



## COURSE DESCRIPTION CARD - SYLLABUS

Course name

**BIOFUELS AND BIORESOURCES**

### Course

Proposed by Discipline

Environmental engineering, mining and energy

Type of studies

Doctoral School

Form of study

full-time

Year/Semester

II/3, III/5

Course offered in

English

Requirements

elective

### Number of hours

Lecture

4

Tutorials

Projects/seminar

### Number of credit points

1

### Lecturers

Responsible for the course/lecturer:

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Responsible for the course/lecturer:

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### Prerequisites

Knowledge: PhD student has basic knowledge in the field of thermodynamic, fuels parameters and bioresources. PhD student has basic knowledge in field of biotechnology.

Skills: PhD student can use analytical methods and basic numerical software for simulation of biofuels composition for different biomass resources.

Social competencies: doctoral student is able to consider opinions of other social groups in his/her deliberations and to conduct debates on various aspects related to the conducted research.

### Course objective

To acquaint PhD students with the theoretical and practical problems related to production of biofuels for energetic application.

### Course-related learning outcomes

#### Knowledge

A PhD student who graduated from doctoral school knows and understands:

- 1) the most important types of bioresources; [P8S\_WG/SzD\_W01]
- 2) the methods of biofuels synthesis and recognize their critical properties; [P8S\_WG/SzD\_W02]
- 3) the existing law-regulations in fields on production of biofuels; [P8S\_WG/SzD\_W02]

#### Skills

A PhD student who graduated from doctoral school can:

- 1) analyze various types of biofuels and methods of their characterization in respect of current EU standards; [P8S\_UW/SzD\_U02]
- 2) critically analyse and assess scientific research results; [P8S\_UW/SzD\_U02]
- 3) prepare high-quality research report on biofuels; [P8S\_UW/SzD\_U02]
- 4) communicate on specialized issues concerning biotechnology at a level that allows active participation in the international scientific community. [P8S\_UK/SzD\_U04]

#### Social competencies

A PhD student who graduated from doctoral school is ready to:

- 1) work independently and in the group both at the scientific research; [P8S\_KK/SzD\_K02]
- 2) recognition of the importance of knowledge in solving cognitive and practical problems in biofuels production; [P8S\_KK/SzD\_K03]

### Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

PQF code	Methods for verification of learning outcomes	Assessment criteria
W01, W02	written final test covering the verification of theoretical knowledge, 7 questions from the material presented during the lectures	number of points 7



U02, U04	final test and rewarding the knowledge necessary to solve scientific problems in the subject, solving one problem related to presented material	number of points 2
K02, K03	written test of social skills in the subject, one question	number of points 1

The maximum number of points is 10. Pass rate is equal 50%.

### Programme content

The lecture reviews the liquid biofuels diversity on a background of other renewable energy sources, highlighting their role in the global energy balance. The basics of Polish, European and worldwide legislation regulating the production, properties and distribution of biofuels will be given together with the most typical classification based on the physical state (biogas, biomass and liquid biofuels) and the generation (Ist, IIrd, IIIrd and IVth generation); the analysis and comparison of potential raw-materials and production technologies, as well as the perspectives for further development will be discussed.

### Course topics

Introduction to biofuels and renewable bioresources - key definitions.

Characteristics and breakdown of biofuels by physical state (biogas, biomass and liquid biofuels) and breakdown of transport biofuels into 1st, 2nd, 3rd and 4th generation fuels.

Biofuel production methods by physical state (biogas, biomass and liquid biofuels).

Applicable legislation regulating both the implementation and quality requirements of marketed products - restrictions on the use of biofuels and biodiesel additives in transport fuels.

Comparison of key properties of conventional fuels with biofuels derived from renewable raw materials.

The theoretical basis of the most important tests from the point of view of biofuel quality control and a discussion of the modern measuring techniques used.

### Teaching methods

Lecture: multimedia presentation including illustrations, examples and basic problems analysis.

### Bibliography

Basic

1. Knothe G., Van Gerpen J., Krahl J — The Biodiesel Handbook, Illinois, 2005, AOCS Press.
2. Olsson L.: — Biofuels, Berlin Heidelberg, 2007, Springer.
3. Skrzyńska, E: Biofuels and bioresources, Monographs of Cracow University of Technology. Engineering and Chemical Technology, 2018, Cracow, Politechnika Krakowska im. Tadeusza Kościuszki, Wydaw. PK, 162 s., ISBN 978-83-65991-01-0

Additional

1. Sobuś, N and Czekaj, I: Catalytic Transformation of Biomass-Derived Hemicellulose Sugars by the One-Pot Method into Oxalic, Lactic, and Levulinic Acids Using a Homogeneous H<sub>2</sub>SO<sub>4</sub> Catalyst, Catalyst 2023.
2. Sobuś, N and Czekaj, I: Lactic acid conversion into acrylic acid and other products over natural and synthetic zeolite catalysts: theoretical and experimental studies, Catalyst Today, 2022.



### Breakdown of average student's workload

	Hours	ECTS
Total workload	25	1,0
Classes requiring direct contact with the teacher	4	0
Doctoral student's own work (literature studies, preparation for evaluation, consultations with the teacher) <sup>1</sup>	21	1,0

<sup>1</sup> delete or add other activities as appropriate