTS points	1.0	1.0		3	
including number of ECTS points for practical (P) classes		1		3	
including number of ECTS points for direct teacher-student contact (BK) classes	0.65	0.7		1.5	

*delete as applicable

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basics of chemical process engineering and unit operations

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SUBJECT OBJECTIVES

C1 Concept of a biorefinery and most common biorefinery concepts for production of fibre and material products, fuel and chemical products from biomass
C2 How biorefineries can be integrated to energy production and oil refineries
C3 Knowledge and skills to solve common process problems in biorefinery processes and understanding of factors that affect the feasibility of biorefinery processes

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge:
PEU_W01 to know the major lignocellulosic biorefining processes (including Kraft pulping) as well as selected future processes.
PEU_W02 know the process conditions and understands the raw materials behavior in the process.

PEU_W03 understands the constraints and benefits in integration of biorefineries to other industrial processes such as bioenergy production. related to skills: PEU_U01 can carry out feasibility analysis of biorefinery processes.

PROGRAMME CONTENT		
Lectures		**Number of hours**
Lec 1	Lignocellulosic biorefining processes	5
Lec 2	Chemical and mechanical pulping	5
Lec 3	Process integration in lignocellulosic biorefinery	5

Classes		**Number of hours**
Cl 1	Lignocellulosic biorefining processes	5
Cl 2	Chemical and mechanical pulping	5
Cl 3	Process integration in lignocellulosic biorefinery	5

Project		**Number of hours**
Proj 1	Analysis of a biorefinery process	30

TEACHING TOOLS USED
N1. Lecture with multimedia presentation N2. Group assignment

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
P1	PEU_W01 – PEU_W03	Exam (max. 10 points)

P = 3.0 if the sum of points in the range 50-60%
3.5 if the sum of points in the range 61-72%
4.0 if the sum of points in the range 73-82%
4.5 if the sum of points in the range 83-92%
5.0 if the sum of points in the range 93-100%
5.5 if the sum of points is 100%, and the student demonstrates the knowledge above the regular material scope

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] Cheng, Lignocellulose Biorefinery Engineering - Principles and Applications, Elsevier 2015

SECONDARY LITERATURE:

[1] Lecture notes and other material from the lecture

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

Assist. Prof. Kristian Melin, kristian.melin@lut.fi

FACULTY CHEMISTRY

SUBJECT CARD

Name of subject in Polish:	Separacje przez adsorpcję w biorafinerii
Name of subject in English:	Separations by adsorption in biorefinery
Main field of study (if applicable):	**CHEMICAL AND PROCESS ENGINEERING**
Specialization (if applicable):	**Engineering chemical processes**
Profile:	**academic**
Level and form of studies:	**2nd level, full-time**
Kind of subject:	**obligatory**
Subject code:	…….
Group of courses:	YES – leading course - project

	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)	15	15		60	
Form of crediting	Crediting with grade	Crediting with grade		Exam Report	
For group of courses mark (X) final course				X	
Number of ECTS points	0.5	0.5		2	
including number of ECTS points for practical (P) classes		0.5		2	
including number of ECTS points for direct teacher-student contact (BK) classes	0.65	0.7		0.75	

*delete as applicable

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basics of chemical process engineering and unit operations

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SUBJECT OBJECTIVES

C1 Concept and mathematical treatment of adsorption column dynamics
C2 Design of adsorption-based processes using propagation velocities of concentration waves
C3 Applications of adsorption, ion exchange, and chromatography in biorefining

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge:
PEU_W01 to understand the periodic nature of adsorption-based separation processes (adsorption, ion exchange, chromatography).
PEU_W02 know the operating principles of most important industrial chromatographic separation process configurations.

related to skills:
PEU_U01 have skills to designing adsorption/chromatographic separation processes based on experimental data and theory

PROGRAMME CONTENT		
Lectures		**Number of hours**
Lec 1	Adsorption column dynamics, propagation of concentration waves	5
Lec 2	Ion exchange in biorefining	1
Lec 3	Chromatographic processes and analysis of process performance	5
Lec 4	Industrial chromatography in biorefining	4

Classes		**Number of hours**
Cl 1	Adsorption column dynamics, propagation of concentration waves	5
Cl 2	Chromatographic processes and analysis of process performance	5
Cl 3	Industrial chromatography in biorefining	5

Project		**Number of hours**
Proj 1	Virtual laboratory project on design of adsorption processes	5
Proj 2	Virtual laboratory project on design of chromatographic processes	10

TEACHING TOOLS USED
N1. Lecture with multimedia presentation N2. Virtual laboratories

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
P1	PEU_W01 – PEU_W03	Final test (max. 10 points)
P = 3.0 if the sum of points in the range 50-60%		

3.5 if the sum of points in the range 61-72%
4.0 if the sum of points in the range 73-82%
4.5 if the sum of points in the range 83-92%
5.0 if the sum of points in the range 93-100%
5.5 if the sum of points is 100%, and the student demonstrates the knowledge above the regular material scope

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] Giuochon et al., Fundamentals of preparative and non-linear chromatography, Elsevier 2006
[2] Wankat, Separation Process Engineering, Pearson 2016

SECONDARY LITERATURE:

[1] Schmidt-Traub et al., Preparative Chromatography, Wiley 2020

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

Prof.Tuomo Sainio, tuomo.sainio@lut.fi

FACULTY CHEMISTRY

SUBJECT CARD

Name of subject in Polish:	Separacje przez filtrację w biorafinerii
Name of subject in English:	Separations by filtration in biorefinery
Main field of study (if applicable):	**CHEMICAL AND PROCESS ENGINEERING**
Specialization (if applicable):	**Engineering chemical processes**
Profile:	**academic**
Level and form of studies:	**2nd level, full-time**
Kind of subject:	**obligatory**
Subject code:	…….
Group of courses:	YES – leading course - laboratory

	Lecture	**Classes**	**Laboratory**	**Project**	**Seminar**
Number of hours of organized classes in University (ZZU)	15	15	15	2	
Number of hours of total student workload (CNPS)	15	15	30	60	
Form of crediting	Crediting with grade	Crediting with grade	Report	Report	
For group of courses mark (X) final course			X		
Number of ECTS points	0.5	0.5	1	2	
including number of ECTS points for practical (P) classes		0.5	1	2	
including number of ECTS points for direct teacher-student contact (BK) classes	0.65	0.7	0.7	0.1	

*delete as applicable

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basics of chemical process engineering and unit operations

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SUBJECT OBJECTIVES

C1 Membrane processes for treating different biorefinery streams.
C2 Membrane materials and modules.
C3 Basic phenomena in membrane processes (fouling, concentration polarization, osmotic pressure)

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge:
PEU_W01 to be familiar with fundamentals of solid-liquid separation processes and their applications in biorefining.
PEU_W02 to be familiar with micro-, ultra- and nanofiltration techniques and applications in biorefining.

relating to skills: PEU_U01 have practical experience in operating membrane filtration units with biobased feedstocks

PROGRAMME CONTENT		
Lectures		**Number of hours**
Lec 1	Solid-liquid separation in biorefining	5
Lec 2	Microfiltration and ultrafiltration, applications in biorefining	5
Lec 3	Nanofiltration and applications in biorefining	5
		15h

Classes		**Number of hours**
Cl 1	Solid-liquid separation in biorefining	5
Cl 2	Microfiltration and ultrafiltration, applications in biorefining	5
Cl 3	Nanofiltration and applications in biorefining	5

Laboratory		**Number of hours**
Lab 1	Filtration of dissolved lignocellulosic biomass	15

Project		**Number of hours**
Proj 1	Applications of filtration in biorefining	2
TEACHING TOOLS USED		
N1. Lecture with multimedia presentation N2. Lab equipment		

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

P1	PEU_W01 – PEU_W03	Final test (max. 10 points)
P = 3.0 if the sum of points in the range 50-60% 3.5 if the sum of points in the range 61-72% 4.0 if the sum of points in the range 73-82% 4.5 if the sum of points in the range 83-92% 5.0 if the sum of points in the range 93-100% 5.5 if the sum of points is 100%, and the student demonstrates the knowledge above the regular material scope		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] Mulder, M., Basic Principles of Membrane Technology, 2nd ed., Kluwer, 1996/2003
[2]

SECONDARY LITERATURE:

[1] de Haan & Padding, Process Technology, an introduction, Chapter 12: Membrane Separations, de Gryter 2022

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

Prof.Mari Kallioinen-Mänttäri, mari.kallioinen-manttari@lut.fi

FACULTY OF CHEMISTRY

SUBJECT CARD

Name of subject in Polish	**Oddziaływania na środowisko**
Name of subject in English	**Environmental impact**
Main field of study (if applicable)	Sustainable Biomass and Bioproducts Engineering
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 (excercises)	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	12				
Number of hours of total student workload (CNPS)	30				
Form of crediting	crediting with grade*				
For group of courses mark (X) final course					
Number of ECTS points	1.0				
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)	0.52				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge of basic environmental protection issues
2. Basic knowledge of general chemistry
3. Basic knowledge of chemical engineering

SUBJECT OBJECTIVES

C1 The lecture will equip students with an understanding of the main goals of sustainable development adopted by the United Nations, related to the environment impact

C2 To familiarize students with the consequences of the negative impact of pollution on all components of the natural environment and prevention methods

C3 To familiarize students with new civilization challenges related to the environment protection (water, soil, air), raw materials usage, waste management, energy and climate problems in various sectors of economy

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge:

PEU_W01 The student knows the goals of sustainable development related to environmental issues and methods of their implementation

PEU_W02 The student knows some of the most common environmental impacts – air pollution, water pollution (seas, rivers, groundwater), soil pollution, waste production, damage to ecosystems and loss of biodiversity

PEU_W03 The student knows the future trends aimed at minimizing the negative impact of pollution on humans and the environment

relating to skills:

PEU_U01 The student is able to think critically about the negative impact of pollution on human functioning and the condition of the natural environment

PEU_U02 The student is able to think critically about the solutions used in the prevention of pollution

PEU_U03 The student has the ability to integrate knowledge in the field of environmental protection, chemical engineering, biotechnology, etc.

