



## COURSE DESCRIPTION CARD - SYLLABUS

Course name

Bioengineering in a circular system technologies [S2TOZ1-TSO>BwGOZ]

### Course

Field of study	Year/Semester
Circular System Technologies	1/2
Area of study (specialization)	Profile of study
Renewable raw material technologies	general academic
Level of study	Course offered in
second-cycle	Polish
Form of study	Requirements
full-time	compulsory

### Number of hours

Lecture	Laboratory classes	Other
15	0	0
Tutorials	Projects/seminars	
0	30	

### Number of credit points

4,00

### Coordinators

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### Lecturers

### Prerequisites

The student should have basic knowledge of physics, organic and physical chemistry concerning the fundamentals of energy exchange in biological and industrial systems, structure, properties of chemical compounds. In addition, the student should have basic knowledge of biology and biotechnology, environmental chemistry, as well as a general knowledge of production processes, especially in a biotechnological and industrial context.

### Course objective

Understanding of the fundamentals of bioengineering and its application to sustainable industry and the environment, and the practical application of circular system technologies concepts in biotechnology, including bio-recycling and the creation of bioproducts.

### Course-related learning outcomes

Knowledge:

K\_W01 Has an in-depth knowledge of physics, chemistry and other related fields relevant to the field of study, useful for describing and solving complex tasks in the field of study.

K\_W02 Has advanced, structured and theoretically underpinned knowledge of the principles of a circular system technologies and the reasons why it is implemented.

K\_W04 Has structured, advanced knowledge to recognise, assess the harmfulness and neutralise factors hazardous to the environment.

K\_W05 Has an in-depth and theoretically underpinned knowledge of modern environmentally friendly technologies.

K\_W06 Has extended knowledge to recognise and differentiate factors hazardous to the environment and knows the principles of waste neutralisation and recovery taking into account the requirements of a circular system technologies.

K\_W09 Is familiar with the basic legal, economic and ethical acts undertaken for environmental protection and circular system technologies.

K\_W16 Has in-depth knowledge of the methods of using plants and microorganisms to produce biological substances.

#### Skills:

K\_U02 Is able to plan, prepare and present a presentation on the implementation of a research task and conduct a substantive discussion on a given topic.

K\_U03 Is able to use his/her knowledge to identify and select methods of disposal/management of various industrial wastes, taking into account the principles of closed loop economy, and to propose improvements to existing technological solutions, taking into account valid legal acts.

K\_U04 Is able to identify and critically evaluate technical solutions for waste recycling in accordance with the principles of the circular system technologies.

K\_U08 Is able to selectively adapt knowledge of chemistry and related fields in planning and implementation of research and technological tasks in the area of technologies based on a circular system technologies, and analyse their impact on the environment.

K\_U09 Be able to interact with others and take a leading role in a team to solve engineering problems concerning methods and equipment used in technologies, including those related to the circular system technologies.

K\_U10 Be able to select methods of recycling, chemical recovery and disposal of various wastes and formulate the assumptions necessary to design innovative solutions based on the principles of the circular system technologies.

K\_U15 Can skilfully use professional literature and expert opinion, integrate obtained information, interpret and critically evaluate it and formulate competent opinions and reports on this basis.

#### Social competences:

K\_K01 Is aware of personal responsibility resulting from his/her professional role and the emergence of moral and ethical problems in the context of professional activities.

K\_K03 Critically assesses his/her knowledge, understands the need for further education and improvement of his/her professional, personal and social competences.

K\_K04 He/she is able to think and act in an entrepreneurial way, while being aware of his/her social role and public interest.

### Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

The knowledge acquired in the lecture is verified in a written examination. Pass mark: 50% of the points. Credit for the project is based on the preparation, in the form of a presentation, of a concept for the use of bioengineering for waste management and recycling of raw materials, the use of plants and microorganisms in remediation processes and the extraction of raw materials for industry.

### Programme content

Content includes biological, engineering and environmental aspects of circular system technologies, recycling, bioremediation and sustainable resource use.

### Course topics

The course topics will include the following thematic modules:

1. The role of bioengineering in a circular system technologies.
2. Bio-processes in a circular system technologies, including the use of biotechnology in production and recycling, the use of plants and micro-organisms in biodegradation, the use of bio-engineering in the treatment of water and water resources.
3. Biotechnology in recycling and recovery of materials.

### Teaching methods

1. lecture: multimedia presentation, discussion.
2. Project: multimedia presentation, discussion.

### Bibliography

Basic:

1. Bruce E. Rittmann, Perry L. McCarty, Environmental Biotechnology: Principles and Applications, McGraw-Hill Education, 2001.
2. Z. Wnuk, Ekologia i ochrona środowiska. Wybrane zagadnienia, Wydawnictwo Uniwersytetu Rzeszowskiego, 2010.
3. M.K. Błaszczak, Biologiczne aspekty oczyszczania ścieków, PWN, 2021.

Additional:

1. J. Kauffman, Kun-Mo Lee, Handbook of Sustainable Engineering, Springer Dordrecht, 2013.
2. A. Szymoniak, R. Stanisławski, A. Błaszczak, Nowoczesna koncepcja ekologii, DIFIN, 2021.
3. M. Kacprzak, K. Fijałkowski, Fitoremediacja. Potencjał roślin do oczyszczania środowiska, PWN, 2022.
4. W. Chełmicki, Woda Zasoby, degradacja, ochrona, PWN, 2022.

### Breakdown of average student's workload

	Hours	ECTS
Total workload	100	4,00
Classes requiring direct contact with the teacher	49	2,00
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	51	2,00