INDBIOT-05:	**BIOFUELS AND BIOREFINERIES**
GENERAL INFORMATION	
Course Coordinator(s)	Marina Tišma, PhD, assoc. prof.
Associate(s)	Sandra Budžaki, PhD, assoc. prof. Ana Bucić-Kojić, PhD, full prof. Mirela Planinić, PhD, full prof.
Study Programme	Interdisciplinary Graduate Study Programme in English: Biotechnology
Course Status	Obligatory
Year of Study, Semester	2nd Year / 3rd Semester
Credits (ECTS)	**5**
Teaching Method (number of classes)	Lectures 30; Seminars 15; Exercises 15; Field Excercises: 10
Expected Number of Students in the Course	25-30
COURSE DESCRIPTION	
Course Aims	
This course aims to provide basic knowledge on the concepts of biorefinery and sustainable development, biovalorization of waste from different industries, types and characterization of the raw materials in biofuel production, existing and advanced technologies in biofuels production.	
Prerequisites for Enrolment and the Entry Competencies Required for the Course	
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Learning Outcomes at the Programme Level Contributed by the Course	
BIOTECH-5; BIOTECH-6; INDBIOT-4	
Learning Outcomes at the Course Level	
After successful completion of this course students are expected to be able to: 1. Understand concept of biorefinery as the main scenario for the future of fossil fuels non-dependence 2. Differentiate alternative methods of biovalorization of waste from food industry, agriculture, forestry, as well as biodegradable fractions of municipal waste 3. Explain the types, methods of production and basic characteristics of biofuels (biogas, bioethanol, biodiesel) 4. Differentiate biofuels of first, second and third generation 5. Perform biocatalytic synthesis of biodiesel in different bioreactor systems 6. Connect theory with the good industry practise	
Course Content	
Lectures. Sustainable energy sources. Overview of biorafineries. Basic information on type and characteristics of biofuels. Types of raw materials, its characteristics and possible application in biofuel / value-added products production. Industrial production of bioethanol. Industrial production of biodiesel. Industrial production of biogas. Advanced technologies in biofuels production. Lignocellulose pretreatment in biofuels production. Application of enzymes and microorganisms in lignocellulose pretreatment. Energy balance and life cycle analysis in biofuels production. **Seminar**. Case study. **Laboratory exercise.** Biodiesel production in different reactors catalysed by lipase. **Field exercise.** Visit to biofuel industrial process and biotechnological start-ups.	
Teaching Methods	
Lectures; seminars; laboratory exercises; field course	
Students' Obligations	

Attendance at all forms of classes is mandatory and the students are obligated to attend all knowledge tests. The students may be absent from 30% (full-time students) and 50% (part-time students) of each of the forms of classes, provided that the absence is justified. An exercise which has not been completed must be made up through a midterm exam.

Monitoring the Activity of the Students *(Connecting Learning Outcomes, Teaching Methods, and Grading)*

Class-related activity	ECTS	Learning outcome	Student activity	Evaluation method	Grade points	
					Min.	Max.
Attending classes	0.25	1-6	Attendance at classes	records	2	10
Seminars	0.75	2-4	Seminar work preparation	Presentation of seminar work	10	20
Laboratory exercise	1	5-6	Practical work	Laboratory exercises report	8	20
Final exam	3	1-5	Studying for the final exam	Oral exam	30	50
Total	**5**				**50**	**100**

Evaluation of the written part of the final exam

Percentage of correct answers (%)	Grade
>95.00	50
90.00-94.99	47
85.00-89.99	45
80.00-84.99	40
75.00-79.99	38
70.00-74.99	35
65.00-69.99	33
60.00-64.99	30

Forming the final grade:
The points granted for the final exam are added to the grade points awarded during class attendance. The grading process is conducted by absolute distribution, i.e. based on total achievements, and compared to the numerical system in the following manner:
A – Excellent (5): 90-100 grade points; B – Very Good (4): 80-89.99 grade points; C – Good (3): 65-79.99 grade points; D – sufficient (2): 50-64.99 grade points

Mandatory Literature (available in the library and via other media)

Title	Number of copies in the library	Availability via other media
Drapcho CM, Nhuan NP, Walker TH: Biofuels Engineering Process Technology, McGraw-Hill, 2020.		

Additional Literature

1. Brar SK, Dhillon GS, Soccol CR: Biotransformation of Waste Biomass into High Value Biochemicals, Springer, 2013.
2. Khanal SK, Surumpalli RY, Zhang TC, Lamsal BP, Tyagi RD, Kao CM: Bioenergy and Biofuels from Biowasates and Biomass. Virginia, USA: American Society of Civil Engineers, 2010.

3. Mousdale DM: Biofuels: Biotechnology, Chemistry, and Sustainable Development, Boca Raton, USA: CRC Press, 2008.
4. Rittmann BE, McCarty PL: Environmental Biotechnology: Principles and Applications. New York, USA: McGraw-Hill, 2001.
5. Scientific and professional papers (available on-line)

Quality Assurance Procedures Designed to Ensure the Acquisition of Outcomes and Competencies

Anonymous, quantitative, standardised student survey on the course and the teacher's work implemented by the Quality improvement office of the Faculty of Food Technology Osijek and/or the Faculty of Medicine Osijek.

Note

E-learning is not included in the class quota, but it is used in teaching and it contains links to various sites and video and audio materials available on websites.