PEU_U04 The student can acquire knowledge (available literature databases, official websites, etc.) about sustainable development related to environment

relating to social competences:

PEU_K01 The student tries to implement the goals of sustainable development related to environmental issues in everyday life

PEU_K02 The student understands the need for systematic knowledge replenishment

PEU_K03 The student understands the need to apply innovations in environment protection

PEU_K04 The student is aware of the importance of the acquired theoretical knowledge and is ready to put acquired skills into practice

PROGRAMME CONTENT

Lecture		Number of hours
Lec 1	**Introduction to the environmental impact:** Human impact on the environment, Sustainable development, Goals of Sustainable development; Industrial ecology	2
Lec 2	**Water pollution:** Sources of water pollution, Common types of water pollutants, Prevention of water pollution, Wastewater treatment	2
Lec 3	**Biomass in environment protection:** Classes of biorefineries, Impact of agriculture on the environment, Sustainable agriculture, Bio-based products for agriculture	2
Lec 4	**Soil pollution:** Origin of soil pollutants, Soil pollutants, Pesticides, Bioremediation of polluted soil	2
Lec 5	**Air pollution:** Classes of air pollutants, Primary and secondary air pollutants, Air pollution effects, Renewable sources of energy	2
Lec 6	**Test**	2
	Total hours	12

TEACHING TOOLS USED

N1. Lecture with multimedia presentation

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT

Evaluation (F – forming during semester), P – concluding (at semester end)	Learning outcomes code (from subject educational effects)	Way of evaluating learning outcomes achievement
F1		

F2		
F3		
P	PEU_W01; PEU_W02; PEU_W03	Exam at the end of the lecture – test

Test: 30 questions with four answers – a, b, c, d; one correct
Scoring and grades:
28, 29, 30 – grade 5.0
25, 26, 27 – grade 4.5
22, 23, 24 – grade 4.0
19, 20, 21 – grade 3.5
16, 17, 18 – grade 3.0

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] https://sdgs.un.org/goals
[2] Malik, A., Grohmann, E., Environmental Protection Strategies for Sustainable Development, Springer, 2012.
[3] G. Tyler Miller, Scott Spoolman. Living in the Environment, 19th Edition; Cengage Learning 2018.

SECONDARY LITERATURE:

[1] Journal - Environmental Impact Assessment Review; Elsevier
[2] Journal - Sustainable Development; John Wiley & Sons Ltd
[3] Journal - Environment, Development and Sustainability; Springer

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

Izabela Michalak, izabela.michalak@pwr.edu.pl

FACULTY OF CHEMISTRY

SUBJECT CARD

Name of subject in Polish	**Dobre Praktyki Laboratoryjne**
Name of subject in English	**Good Laboratory Practice**
Main field of study (if applicable)	Sustainable Biomass and Bioproducts Engineering
Specialization (if applicable)	----
Profile:	academic
Level and form of studies:	2nd level, full-time
Kind of subject:	obligatory / optional / university-wide
Subject code	…….
Group of courses	NO

	Lecture	Classes (excercises)	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	8		16		
Number of hours of total student workload (CNPS)	15		45		
Form of crediting	Examination / ~~crediting with grade~~*		Examination / crediting with grade*		
For group of courses mark (X) final course					
Number of ECTS points	0.5		1.5		
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)	0.347		0.747		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic principles of chemistry, theoretical and practical.
2. Knowledge in the field of basis of working in the laboratory of chemistry is recommended.

SUBJECT OBJECTIVES

C1 Gaining knowledge on the fundamental principles of GLP.
C2 Acquaintance with the rules of Globally Harmonized System (GHS).
C3 Gaining knowledge in the field of Standard Operating Procedures (SOPs) and quality assurance of the functioning of the laboratory.
C4 Acquaintance with the rules of methods validation and instruments qualification.
C5 Acquiring the ability to present work results.

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge:

PEU_W01 Student gained knowledge in the field of GLP application in the laboratory.
PEU_W02 Student obtained the information about ways of implementing SOPs into the laboratory routine.
PEU_W03 Student gained knowledge on quality assurance of the functioning of the laboratory.

relating to skills:
PEU_U01 Student is able to evaluate the quality of an experimental result.
PEU_U02 Student knows to plan and implement an experiment.
PEU_U03 Student is able to report the results of the work according to GLP.

relating to social competences:
PEU_K01 Student is able to interact in a group and to plan an experiment.
PEU_K02 Student is able to discuss the quality of an experimental result.
PEU_K03 Student works consciously and effectively in a sub-group to searches information and can subject them to critical analysis.

PROGRAMME CONTENT

Lecture		Number of hours
Lec 1	Fundamental points of Good Laboratory Practice (GLP). The role of Environmental Health and Safety Division of OECD. Globally Harmonized System. REACH.	2
Lec 2	GLP principles: test facility organisation and personnel, quality assurance programme, facilities, test systems, test and facilitate items.	2
Lec 3	Rules performing studies: study plan, protocol, Standard Operating Procedures (SOPs). Raw data and data collection (recording, reporting, storage, archiving).	2
Lec 4	Quality assurance: master schedule, inspection plan, quality assurance statement. Validation (a method) vs. qualification (an instrument), accuracy, precision, and sensitivity. Stepwise implementation of GLP.	2
	Total hours	**8**

Laboratory		Number of hours
La1	Equipment Suitability and Calibration.	5
La2	Sampling and quality control of test substance.	5
La3	Accuracy, precision, and sensitivity – in analytical method.	5
La4	Summarizing the laboratory classes, discussion the final report.	1
	Total hours	**16**

TEACHING TOOLS USED

N1. Multimedia presentation.
N2. Practical laboratory classes
N3. Discussion
N4. Consultation.

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT

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

F1	PEU_W01, PEU_W02, PEU_W03	Test of choice.
F2	PEU_U01, PEU_U02,	Tests during each laboratory classes
F3	PEU_U03	Final report
P		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] OECD Principles on Good Laboratory Practice. Revised in 1997. 1998.
[2] Handbook: good laboratory practice (GLP): quality practices for regulated non-clinical research and development - 2nd ed., WHO, 2009.
[3] J. P. Seiler, Good Laboratory Practice — the Why and the How. Springer-Verlag Berlin Heidelberg 2005.
[4] Globally Harmonized System (GHS) of classification and labelling of chemicals. 5th Ed., United Nations, 2013.
[5] Laboratory Quality Standards and their Implementation. WHO, 2011.

SECONDARY LITERATURE:

[1] The application of the GLP principles to short term studies. OECD Series on Principles of GLP and Compliance Monitoring, Number 6 (Revised). 1999.
[2] The application of the GLP principles to short term studies. OECD Series on Principles of GLP and Compliance Monitoring, Number 7 (Revised). 1999.
[3] Chemical Laboratory Safety and Security: A Guide to Developing Standard Operating Procedures. Committee on Chemical Management Toolkit Expansion: Standard Operating Procedures, Board on Chemical Sciences and Technology, Division on Earth and Life Studies. The National Academies Press, Washington, DC, 2016.

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

Izabela Pawlaczyk-Graja, Assoc. Prof., PhD, DSc, Eng. izabela.pawlaczyk@pwr.edu.pl
Jolanta Warchoł, Assoc. Prof., PhD, DSc, Eng. jolanta.warchol@pwr.edu.pl

FACULTY OF CHEMICAL SCIENCE AND TECHNOLOGY

SUBJECT CARD

Name of subject in Polish	Ocena cyklu życia.
Name of subject in English	Life Cycle Assessment
Main field of study (if applicable)	Environmental Impact / Life Cycle Assessment
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 (exercises)	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	10		-	-	-
Number of hours of total student workload (CNPS)	30			-	-
Form of crediting	Crediting with grade (test)		-	-	-
For group of courses mark (X) final course			-		
Number of ECTS points	1	-	-	-	-
including number of ECTS points for practical classes (P)	-	-	-	-	-
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	0.433	-	-	-	-

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Previous knowledge in Chemical Processes/Chemical Engineering and identifying environmental impacts.

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SUBJECT OBJECTIVES

C1 To acquire the basic therorical knowledge about Life Cycle Assesment (LCA)
C2 To identify correctly Goals, Scopes, Uncertainities and Sensitivities for LCA
C3 To apply such theory in specific case studies.
C4 To have skills identifying critical points and bottlenecks in LCA.

SUBJECT EDUCATIONAL EFFECTS

Relating to knowledge:

PEU_W01.- To conceptualize engineering models, apply innovative methods in problem solving and appropriate software applications, for analyzing proscesses under an invironmental point of view. (PEU_W01)

PEU_W02.- To analyze products, processes, systems and services of the chemical or environmental industries, being capable to identify environmental impacts and other aspects needed for the Life Cycle Assessment protocols (PEU_W02).

