INDBIOT-02:	**FERMENTATION TECHNOLOGIES**
GENERAL INFORMATION	
Course Coordinator(s)	Borislav Miličević, PhD, full prof. Vinko Krstanović, PhD, full prof.
Associate(s)	Antun Jozinović, PhD, assist. prof. Kristina Mastanjević, PhD, assist. prof.
Study Programme	Interdisciplinary Graduate Study Programme in English: Biotechnology
Course Status	Obligatory
Year of Study, Semester	2nd Year / 3rd Semester
Credits (ECTS)	**6**
Teaching Method (number of classes)	Lectures 30; Seminars 15; Exercises 30
Expected Number of Students in the Course	25-30
COURSE DESCRIPTION	
Course Aims	
The aim of this course is to gain knowledge about fermentation technologies, application of microorganisms, enzymes, animal and plant cells and their analogues in biotechnological production of different products.	
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-2; INDBIOT-3	
Learning Outcomes at the Course Level	
After completion of lectures, seminars and exercises, self-study and the passed exam students will: 1. Compare different types of fermentations. 2. Distinguish the role of microorganisms, enzymes, animal and plant cells and their analogues in fermentation processes. 3. Compare production technologies for different types of fermentation processes. 4. Propose process conditions for selected fermentation processes. 5. Apply acquired analytical and critical skills to develop and implement technological solutions during conducting the fermentation.	
Course Content	
Lectures. Historical development and perspectives of fermentation technology. Introduction to fermentation processes, biological pathways, kinetics, microorganisms and enzymes - opportunities and limitations of metabolite production, microbial cultures for fermentation processes. Media formulation, inoculum development, process optimization. Classification and characteristics of individual fermentation processes. Types and basic concepts for the selection, design and operation of fermenters. Selected technological fermentation processes for the production of selected products (alcohols, SCPs, enzymes, organic acids, amino acids, vitamins, antibiotics, hormones and alkaloids). **Seminar.** Calculation for the production of the microbial biomass of *Saccharomyces cerevisiae*. Microbial enzyme production. Production and application of amino acids. Production and application of antibiotics. Production and application of vitamins. Biotransformation. Application of microorganisms in food production. **Laboratory exercises.** Production and isolation of alcohol fermentation metabolites. Quantitative and qualitative analysis. Microaerophilic production process to produce lactic acid. Crabtree effect in *Saccharomyces cerevisiae*.	
Teaching Methods	
Lectures; seminars; laboratory exercises	

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 or a seminar 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	0.50	1-5	Attendance at classes	Keeping records	2	10
Seminars	1.50	1-2	Seminar work preparation	Presentation of seminar work	10	20
Laboratory exercises	1	3-4	Practical work	Laboratory exercises report	8	20
Final exam	3	1-5	Studying for the final exam	Written exam	30	50
Total	**6**				**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
Okafor N, Okeke BC: Modern Industrial Microbiology and Biotechnology, 2nd Ed., CRC Press, Boca Raton, 2018.	-	yes
Additional Literature		

1. Stanbury PF, Whitaker A, Hall SJ: Principles of Fermentation Technology, 3rd Ed., Butterworth-Heinemann, 2017.
2. Bamforth CW, Ward RE: The Oxford Handbook of Food Fermentations. Oxford, 2014.

3. Bamforth CW: Food, Fermentation, and Micro-organisms. Oxford: Blackwell Science, 2005.
4. Pometto A, Shetty K, Paliyath G, Levin RE: Food Biotechnology 2nd Ed., CRC Press, 2005.
5. Scientific and professional papers related to particular chapters (available online)

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.