

**COURSE OFFERED IN THE DOCTORAL SCHOOL**

Code of the course	4606-ES-0000GIP-0314	Name of the course	Polish	Biotechnologiczna produkcja materiałów użytecznych z odpadów		
			English	Biotechnological production of materials from waste		
Type of the course	specialization					
Course coordinator	Prof. Agnieszka Tabernacka, PhD, DSc, Eng.	Course teacher	Prof. Agnieszka Tabernacka, PhD, DSc, Eng.			
Implementing unit	Faculty BSHEE	Scientific discipline / disciplines*	Environmental Engineering, Mining and Energy, Biotechnology, Materials Engineering			
Level of education	Doctoral studies	Semester	spring			
Language of the course	English					
Type of assessment	Evaluation grade	Number of hours in a semester	30	ECTS credits	2	
Minimum number of participants	12	Maximum number of participants	30	Available for students (BSc, MSc)	Yes/No	
Type of classes		Lecture	Auditory classes	Project classes	Laboratory	Seminar
Number of hours	in a week	2				
	in a semester	30				

\* does not apply to the Researcher's Workshop

**1. Prerequisites**

none

**2. Course objectives**

The aim of the course is to familiarise PhD students in the Doctoral School with the microbiological processes used in the production of useful materials from waste and wastewater, including biofuels and biopolymers.

**3. Course content (separate for each type of classes)**

**Lecture**

1. Ethanol fermentation in production of bioethanol from waste.
2. Production of methane and biohydrogen from sewage sludge and waste.
3. Biotechnological oil production and use of enzymes for biodiesel production.
4. Biological production of single cell protein from sewage sludge and waste biomass.
5. Biotechnological methods of producing biodegradable polymers (polyhydroxyalkanoates, polylactide, microbial cellulose)
6. Biomass as a source of surfactants.
7. Biotechnological methods for the production of enzymes, drugs, colouring and aroma substances from waste biomass
8. Biological plant protection agents from bio-waste

**Laboratory**

-

**4. Learning outcomes**

Type of learning outcomes	Learning outcomes description	Reference to the learning outcomes of the WUT DS	Learning outcomes verification methods*

Knowledge			
K01	Student has a detailed knowledge of the microbiological processes used in the production of useful products from wastewater and waste, which is part of the dilemmas of modern civilisation	SD_W2	presentation evaluation; active participation during classes; test
K02	Student has knowledge of final product recovery methods in biotechnology processes.	SD_W3	presentation evaluation; active participation during classes; test
Skills			
S01	Student can assess the applicability of biological methods for obtaining useful products from wastewater and waste, i.e. effectively obtain and use information on this subject from national and international sources	SD_U1	presentation evaluation; active participation during classes; test
S02	Student can determine the conditions for microbiological processes and develop a biotechnological process for producing useful products from waste biomass	SD_U2	presentation evaluation; active participation during classes; test
Social competences			
SC01	Student is ready to recognise the importance of knowledge and scientific achievements in solving cognitive and practical problems	SD_K2	presentation evaluation; active participation during classes; test
SC02	Student is able to think and act creatively and entrepreneurially	SD_K4	presentation evaluation; active participation during classes; test

\*Allowed learning outcomes verification methods: exam; oral exam; ; oral test; project evaluation; report evaluation; presentation evaluation; active participation during classes; homework; tests

#### 5. Assessment criteria

presentation evaluation 40%; active participation during classes 20%; test 40%

#### 6. Literature

##### Primary references:

- [1] Klimiuk E., Pokój T., Pawłowska M. (2012) Biopaliwa. Technologie dla zrównoważonego rozwoju. PWN, Warszawa.
- [2] Sessini V.; Ghosh S.; Mosquera M.E.G. (red.) (2023) Biopolymers : synthesis, properties and emerging applications.
- [3] Dawes, E.A (2012) Novel Biodegradable Microbial Polymers. Springer Books
- [4] Kosaric N.; Sukan F. V. (2014) Biosurfactants. CRC Press.
- [5] Kowal K., Libudzisz Z., Żakowska Z. (2009) Mikrobiologia techniczna. T. 1, 2. PWN, Warszawa
- [6] Fang, Xu ; Qu, Yinbo; Fang, Xu ; Qu, Yinbo (2018) Fungal Cellulolytic Enzymes: Microbial Production and Application. Singapore: Springer Singapore Pte. Limited

##### Secondary references:

- [1] Scientific articles on bioeconomy, circular economy, biotechnology

7. PhD student's workload necessary to achieve the learning outcomes**		
No.	Description	Number of hours
1	Hours of scheduled instruction given by the academic teacher in the classroom	30
2	Hours of consultations with the academic teacher, exams, tests, etc.	10
3	Amount of time devoted to the preparation for classes, preparation of presentations, reports, projects, homework	10
4	Amount of time devoted to the preparation for exams, test, assessments	10
<b>Total number of hours</b>		<b>60</b>
<b>ECTS credits</b>		<b>2</b>

\*\* 1 ECTS = 25-30 hours of the PhD students work (2 ECTS = 60 hours; 4 ECTS = 110 hours, etc.)

8. Additional information	
Number of ECTS credits for classes requiring direct participation of academic teachers	1
Number of ECTS credits earned by a student in a practical course	0