PEU_W03.- To adapt to changes, being able to apply new and advanced technologies and other relevant developments, with initiative and entrepreneurial spirit. (PEU_W03)

Relating to skills:

PEU_U01.- To be able to identify their own training needs in the field of study of LCA or environmental engineering and to organize their own learning with a high degree of autonomy in all kinds of contexts (structured or unstructured). (PEU_U01)

PEU_U02- To possess the skills of autonomous learning in order to maintain and improve the competences of chemical engineering that allow the continuous development of the profession, being capable to apply to LCA. (PEU_U02)

PEU_U03- To have acquired advanced knowledge and demonstrated an understanding of the theoretical and practical aspects and of the working methodology in the field of LCA with a depth that reaches the forefront of knowledge. (PEU_U03)

PEU_U04- To be able to deal with complex situations or those that require the development of new solutions in the academic, work or professional field of study of Chemical Processes in general and LCA in particular. (PEU_U04)

PEU_U05- To adapt to changes, being able to apply new and advanced technologies and other relevant developments, with initiative and entrepreneurial spirit. (PEU_U05)

Relating to social competences:

PEU_K01- To be able, through arguments or procedures developed and supported by themselves, to apply their knowledge, understanding and problem-solving skills in complex or professional and specialized work environments that require the use of creative or innovative ideas. (PEU_K01)

PEU_K02- To have the ability to collect and interpret data and information on which to base their conclusions including, where necessary and relevant, reflection on social, scientific or ethical issues in the field of LCA. (PEU_K02)

PEU_K03- To know how to communicate to all types of audiences (specialized or not) in a clear and precise way, knowledge, methodologies, ideas, problems and solutions in the field of the study of LCA. (PEU_K03)

PROGRAMME CONTENT		
Lecture		**Number of hours**
Lec 1	Topic 1. Introduction to LCA: History and main Characteristics and Applications.	0.5
Lec 2	Topic 2. LCA Methodology: Goal and Scope definition.	1
Lec 3	Topic 3. Life Cycle Inventory Analysis	1
Lec 4	Topic 4. Life Cycle Impact Assessment	1
Lec 5	Topic 5. Uncertainty Management and Sensitivity Analysis	1
Lec 6	Topic 6. Life Cycle Interpretation	1
Lec 7	Topic 7. LCA Critical Review	1
Lec 8	Topic 8. Costing LCA and Social LCA	1
	Topic LCA of Chemicals and Chemical Products. Case studies.	1
	Topic LCA of Biofuels and Biomaterials. Case studies.	1.5

	Total hours	10h

Laboratory		**Number of hours**
Lab 1		
Lab 2		
Lab 3		
Lab 4		
Lab 5		
…		
	Total hours	-

Project		**Number of hours**
Proj 1		
Proj 2		
Proj 3		
Proj 4		
…		
	Total hours	-

Seminar		**Number of hours**
Semin 1		
Semin 2		
Semin 3		
…		
	Total hours	-

TEACHING TOOLS USED
N1. Lecture with multimedia presentation N2. Practical Case Studies with multimedia presentation.

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT

Evaluation (F – forming during semester), P – concluding (at semester end)	Learning outcomes code (from subject educational effects)	Way of evaluating learning outcomes achievement
F1	E02 (PEU_W01) E03 (PEU_W02) G10 (PEU_W03) MC6 (PEU_U01) G11 (PEU_U02)	Tests including theory from Lectures and practical questions analogous to the case study activities done in Classes (0-10)

	MC1 (PEU_U03) MC4 (PEU_U04) G10 (PEU_U05) MC2 (PEU_K01) MC3 (PEU_K02) MC5 (PEU_K03)	
P = F1 test at the end of the classes.		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] Hauschild, M.Z.; Rosenbaum, R. K. and Olsen, S.I. *Life Cycle Assessment. Theroy and Practice.* Springer. ISBN 978-3-319-56474-6. (2018)

[2] Grahl, B. and Klöpffer, W. *Life Cycle Assessment (LCA): A Guide to Best Practice.* Wiley. ISBN: 3527329862 (2014).

[3] Saade-Sbeih, M.; Jolliet, A.; Shaked, S.; Crettaz, P. and Jolliet, O. *Environmental Life Cycle Assessment.* CRC Press. ISBN 9781439887660 (2015).

SECONDARY LITERATURE:

[4] Passarini, F. and Ciacci, L. *Life Cycle Assessment (LCA) of Environmental and Energy Systems*. Energies. ISSN 1996-1073 (2021)

[5] Curran, M.A. *Life Cycle Assessment Handbook: A Guide for Environmentally Sustainable Products*. Scrivener Publishing LLC. ISBN:9781118099728 (2012).

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

Francisco Javier Ramos (Javier.Ramos@uclm.es)

FACULTY OF CHEMISTRY

SUBJECT CARD

Name of subject in Polish	Waloryzacja bioproduktów i gospodarka odpadami
Name of subject in English	**Bioproducts valorization and waste management**
Main field of study (if applicable)	
Specialization (if applicable)	----
Profile:	academic
Level and form of studies:	2nd level, full-time
Kind of subject:	**obligatory**
Subject code	…….
Group of courses	YES – leading course - LABORATORY

	Lecture	Classes (excercises)	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15		18		7
Number of hours of total student workload (CNPS)	45		54		21
Form of crediting	crediting with grade*		crediting with grade*		crediting with grade*
For group of courses mark (X) final course			X		
Number of ECTS points	1.5		1.8		0.7
including number of ECTS points for practical classes (P)			1.8		0.7
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	0.65		0.84		0.327

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. NONE
2.
3.

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SUBJECT OBJECTIVES

C1 Understanding the fundamental aspects of the Enviromental Managment System
C2 Acquiring abilities on the use of a software tool for Life Cycle Assessment
C3 Understanding the current trends in waste valorization
C4 Understanding the concepts for producing high-valued bioproducts

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge:
PEU_ 1 Introduction to Environmental Management System
PEU_ 2 Valorization of solid wastes
PEU_ 3 Practical operation of waste valorization
PEU_ 4 Basic knowledge for using a software tool to carry out the LCA

relating to skills:
PEU_U01 Capacity for critical thinking and decision making

PEU_U02 Synthesis capacity
PEU_U03 Ability to analyze and solve problems
PEU_U04 Ability to learn and work autonomously
PEU_U05 Ability to apply theoretical knowledge to practice
…
relating to social competences:
PEU_K01 Ability to work in group
PEU_K02 Ability for getting common objectives
PEU_K03 Leader skills

PROGRAMME CONTENT

Lecture		**Number of hours**
Lec 1	Environmental Managment System (EMS)	4
Lec 2	Solid Waste Valorization	2
Lec 3	Alternative biobased chemical precursors	1
Lec 4	Synthesis of bioproducts (biopolyols, biopolyurethane foams and biolubricants)	1
Lec 5	Lignin valorization	7
	Total hours	15

Classes		**Number of hours**
Cl 1		
Cl 2		
Cl 3		
..		
	Total hours	

Laboratory		**Number of hours**
Lab 1	Software tool for Life Cycle Assessment	10
Lab 2	Epoxidation of grape seed oil	4
Lab 3	Epoxide ring-opening and bioPU formation	4
…		
	Total hours	18

Project		**Number of hours**
Proj 1		
Proj 2		
Proj 3		
…		
	Total hours	

Seminar		**Number of hours**
Semin 1	Application of the Environment Managment System	6
Semin 2	Seminar about Valorization of Lignin wastes	1
	Total hours	7

TEACHING TOOLS USED
N1. Lecture with multimedia presentation N2. Case Based Learning N3. Computational classes N4. Practical laboratory classes

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT

Evaluation (F – forming during semester), P – concluding (at semester end)	Learning outcomes code (from subject educational effects)	Way of evaluating learning outcomes achievement
F1	PEU_U01 PEU_U02 PEU_U03 PEU_U04 PEU_U05 PEU_K01 PEU_K02 PEU_K03	Seminar Group Report (30 %)
F2	PEU_K01 PEU_K02 PEU_3 to PEU_4	Laboratory Group Report (30 %)
P1	PEU_1 to PEU_2	Test Exam/Short Questions about Lectures (40 %)

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] I. V. Muralikrishna and Valli Manickam. Environmental Management: Science and Engineering for Industry. Ed. Butterworth-Heinemann 2017. ISBN-13: 978-012811989

[2] Elena Crstina Rada. Waste Management and Valorization. Ed. Apple Academic Press. 2016. Ebook ISBN: 9781315365251. https://doi.org/10.1201/b19941

[3] Development of biomaterials from renewable resources; Thesis, Juan Carlos de Haro Sánchez, 2018

[4] Chemicals and materials from renewable resources / Joseph J. Bozell, editor. Washington, D.C. : American Chemical Society, cop. 2001.

SECONDARY LITERATURE:

[1] https://www.epa.gov/saferchoice/integrated-environmental-management-systems-iems-implementation-guide

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FACULTY CHEMISTRY

SUBJECT CARD

Name of subject in Polish:	Modele biznesowe i analiza rynkowa LUT
Name of subject in English:	Business models and market analysis LUT
Main field of study (if applicable):	**CHEMICAL AND PROCESS ENGINEERING**
Specialization (if applicable):	**Engineering chemical processes**
Profile:	**academic**
Level and form of studies:	**2nd level, full-time**
Kind of subject:	**obligatory**
Subject code:	…….
Group of courses:	YES – leading course - PROJECT

		Classes	**Laboratory**	**Project**	**Seminar**
Number of hours of organized classes in University (ZZU)		15		2	
Number of hours of total student workload (CNPS)		15		60	
Form of crediting		Crediting with grade		Report	
For group of courses mark (X) final course				X	
Number of ECTS points		0.5		2	
including number of ECTS points for practical (P) classes		0.5		2	
including number of ECTS points for direct teacher-student contact (BK) classes		0.7		0.1	

*delete as applicable

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basics of chemical process engineering

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SUBJECT OBJECTIVES

C1 Basic concepts of financial analysis and business plan
C2 Ability to study a previously unknown product or market

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge:
PEU_W01 making an economic forecast and a business plan of a business project in the chemical sector
PEU_W02 tools for financial analysis
PEU_W03 different SWOT analysis approaches to a chosen business case

PROGRAMME CONTENT

Classes		Number of hours
Cl 1	Financial analysis tools	5
Cl 2	Value proposition and business plan	5
Cl 3	SWOT analysis methods	5
	Total hours	15h

Project		Number of hours
Proj1	Building a business canvas for a biorefinery project	2
	Total hours	15h

TEACHING TOOLS USED
N1. Lecture with multimedia presentation

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
P1	PEU_W01 – PEU_W03	Final test (max. 10 points)

P = 3.0 if the sum of points in the range 50-60%
3.5 if the sum of points in the range 61-72%
4.0 if the sum of points in the range 73-82%
4.5 if the sum of points in the range 83-92%
5.0 if the sum of points in the range 93-100%
5.5 if the sum of points is 100%, and the student demonstrates the knowledge above the regular material scope

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] Sillanpää & Ncibi, A Sustainable Bioeconomy: The Green Industrial Revolution, Springer, 2017

SECONDARY LITERATURE:

[1] Lynd et al., Strategic Biorefinery Analysis: Analysis of Biorefineries, NREL 2005

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

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FACULTY CHEMISTRY

SUBJECT CARD

Name of subject in Polish:	Modele biznesowe i analiza rynkowa UCLM
Name of subject in English:	Business models and market analysis UCLM
Main field of study (if applicable):	**CHEMICAL AND PROCESS ENGINEERING**
Specialization (if applicable):	**Engineering chemical processes**
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)	15				
Number of hours of total student workload (CNPS)	15				
Form of crediting	Crediting with grade				
For group of courses mark (X) final course					
Number of ECTS points	0.5				
including number of ECTS points for practical (P) classes					
including number of ECTS points for direct teacher-student contact (BK) classes	0.65				

*delete as applicable

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basics of chemical process engineering

\

SUBJECT OBJECTIVES

C1 Basic concepts of financial analysis and business plan
C2 Ability to study a previously unknown product or market

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge:
PEU_W01 making an economic forecast and a business plan of a business project in the chemical sector
PEU_W02 tools for financial analysis
PEU_W03 different SWOT analysis approaches to a chosen business case

PROGRAMME CONTENT		
Lectures		**Number of hours**
Lec 1	The multidimensional impact of bioeconomy on Europe	1
Lec 2	Characteristics and implementation of bioeconomy	2
Lec 3	Value proposition	2
Lec 4	Business Plan	3
Lec 5	Economic evaluation	3
Lec 6	SWOT analysis principle and various methods	2
Lec 7	Business canvas	2
	Total hours	15h

TEACHING TOOLS USED
N1. Lecture with multimedia presentation

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
P1	PEU_W01 – PEU_W03	Final test (max. 10 points)

P = 3.0 if the sum of points in the range 50-60%
3.5 if the sum of points in the range 61-72%
4.0 if the sum of points in the range 73-82%
4.5 if the sum of points in the range 83-92%
5.0 if the sum of points in the range 93-100%
5.5 if the sum of points is 100%, and the student demonstrates the knowledge above the regular material scope

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] Sillanpää & Ncibi, A Sustainable Bioeconomy: The Green Industrial Revolution, Springer, 2017

SECONDARY LITERATURE:

[1] Lynd et al., Strategic Biorefinery Analysis: Analysis of Biorefineries, NREL 2005

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

Prof. Tuomo Sainio, tuomo.sainio@lut.fi, F.J. Fernandez, I. Gracia (UCLM)

FACULTY OF CHEMISTRY

SUBJECT CARD

Name of subject in Polish	Bezpieczeństwo chemiczne
Name of subject in English	Chemicals safety
Main field of study (if applicable)	Sustainable Biomass and Bioproducts Engineering
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 (excercises)	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	12				
Number of hours of total student workload (CNPS)	30				
Form of crediting	Crediting with grade*				
For group of courses mark (X) final course					
Number of ECTS points	1				
including number of ECTS points for practical classes (P)					
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	0.52				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Fundamental knowledge of classification and physical/chemical characteristics of natural products and biomass
2. Fudamental knowledge about green chemistry and biomass processing
3. Basic skills for the use of applications for smart-phones and/or tablets and/or personal computers.

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SUBJECT OBJECTIVES

C1 Providing essential know-how about hazards and risks related to the management, handling, transport and disposal of potentially hazardous chemical and biological substances

C2 Raising awareness on the potential risks related to the handling, management and processing of biomass-related chemicals

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge:

PEU_W01: Attendees will gain expertise on the safe, secure and healthy management of potentially hazardous chemicals

PEU_W02: Attendees will be able to identify and classify hazardous substances according to their risks to human health and environment

PEU_W03: Attendees will develop preparedness in facing and managing emergency situations involving hazardous chemical and biological materials during biomass processingPEU_W04: Attendees will gain knowledge about international guidelines and

regulations for the assessment of chemical risk in laboratories, small production sites and industrial facilities.

relating to skills:

PEU_U01: Attendees will gain know-how in the use of applications for smartphones and software computer devices for the evaluation of risks related to chemical and biological hazardous materials

PEU_U02

…

relating to social competences:

PEU_K01: Attendees will enhance their ethical approach towards a sustainable and safe Chemistry in working environments

PEU_K02

PROGRAMME CONTENT

	Lecture	**Number of hours**
Lec 1	Definition and assessment of chemical and biological risks. Safety and Security issues. Overview on international and EU regulations.	2
Lec 2	Identification, classification and management of chemical hazard (Global Harmonized System and Safety Data Sheets)	2
Lec 3	Planning and organization of key actions in incidents involving hazardous materials	2
Lec 4	Hazards to humans and the environment connected with biomass and bioproducts. New trends towards a safer Chemistry.	2
Lec 5	Management of hazardous waste products deriving from biomass processing. New strategies for a lower impact.	2
Lec 6	Chemical plant safety audits and layers of protection analysis	2
	Total hours	12

TEACHING TOOLS USED

N1. Lecture with PPT and multimedia presentations.
N2. Interactive session with the use of students' individual devices (smartphone or tablet or presonal computer)
N3.

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT

Evaluation (F – forming during semester), P – concluding (at semester end)	Learning outcomes code (from subject educational effects)	Way of evaluating learning outcomes achievement
F1	PEU_W01 PEU_W03 PEU_W04	Test at the end of 6-classes package
F2	PEU_W02 PEU_U01	Report on the emergency response to a simulated incident scenario
F3		
P		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] F. Benolli, V. Dal Santo, S. Econdi, C. Evangelisti, A. M. Ferretti, M. Guidotti, L. Polito, M. C. Ranghieri, R. Soave, Handbook Chemical and Biological Waste Management. 2019. ISBN: 9788890756955 https://www.academia.edu/56230250/Handbook_Chemical_and_Biological_Waste_Management (freely downloadable)
[2] Emergency Response Guidebook (ERG), 2020 Edition, https://www.phmsa.dot.gov/hazmat/erg/emergency-response-guidebook-erg (freely downloadable)
[3] World Health Organization. Promotion of Chemical Safety Unit, Hazardous chemicals in human and environmental health, 2000. https://apps.who.int/iris/handle/10665/66161 (freely downloadable)
[4]

SECONDARY LITERATURE:

[1] N. Langerman, ACS Chem. Health Saf. 2020, 27, 346−351.
[2] Bretherick's Handbook of Reactive Chemical Hazards, Eighth Edition, Elsevier, 2017. ISBN: 978-0-08-100971-0
[3]

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

Dr Matteo Guidotti, CNR SCITEC National Research Council, Milan, Italy
Dr Rohan Perera, OPCW, Sri Lanka

FACULTY OF CHEMISTRY

SUBJECT CARD

Name of subject in Polish	**Metodologia badań naukowych**
Name of subject in English	**Research Methodology**
Main field of study (if applicable)	Sustainable Biomass and Bioproducts Engineering
Specialization (if applicable)	----
Profile:	academic
Level and form of studies:	2nd level, full-time
Kind of subject:	obligatory
Subject code	…….
Group of courses	YES – leading course - project

	Lecture	Classes (excercises)	Laboratory	Project (P)	Seminar (S)
Number of hours of organized classes in University (ZZU)	6			**18**	
Number of hours of total student workload (CNPS)	15			45	
Form of crediting	crediting with grade*			crediting with grade*	
For group of courses mark (X) final course				X	
Number of ECTS points	0.5			1.5	
including number of ECTS points for practical classes (P)				1.5	
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	0.26			0.90	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge on research problem solving.
2. Basic knowledge of mathematical calculations, linear algebra.
3. Basic ability to use spreadsheet software.
4. Basics of statistics.

SUBJECT OBJECTIVES

C1 Acquainting the student with the strategies of defining the research problem, planning the experiment, and data collecting.

C2 Acquainting the student with possibilities of mathematical models utilization in experiment optimization – including analysis, interpretation of data, and methods of presentation of them.

C3 Getting acquainted with the methodology of preparation of research project (topic selection, analysis of the current state of knowledge, collection of data, data processing and presentation, interpretation, drawing conclusions, etc.).

C4 Getting acquainted with the possibilities of using *Statistica* software in the statistical analysis of the obtained research results (selection of statistical test, correlations, data modeling, data visualization, descriptive statistics etc.).

C5 Getting acquainted with the structure of a scientific publication and the methodology of its preparation.

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge:

PEU_W01 Student gained knowledge in the field of strategies of defining research problems, planning an experiment, and data collecting, according to *Design Thinking* process.
PEU_W02 Student has information about data analysis methods with aid of statistics.
PEU_W03 Student gained knowledge on possibilities of mathematical models utilization in experiment optimization – including analysis, interpretation of data, and methods of presentation of them.

relating to skills:

PEU_U01 Student is able to prepare research project/scientific publication.
PEU_U02 Student is able to choose the appropriate database of research articles in order to collect the required literature.
PEU_U03 Student is able to perform statistical analysis of the obtained results – application of the correct statistical tests to analyze, model and visualize the results.
PEU_U04 Student is able to correctly plan the experiment (RSM).
PEU_U05 Student is able to discuss and summarize the obtained results as well as present them in the form of summary multimedia presentation.

relating to social competences:

PEU_K01 Student is aware of the importance of the acquired practical knowledge and is ready to put this skill into practice (e.g., preparation of scientific publication, Master thesis, etc.).
PEU_K02 Student understands the need for systematic knowledge replenishment.
PEU_K03 Student works consciously and effectively in a sub-group during performing the data collection and results processing.
PEU_K04 Student is able to interact in a group and to discuss on a complex research problem.

PROGRAMME CONTENT

Lecture		**Number of hours**
Lec 1	Introduction to Research Methodology: research problem, research design, methods of data collection and presentation. *Design Thinking* process.	2
Lec 2	Methods of experimental data processing and its analysis. Confidence intervals and statistical hypothesis testing. Data distribution and its utilization. Descriptive data analysis.	2
Lec 3	Correlation analysis of experimental data. Methodology of an experiment design. The research report.	2
Total hours		6
Project		**Number of hours**

Proj 1	Idea of a research project (task, publication); searching for articles in databases; construction of a scientific article; searching for information in an article; interpretation of results in a scientific article	2
Proj 2	Statistical analysis – Introduction to the statistical analysis; Parametric and nonparametric tests for comparison of two groups	3
Proj 3	Statistical analysis – Usage of ANOVA tests in data analysis; Nonparametric tests for comparison of more than two groups	3
Proj 4	Statistical analysis – Correlation analysis; Simple and Multiple Linear Regression models	3
Proj 5	Methods of experiment planning; Determination of the independent variables; Preparation of the experimental matrix; Response surface methodology (RSM)	2
Proj 6	Summary short project. Comprehensive development of the scientific publication framework (suggested database analysis, assessment of data complexity, proposals for experimental methodology, data analysis and results presentation)	2
Total hours		18

TEACHING TOOLS USED
N1. Multimedia presentation N2. Computational classes – computer and the use of *Excel* and *Statistica* software

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT

Evaluation (F – forming during semester), P – concluding (at semester end)	Learning outcomes code (from subject educational effects)	Way of evaluating learning outcomes achievement
P	PEU_W01 – W03	test from theoretical part
F2	PEU_W01 – PEU_W03 PEU_U01-U05	project implementation/multimedia presentation

F2 - mean from 4 elements:
1. Task – Statistical analysis in prepared project
2. Task – Experiment planning in prepared project
3. Task – Evaluation of the project (selection of databases, publications, research methods, interpretation of results, summary)
4. Task – Multimedia presentation

Grades:
3.0 – 3.25 – grade 3.0
3.26 – 3.75 – grade 3.5
3.76 – 4.25 – grade 4.0
4.26 – 4.75 – grade 4.5
4.76 – 5.0 – grade 5.0

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] N. Walliman, Research Methods The Basics. Taylor & Francis e-Library, 2011.
[2] P. Pandey, M. M. Pandey, Research Methodology: Tools And Techniques. Bridge Center, 2015.
[3] L. Rogers, D. Willoughby, Numbers: data and statistics for the non-specialist, HarperCollins Publishers, London, 2013.
[4] R. Larson, B. Farber, Elementary Statistics. Picturing the World. Pearson, 7th edition, 2018.

SECONDARY LITERATURE:

[1] C. Mueller-Roterberg, Handbook of Design Thinking. Tips & Tools for how to design thinking. Independently published, ISBN-10 : 1790435374, 2018.
[2] M. Vianna, Y. Vianna, I. K. Adler, B. Lucena, B. Russo, Design Thinking. Business Innovation. MJV Tecnologia ltda, 2011.
[3] C. F. J.Wu, M. Hamad, Experiments: Planning, Analysis, and Parameter Design Optimization, John Wiley & Sons, Inc., New York, 2000.

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Izabela Pawlaczyk-Graja, Assoc. Prof., PhD, DSc, Eng., izabela.pawlaczyk@pwr.edu.pl

FACULTY CHEMISTRY

SUBJECT CARD

Name of subject in English:	**Knowledge Management and Communication Skills**
Main field of study (if applicable):	Sustainable Biomass and Bioproducts Engineering
Specialization (if applicable):	**Engineering chemical processes**
Profile:	A**cademic**
Level and form of studies:	**2nd level, full-time**
Kind of subject:	**obligatory**
Subject code:	…….
Group of courses:	YES – leading course - lecture

	Lecture	**Classes**	**Laboratory**	**Project**	**Seminar**
Number of hours of organized classes in University (ZZU)	11			5	14
Number of hours of total student workload (CNPS)	33			15	42
Form of crediting	crediting with grade			crediting with grade	crediting with grade
For group of courses mark (X) final course	X				
Number of ECTS points	**1.1**			0.5	1.4
including number of ECTS points for practical (P) classes				0.5	1.4
including number of ECTS points for direct teacher-student contact (BK) classes	0.477			0.25	0.653

*delete as applicable

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. B2 english level: user can communicate easily and spontaneously in a clear and detailed manner.
2. Basic knowledge of computer tools.

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SUBJECT OBJECTIVES

relating to knowledge:

C1 Learn the use of the scientific information tools
C2 Develop the communication abilities: verbal and non-verbal
C3 Learn the fundamentals of the Project Management
C4 To be able to perform the managing tasks of a chemical engineer board

relating to skills:

C5 To direct and manage environmental and/or energy activities.
C6 To be able to communicate using different media

relating to social competences:

C7	To lead and define multidisciplinary teams capable of solving technical changes and management needs in national and international contexts

SUBJECT EDUCATIONAL EFFECTS

related to knowledge:

PEU_W01student knows and are able to use the basis scientific information tools: Scifinder, Scopus, Mendley, Spacenet

PEU_W02 student knows the peculiarities and is able to elaborate technical reports, scientific articles, Thesis, patents and other technical documents.

PEU_W03 student can plan, organize and deliver a talk, debate or a class in the field of material production or chemical engineering

PEU_W04 student has knowledge about the fundamentals of the management of a project for the construction of a commercial plant for bioproduct production.

PROGRAMME CONTENT

Lectures		**Number of hours**
Lec 1	Introduction to the management of knowledge. Scientific Databases: Scifinder and Scopus, Types of Technical Documents, The Scientific Journals, open access.	1
Lec 2	Formal characteristics of scientific articles. The preparation of articles. Formalities of technical reports. MsWord and Mendeley tools for scientific writing.	1
Lec 3	Preparation and delivery of effective presentations.	1
Lec 4	The intellectual property protection. basic Key points of the international patent regulations.	1
Lec 5	Interpersonal communication and management skills: including teamwork, group roles, leading and facilitating groups, project management and international communication.	1
Lec 6	Job Search: Job sources, self-knowledge, interviewing,	1
Lec 7	Funding Strategies for Research Projects. Sources for funding. Conceptualization, planning and execution of a research project	1
Lec 8	Directive function for Project Management	2
Lec 9	Project Management Tools	2

Classes		**Number of hours**
Proj 1		
Proj 2		
Proj 3		

Proj 4		

Laboratory		Number of hours
Proj 1		
Proj 2		
Proj 3		
Proj 4		

Project		Number of hours
Proj 1	Case of Study for Project Managenment	5
Proj 2		
Proj 3		
Proj 4		

Seminar		Number of hours
Proj 1	Training on the use of Scientific Databases: Scifinder and Scopus, for searching information about the subject of the course project.	2
Proj 2	Seminar about the use of Mendeley tools for citation in scientific writing.	2
Proj 3	Preparation of a preliminar presentations about the subject elected for the group project	2
Proj 4	Analysis of the intellectual property situation of the elected project: Novelty and previous protection.	2
Proj 5	Debate league and role play as tool to improve the communication skills	2
Proj 6	CV writing and job interview	2
Proj 7	Presentation about the advancements in the elaboration of the group research project	2

TEACHING TOOLS USED
N1. Lecture with multimedia presentation

N2. Software on-line for literature finding
N3. Software Tool for scientific citation
N4. Presentations, interviews, role game, performed by students
N5. Talks and discussion with experts

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_W01 – PEU_W04	Individual or Group Work (apro. 1 per lesson) (max. 7 points). It is mandatory to present at least the 80 % of the works proposed.
P2	PEU_W01 – PEU_W04	Writen Research Report and Report Presentation. (max. 3 points)
The final mark will be the sum of both values, that is, the continuous learning evaluation (7/10)and the final report (3/10) with a maximum of 10 points.		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] Writing Scientific Research Articles. Strategy and Steps, Margaret Cargill and Patrick O'Connor, John Wiley & Sons, Ltd., 2009. ISBN 978-1-4051-8619-3
[2] Research Methodology– Contemporary Practices, Md. Mamun Habib, Bishwajit Banik Pathik and Hafsa Maryam, Cambridge Scholars, Newcastle upon Tyne, ISBN (10): ISBN 978-1-84920-300-5
[3] The Complete Presentation Skills Handbook, Suzy Siddons, Kogan Page Limited, 2008, London, United Kingdom, ISBN 978 0 7494 5037 3
[4] Antonio de Lucas Martínez (Dir.) Francisco Jesús Fernández Morales (Coord.) Jesús David Sánchez de Pablo González del Campo (Coord.) Ignacio Gracia Fernández (Coord.) Bases de economía para la función directiva del ingeniero químico Ediciones de Castilla-La Mancha ISBN: 978-84-9044-232-6

SECONDARY LITERATURE:

[1]

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

JUAN FRANCISCO RODRÍGUEZ, juan.rromero@uclm.es

FACULTY CHEMISTRY

SUBJECT CARD

Name of subject in English:	Design and optimization of experiments
Main field of study (if applicable):	**CHEMICAL AND PROCESS ENGINEERING**
Specialization (if applicable):	**Engineering chemical processes**
Profile:	**academic**
Level and form of studies:	**2nd level, full-time**
Kind of subject:	**obligatory**
Subject code:	…….
Group of courses:	YES – leading course - project

	Lecture	**Classes**	**Laboratory**	**Project**	**Seminar**
Number of hours of organized classes in University (ZZU)	15	15		**2**	
Number of hours of total student workload (CNPS)	15	15		90	
Form of crediting	Crediting with grade	Crediting with grade		Report	
For group of courses mark (X) final course				X	
Number of ECTS points	0.5	0.5		3	
including number of ECTS points for practical (P) classes		0.5		3	
including number of ECTS points for direct teacher-student contact (BU) classes	0.65	0.7		0.1	

*delete as applicable

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Engineering mathematics
2. Basics of technical computing

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SUBJECT OBJECTIVES

C1 Concept of design of experiments
C2 Origin and mitigation of uncertainty in experiments
C3 Factorial design methods and analysis of variance

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge:
PEU_W01 understand the importance of designed experiments.
PEU_W02 effective experimentation, and regression analysis and basic analyses of variance (ANOVA).
PEU_W03 optimization of an engineering process using design of experiments and data analysis

PROGRAMME CONTENT		
Lectures		**Number of hours**
Lec 1	Importance of experimental design	2
Lec 2	Minimization of prediction uncertainty of regression models.	4
Lec 3	Basic factorial designs: 2N, Central Composite designs for regression analysis. Screening designs.	6
Lec 4	Experimental optimization of industrial processes.	3

Classes		**Number of hours**
Cl 1	Minimization of prediction uncertainty of regression models.	5
Cl 2	Basic factorial designs: 2N, Central Composite designs for regression analysis. Screening designs.	5
Cl 3	Experimental optimization of industrial processes.	5

Project		**Number of hours**
Proj 1	Design of experiments	2

TEACHING TOOLS USED
N1. Lecture with multimedia presentation N2. Group assignment N3. Computer simulations

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
P1	PEU_W01 – PEU_W03	Final test (max. 10 points)

P = 3.0 if the sum of points in the range 50-60%
3.5 if the sum of points in the range 61-72%
4.0 if the sum of points in the range 73-82%
4.5 if the sum of points in the range 83-92%
5.0 if the sum of points in the range 93-100%
5.5 if the sum of points is 100%, and the student demonstrates the knowledge above the regular material scope

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] Box et al., Statistics for Experimenters, Wiley 2005, 2nd Edition.
[2] Montgomery, D. C.: Design and Analysis of Experiments, Wiley 2013, 8th Edition.

SECONDARY LITERATURE:

[1] Lecture notes and other material from the lecture

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

Prof. Satu-Pia Reinikainen, satu-pia.reinikainen@lut.fi

FACULTY CHEMISTRY

SUBJECT CARD

Name of subject in Polish:	Język hiszpański podstawowy i kultura regionalna
Name of subject in English:	Basic Spanish language and local culture
Main field of study (if applicable):	**Sustainable Biomass and Bioproducts Engineering**
Specialization (if applicable):	**-**
Profile:	**academic**
Level and form of studies:	**2nd level, full-time**
Kind of subject:	**elective**
Subject code:	JZL100990C / JZL100991P
Group of courses:	YES – leading course - CLASSES

	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		Crediting with grade		Crediting with grade	
For group of courses mark (X) final course		X			
Number of ECTS points		2		1	
Including number of ECTS points for practical (P) classes		2		1	
Including number of ECTS points for direct teacher-student contact (BU) classes		1.4		0.75	

*delete as applicable

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

Good English skills

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SUBJECT OBJECTIVES

C1 Basics of Spanish language

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge:

PEU_W01 knowing the vocabulary and phrases for common everyday situations

PEU_W02 ability to talk about oneself and understand basic questions

PEU_W03 student develops a basic knowledge of speaking and listening skills in Spanish language.

PEU_W04 student knows the cultural and social evolution in Poland and Lower Silesia region and our main traditions

PEU_W05 student knows the natural and cultural places of the Lower Silesia region

PROGRAMME CONTENT

Classes		Number of hours
Zaj. 1	Principles of class work and credit requirements. Learning the phonetic system of Spanish. Basic phrases useful to use in class.	2
Zaj. 2	Basic phrases useful during a visit to Spain. The main number up to 10. Famous people of Spanish origin. Spanish surnames and first names. The origins of Spanish words.	2
Zaj. 3	Phrases useful for giving basic information about yourself and your reasons for learning Spanish. Central and South America - countries and capitals, beauty of landscapes, mosaic of cultures. International vocabulary.	2
Zaj. 4	First contacts. Making acquaintances at a conference (formal and informal style), topics of conversation at the first meeting: country and place of birth, asking how you feel, phrases of politeness, language skills, asking about the place of speech.	2
Zaj. 5	Asking for phone number, email address, place of residence. I have an interesting job: occupation and place of work. Basic personal information (short self-presentation) and presentation of other people.	2
Zaj. 6	Jobs, professions and characteristics of different kinds of professions, studies, department names. Fields of study, thesis topics. Work environment: basic activities performed at work.	2
Zaj. 7	My family. Family members. Work environment.	2
Zaj. 8	Describing the appearance and character of people, marital status. Main numbers up to 100.	2
Zaj. 9	Months and dates. Traveling in Spain: modes of transportation, types of tickets, interesting facts about moving through the city.	2
Zaj. 10	Food. Basic foods (including Spanish). Frequency of activities. Basic units of weight and capacity (ton, kilogram, gram, liter).	2
Zaj. 11	Shopping at the market: fruits, vegetables, basic phrases. The prime number to a million. Shopping in a supermarket, asking about the price. Operations on numbers up to a million.	2
Zaj. 12	In a bar, ordering a small food meal (tapas) and drinks - Spanish customs. Units of time, telling the time, time of day.	2
Zaj. 13	Meals, in a restaurant, typical Spanish food, eating habits, asking for a meal.	2
Zaj. 14	Description of the city (with example of Seville), sightseeing in Seville, historical monuments. Sides of the world.	2

Zaj. 15	Assessment test. Visiting Spanish-speaking countries.	2
	Total hours	30

Project		**Number of hours**
Proj 1	Practical classes in polish natural districts (recreational and tourist activities, e.g. hiking, cycling, skiing)	5
Proj 2	Get familiar with regional culture (visit to a museum, theatre, philharmonic, etc.)	5
Proj 3	Practical classes of regional cuisine (workshops on preparing regional dishes, e.g. dumplings, stuffed cabbage, etc.)	5
	Total hours	15

TEACHING TOOLS USED
N1. Practical language classes N2. Practical classes in natural/ historical places. N3. Activities based on projects

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_W01 – PEU_W04	Final test = 10 points
F2	PEU_W04 – PEU_W05	Reports = 10 points
P P = 3.0 if the sum of points in the range 50-60% 3.5 if the sum of points in the range 61-72% 4.0 if the sum of points in the range 73-82% 4.5 if the sum of points in the range 83-92% 5.0 if the sum of points in the range 93-100% 5.5 if the sum of points is 100%, and the student demonstrates the knowledge above the regular material scope		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

1. ¡Nos vemos! 1, podręcznik i zeszyt ćwiczeń, autorzy: E. M. Lloret, R. Ribas, B. Wiener, M. Görrissen, M. Häuptle-Barceló, P. Pérez Cañizares, Difusión

SECONDARY LITERATURE:

1. L. Aragonés, R. Palencia, Gramática de uso del español. Teoría y práctica A1-A2, SM
2. J. Fernández, R. Fernández Jódar, X. Pascual López, Gramatyka języka hiszpańskiego, A1, A2, B1, Draco
3. M. Baralo, M. Genís, Mª Eugenia Santana, Vocabulario. Nivel elemental A1-A2, Anaya
4. A. Bitton, 3 por uno A1. Repasa, Edelsa
5. A. Kowalewska, Hiszpański nie gryzie, A1-A2, Edgard
6. Wirtualne Środowisko Nauki (www.wsn.sjo.pwr.edu.pl): Język ogólny: język hiszpański A1 - materiały do samodzielnej pracy; Język specjalistyczny: język hiszpański A1 – materiały do pracy na lektoratach i materiały do samodzielnej nauki.

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

Magdalena Zalewska (magdalena.zalewska@pwr.edu.pl)
dr hab. inż. Jolanta Warchoł, prof. uczelni (jolanta.warchol@pwr.edu.pl)

FACULTY OF CHEMISTRY

SUBJECT CARD

Name of subject in Polish	Filozofia nauki
Name of subject in English	Philosophy of Science
Main field of study (if applicable)	Sustainable Biomass and Bioproducts Engineering
Specialization (if applicable)	----
Profile:	academic
Level and form of studies:	2nd level, full-time
Kind of subject:	obligatory / optional / university-wide
Subject code	…….
Group of courses	NO

	Lecture	Classes (exercises)	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15				
Number of hours of total student workload (CNPS)	30				
Form of crediting	crediting with grade*				
For group of courses mark (X) final course					
Number of ECTS points	1				
including number of ECTS points for practical classes (P)					
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	0.65				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic humanistic knowledge.

SUBJECT OBJECTIVES

C1 To acquaint students with major philosophical issues concerning science.
C2 To raise students' awareness of the social role and responsibility of scientists.
C3 To help students improve their critical thinking skills.

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge:

PEU_W01 [P7S_WK3]: Knows and understands the fundamental dilemmas of modern civilization.

relating to skills:

PEU_U01 [P7S_UU] Is able to autonomously plan and implement personal lifelong learning and direct others in this area.

relating to social competences:
PEU_K01 [P7S_KK1]: Is ready to critically evaluate received information.
PEU_K02 [P7S_KK2]: Is ready to recognize the value of knowledge in solving cognitive and practical problems and to seek expert advice when having difficulty solving a problem independently

PROGRAMME CONTENT		
Lecture		**Number of hours**
Lec 1	Introduction to the philosophy of science.	1
Lec 2	Defining science: The concept of science in a historical perspective. Contemporary ideal of science. Science – one or many?	2
Lec 3	In search of the scientific method: Inductivism, verificationism and falsificationism; their problems and merits.	2
Lec 4	Theories of scientific development	2
Lec 5	The problem of pseudosciences. Revised approach to the demarcation problem.	2
Lec 6	Bad science: Scientific misconduct and scientific fraud.	2
Lec 7	Contemporary academic environment and its impact on the development of science.	2
Lec 8	Science and truth: epistemological and axiological perspective. Summary of the course.	2
		15

TEACHING TOOLS USED

N1. Informative lecture with multimedia presentation
N2. Conversational lecture
N3. Individual and group work of students

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT

Evaluation (F – forming during semester), P – concluding (at semester end)	Learning outcomes code (from subject educational effects)	Way of evaluating learning outcomes achievement
F1	PEU_W01	In-class presentation or a written assignment
F2	PEU_U01 PEU_K01 PEU_K02	In-class activity
P = (F1 + F2)/2		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] Bielik L., *Methodology of Science: An Introduction*, Comenius University in Bratislava (2019)
[2] Lipton P., *Inference to the Best Explanation*, Routledge (1991)
[3] Papineau D. (ed.), *The Philosophy of Science*, Oxford University Press (1996)
[4] Pigliucci M., Boundry M. (eds.), *Philosophy of Pseudoscience: Reconsidering the Demarcation Problem*, The University of Chicago Press (2013)
[5] Pigliucci M., *Nonsense on Stilts: How to Tell Science from Bunk*, The University of Chicago Press (2010)
[6] Psillos S., *Philosophy of Science A–Z*, Edinburgh University Press (2007)
[7] Ritchie S., *Science Fictions. Exposing Fraud, Bias, Negligence and Hype in Science*, Vintage (2021)
[8] Stanford Encyclopedia of Philosophy, https://plato.stanford.edu/

SECONDARY LITERATURE:

[1] Baird D., Scerri E., McIntyre L. (eds.), *Philosophy of chemistry. Synthesis of a New Discipline*, Springer (2005)
[2] Cartwright N., *How the Laws of Physics Lie*, Oxford University Press (1983)
[3] Duhem P., *The Aim and Structure of Physical Theory*, P.P. Wiener (trans), Princeton University Press (1954)
[4] Hacking I., *Representing and Intervening Introductory Topics in the Philosophy of Natural Science*, Cambridge University Press (1983)
[5] Hossenfelder S., *Lost in Math: How Beauty Leads Physics Astray*, Hachette (2018)
[6] Kragh H., *Higher Speculations: Grand Theories and Failed Revolutions in Physics and Cosmology*, Oxford University Press (2015)
[7] Krimsky S., *Science in the Private Interest: Has the Lure of Profits Corrupted Biomedical Research?*, Rowman & Littlefield Publishers (2003)
[8] Kuhn T.S., *The Structure of Scientific Revolutions*, University of Chicago Press (1962)
[9] Latour B., Woolgar S., *Laboratory Life: The Construction of Scientific Facts*, Sage (1979)
[10] Lakatos I., *The Methodology of Scientific Research Programmes*, Cambridge University Press (1978)
[11] Park R, *Voodoo Science: The Road from Foolishness to Fraud*, Oxford University Press (2000)
[12] Poincaré H., *The Value of Science*, Modern Library (2001)
[13] Popper K.R., *Conjectures and Refutations*, Routledge (1963)
[14] Popper K.R., *The Logic of Scientific Discovery*, Routledge (2002)

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

Mateusz Kotowski, mateusz.kotowski@pwr.edu.pl

FACULTY CHEMISTRY

SUBJECT CARD

Name of subject in Polish: Język polski i kultura regionalna
Name of subject in English: **Polish Language and local culture**
Main field of study (if applicable): Sustainable Biomass and Bioproducts Engineering
Specialization (if applicable):
Profile: **academic**
Level and form of studies: **2nd level, full-time**
Kind of subject: **elective**
Subject code: JZL100992C / JZL100993P
Group of courses: YES – leading course - CLASSES

	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		crediting with grade		crediting with grade	
For group of courses mark (X) final course		X			
Number of ECTS points		2.0		1.0	
including number of ECTS points for practical (P) classes		2		1	
including number of ECTS points for direct teacher-student contact (BK) classes		1.4		0.75	

*delete as applicable

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

Not applicable

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SUBJECT OBJECTIVES

C1. Understanding the basic grammar and simple texts in local language.
C2. To be able to keep basic conversations of daily life in local language.
C4. Understanding the cultural heritage and traditions related with Industrial Development.
C5. Identifying some natural and cultural places of the Lower Silesia region.

SUBJECT EDUCATIONAL EFFECTS

related to knowledge:

PEU_W01student knows basic vocabulary and structures to communicate in daily life.
PEU_W02 student knows basic grammatic rules to write short texts.

PEU_W03 student develops a basic knowledge of speaking and listening skills in Polish language.
PEU_W04 student knows the cultural and social evolution in Poland and Lower Silesia region and our main traditions
PEU_W05 student knows the natural and cultural places of the Lower Silesia region

PROGRAMME CONTENT

Classes		Number of hours
Zaj.1	*Język polski, Polska i Polacy* Polish Language, Polish people, Polish culture – introduction & basic information	2
Zaj.2	*Skąd jesteś?* Questions identifying people and things; greetings and farewells; nationality; introducing oneself and other people; talking about age; language etiquette in Poland	2
Zaj.3	*Co lubisz robić?* Asking for information; expressing interests; description of a person; free-time activities in Poland; 10 most famous Poles you should know about	2
Zaj. 4	*Jestem głodny!* Polish quisine; expressing likes and dislikes; shopping; asking for the price; ordering food; eating habits in Poland	2
Zaj. 5	*Plan dnia – rutyna* Asking for the time; expressing time and frequency; time relations; days of the week; parts of the day; months & seasons; history of Poland in brief	2
Zaj. 6	*Kim jesteś, czym się zajmujesz?* Collecting information; talking about family; talking about job, occupation, proffesion; asking questions; holidays in Poland	2
Zaj. 7	*Zapraszam cię do kina, restauracji i na koncert!* Invitations and replies; expressing preferences; suggestions and proposals; expressing certainty and uncertainty; Polish film and literature	2
Zaj. 8	*Zwiedzamy Dolny Śląsk!*	2

	Asking for directions; city infrastructure; booking a taxi; travelling in the city; the most beautiful places of Lower Silesia	
Zaj. 9	*Poznajemy Polskę!* Travelling by bus & by train; buying the ticket; asking for information; at the hotel; sightseeing tours; regions of Poland & largest Polish cities	2
Zaj. 10	*Wczoraj robiłem zakupy!* Talking about the past; shopping in *galeria handlowa*; types of shops; clothes; expressing compliments; Poland's economic transformation after 1989	2
Zaj. 11	*Gdzie mieszkasz?* Different places to live; renting a flat; living in a dormitory & in a rented flat pros and cons; pieces of furniture; home appliances; great Polish scientists	2
Za.12	*Kiedy będą wakacje?* Talking about plans for the future; summer & winter holiday activities; weather forecasts; offers of Travel Agency; postcard greetings; most famous Polish tourist attractions	2
Zaj. 13	*Na uniwersytecie* Education now and then; e-learning; education during the pandemic; academic vocabulary; system of education in Poland	2
Zaj.14	*Sport to zdrowie!* Training – pros and cons; health and illness; appointment at the doctor; at the pharmacy; parts of the body; first aid kit; Polish sport celebrities	2
Zaj.15	*Wszystkiego najlepszego!* Family & public celebrations; greetings for different occasions; Polish traditions & customs; Poles and the Polish Diaspora in the world. Final test	2
	Total hours	30h

Project		Number of hours
Proj 1	Practical classes in polish natural districts (recreational and tourist activities, e.g. hiking, cycling, skiing)	5
Proj 2	Get familiar with regional culture (visit to a museum, theatre, philharmonic, etc.)	5
Proj 3	Practical classes of regional cuisine (workshops on preparing regional dishes, e.g. dumplings, stuffed cabbage, etc.)	5
	Total hours	15

TEACHING TOOLS USED
N1. Practical language classes N2. Practical classes in natural/ historical places. N3. Activities based on projects

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_W01 – PEU_W04	Final test = 10 points
F2	PEU_W04 – PEU_W05	Reports = 10 points
P P = 3.0 if the sum of points in the range 50-60% 3.5 if the sum of points in the range 61-72% 4.0 if the sum of points in the range 73-82% 4.5 if the sum of points in the range 83-92% 5.0 if the sum of points in the range 93-100% 5.5 if the sum of points is 100%, and the student demonstrates the knowledge above the regular material scope		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

1. Gałat E., Sałęga-Bielowicz B., *Język polski? Chcę i mogę! Podręcznik do nauki języka polskiego jako obcego. Poziom A1. Część I,* Kraków 2018.
2. Gałat E., Sałęga-Bielowicz B., *Język polski? Chcę i mogę! Podręcznik do nauki języka polskiego jako obcego. Poziom A1. Część II*, Kraków 2019.

SECONDARY LITERATURE:

1. Davies N., *Heart of Europe. A short history of Poland*, Oxford 2001
2. Miodunka W., *Cześć, jak się masz? Część pierwsza: Spotykamy się w Polsce. A Polish Language Textbook,* wyd. II, Kraków 2012, 2020

On-line resources:

1. *Dolnośląskie, https://www.popolskupopolsce.edu.pl/baza-wiedzy*
2. *The Hidden Treasures of Lower Silesia*, https://poland.pl/tourism/urban-tourism/hidden-treasures-lower-silesia

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

Agnieszka Szukalska, (agnieszka.szukalska@pwr.edu.pl)
dr hab. inż. Jolanta Warchoł, prof. uczelni (jolanta.warchol@pwr.edu.pl)

FACULTY CHEMISTRY

SUBJECT CARD

Name of subject in Polish:	Język fiński podatawowy
Name of subject in English:	Basic Finnish language
Main field of study (if applicable):	**CHEMICAL AND PROCESS ENGINEERING**
Specialization (if applicable):	**Engineering chemical processes**
Profile:	**academic**
Level and form of studies:	**2nd level, full-time**
Kind of subject:	**elective**
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)		120			
Form of crediting		Crediting with grade			
For group of courses mark (X) final course					
Number of ECTS points		4			
including number of ECTS points for practical (P) classes		4			
including number of ECTS points for direct teacher-student contact (BK) classes		1.4			

*delete as applicable

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Good English skills

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SUBJECT OBJECTIVES

C1 Basics of Finnish language

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge:

PEU_W01 knowing the vocabulary and phrases for common everyday situations

PEU_W02 ability to talk about oneself and understand basic questions

PROGRAMME CONTENT

Classes		Number of hours
Cl 1-15	Basic vocabulary and reading	30

TEACHING TOOLS USED
N1. Practical language classes N2. Group discussions

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
P1	PEU_W01 – PEU_W02	Final test (max. 10 points)

P = 3.0 if the sum of points in the range 50-60%
3.5 if the sum of points in the range 61-72%
4.0 if the sum of points in the range 73-82%
4.5 if the sum of points in the range 83-92%
5.0 if the sum of points in the range 93-100%
5.5 if the sum of points is 100%, and the student demonstrates the knowledge above the regular material scope

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] Kuisma et al., Sun suomi - Finnish for beginners, Otava 2020

SECONDARY LITERATURE:

[1] Classes notes and other material from the classes

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

Prof. Tuomo Sainio, tuomo.sainio@lut.fi

FACULTY CHEMISTRY

SUBJECT CARD

Name of subject in Polish: Hiszpański język i kultura
Name of subject in English: **Spanish Language and Culture**
Main field of study (if applicable): Sustainable Biomass and Bioproducts Engineering
Specialization (if applicable):
Profile: **academic**
Level and form of studies: **2nd level, full-time**
Kind of subject: **elective**
Subject code: …….
Group of courses: YES – leading course - CLASSES

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	-	16	22	-	2
Number of hours of total student workload (CNPS)	-	48	66	-	6
Form of crediting	crediting with grade	crediting with grade	crediting with grade		crediting with grade
For group of courses mark (X) final course		X			
Number of ECTS points	-	1.6	2.2	-	0.2
including number of ECTS points for practical (P) classes		1.6	2.5		0.2
including number of ECTS points for direct teacher-student contact (BK) classes		0.747	1.027		0.093

*delete as applicable

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Not applicable

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SUBJECT OBJECTIVES

C1. To know the evolution and development of Spanish Language and some basic concepts.
C2. Understanding the basic grammar and simple texts in local language.
C3. To be able to keep basic conversations of daily life in local language.
C4. Understanding the cultural heritage and traditions related with Industrial Development.
C5. Identifying some Natural Patrimony and Protected Areas.

SUBJECT EDUCATIONAL EFFECTS

related to knowledge:
PEU_W01student knows basic vocabulary and structures to communicate in daily life.

PEU_W02 student knows basic grammatic rules to write short texts.
PEU_W03 student develops a basic knowledge of speaking and listening skills in Spanish language.
PEU_W04 student knows the cultural and social evolution in Spain and Castilla La Mancha and our main traditions
PEU_W05 student knows the singularities of national natural parks specially in Castilla la Mancha Region.

PROGRAMME CONTENT		
Classes		**Number of hours**
1	Evolution of Spanish language and basic structures for beginners	1
2	Grammatic rules and short texts reading in local language	1
3	Basic dialogues to daily life in Spanish Language	1
4	Historical, cultural, and Social Development of Spain and Castilla La Mancha	1
5	Basic concepts and sustainability of Regional Natural Parks	1
6	Final test.	1
7	Writing a CV / basic tips for a job interview meeting in Spanish.	2
8	Discussion of reports from cultural visits	2
9	How to improve the sustainability of a Natural landscape / Natural National Park in Castilla la Mancha.	2
10	Research and practice of Spanish Language	1
11	Research and practice of Spanish grammar and reading	1
12	Dialogue practice	1
13	Research about cultural and social development of Castilla La Mancha and Spain	1
		16 h

Laboratory		**Number of hours**
Proj 1	Practical classes in Regional Natural Park	8
Proj 2	Practical classes in historical places	8
Proj 3	Practical classes in regional museums	6
Proj 4		

Seminar		**Number of hours**
Proj 1	Online Learning Tools- Kahoot Quiz	1

Proj 2	Online Learning Tools – Brainstorming and feedback (Miro)	1
Proj 3		
Proj 4		

TEACHING TOOLS USED
N1. Lecture with multimedia presentation. N2. Reports. N3. Activities based on projects N4. Practical Visits N5. Virtual Learning 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_W01 – PEU_W05	Reports-Seminars = 10 points
F2	PEU_W01 – PEU_W05	Final test = 10 points
P P = 3.0 if the sum of points in the range 50-60% 3.5 if the sum of points in the range 61-72% 4.0 if the sum of points in the range 73-82% 4.5 if the sum of points in the range 83-92% 5.0 if the sum of points in the range 93-100% 5.5 if the sum of points is 100%, and the student demonstrates the knowledge above the regular material scope		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] Laura Carbonell. GuíaBurros Spanish Grammar Cheat Sheet. A quick and easy guide to Spanish Grammar. ISBN: 9788412453508, 2021.

[2] María Victoria Gómez de Erice, Estela Zalba, Norma Arenas, Mabel Fariña, Celia Párraga, Viviana Gantus; Gramatica para todos, EDIUNC, Mendoza (Argentina). 2005.

SECONDARY LITERATURE:

[1] David A. Pharies, A Brief History of the Spanish Language. University of Chicago Press, 2008.

[2] Estrella Montolio, Carolina Figueras. Mar Garachana. Santiago Barriendos. Manual práctico de escritura académica. Editorial Ariel. 2000

[3] Mata Olmo, R and Sanz Herráiz, C. Atlas de los paisajes de España. Ministerio de Medio Ambiente. Madrid. 2003.

SUBJECT SUPERVISOR (NAME AND SURNAME, E-MAIL ADDRESS)
Ignacio Garrido; Ignacio.Garrido@uclm.es Martin Muñoz; Martin.Munoz@uclm.es

FACULTY CHEMISTRY

SUBJECT CARD

Name of subject in Polish:	Fińska kultura i język
Name of subject in English:	Finnish culture and language
Main field of study (if applicable):	**CHEMICAL AND PROCESS ENGINEERING**
Specialization (if applicable):	**Engineering chemical processes**
Profile:	**academic**
Level and form of studies:	**2nd level, full-time**
Kind of subject:	**obligatory**
Subject code:	…….
Group of courses:	YES – leading course - CLASSES

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)		30		10	
Number of hours of total student workload (CNPS)		90		30	
Form of crediting		crediting with grade		crediting with grade	
For group of courses mark (X) final course		X			
Number of ECTS points		3		1	
including number of ECTS points for practical (P) classes		3		1	
including number of ECTS points for direct teacher-student contact (BK) classes		1.4		0.5	

*delete as applicable

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Good English skills

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SUBJECT OBJECTIVES

C1 Finnish culture and ways of living in Finland
C2 Basics of Finnish language

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge:
PEU_W01 knowing the vocabulary and phrases for common everyday situations
PEU_W02 ability to talk about oneself and understand basic questions
PEU_W03 knowledge about the Finnish culture and society

PROGRAMME CONTENT

Classes		Number of hours
Cl 1	Basic vocabulary and reading	20
Cl 2	Finnish culture	10
Project		**Number of hours**
Proj 1	Practical classes in local cultural places	10

TEACHING TOOLS USED

N1. Lecture with multimedia presentation
N2. Group discussions

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
P1	PEU_W01 – PEU_W03	Final test (max. 10 points)

P = 3.0 if the sum of points in the range 50-60%
3.5 if the sum of points in the range 61-72%
4.0 if the sum of points in the range 73-82%
4.5 if the sum of points in the range 83-92%
5.0 if the sum of points in the range 93-100%
5.5 if the sum of points is 100%, and the student demonstrates the knowledge above the regular material scope

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] Kuisma et al., Sun suomi - Finnish for beginners, Otava 2020

SECONDARY LITERATURE:

[1] Lecture notes and other material from the lecture

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

Prof. Tuomo Sainio, tuomo.sainio@lut.fi

FACULTY OF CHEMISTRY

SUBJECT CARD

Name of subject in Polish	Praca Dyplomowa
Name of subject in English	Master thesis
Main field of study (if applicable)	Sustainable Biomass and Bioproducts Engineering
Specialization (if applicable)	----
Profile:	academic
Level and form of studies:	2nd level, full-time
Kind of subject:	optional
Subject code	…….
Group of courses	NO

	Lecture	Classes (exercises)	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)			360		
Number of hours of total student workload (CNPS)			900		
Form of crediting			crediting with grade*		
For group of courses mark (X) final course					
Number of ECTS points			30		
including number of ECTS points for practical classes (P)			30		
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)			16,8		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

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

SUBJECT OBJECTIVES

C1 Acquiring the ability to use scientific literature and other sources of knowledge.
C2 Learning to select and organize knowledge in terms of a specific topic.
C3 Acquiring the ability to create a written study on a selected scientific or practical topic.
C4 Expanding knowledge in a specialized field within the field of study
C5 Acquainting with the basic methodology of scientific work

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 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,
PEU_U04 - can prepare a written study on a selected scientific or practical issue.
PEU_U05 - (optional) can carry out experiments / make a project / create software as well as process the results and draw conclusions from his achievements.

PROGRAMME CONTENT		
Laboratory		**Number of hours**
La 1-15	Individual student work according to the schedule agreed with the thesis supervisor.	360
		360

TEACHING TOOLS USED
N1. Consultations

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT

Evaluation (F – forming during semester), P – concluding (at semester end)	Learning outcomes code (from subject educational effects)	Way of evaluating learning outcomes achievement
P	PEU_W01 – PEU_W02 PEU_U01 – PEU_U05	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