INDBIOT-06:	**WASTE MANAGEMENT IN BIOPROCESS INDUSTRY**
GENERAL INFORMATION	
Course Coordinator(s)	Natalija Velić, PhD, assoc. prof.
Associate(s)	Marina Tišma, PhD, assoc.prof.
Study Programme	Interdisciplinary Graduate Study Programme in English: Biotechnology
Course Status	Obligatory
Year of Study, Semester	2nd Year / 3rd Semester
Credits (ECTS)	**4**
Teaching Method (number of classes)	Lectures 20; Seminars 10; Exercises 10; Field Exercises: 10
Expected Number of Students in the Course	25-30

COURSE DESCRIPTION

Course Aims

Introduce students to methods of proper waste management generated during the production process in different bioprocess industries with the aim of environmental protection, and introduce them to methods of waste treatment and the possibilities of reuse.

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

INDBIOT-4; BIOTECH-7

Learning Outcomes at the Course Level

After attending lectures and successfully completing seminars and exercises, learning independently, and passing the exam, the students will be able to:

1. Compare different waste management systems
2. Interpret and compare national and international waste management legislation and regulations
3. Identify the methods of sustainable waste management
4. Classify waste materials of bioprocess industries, analyse the waste generation points and costs of removal, treatment, reuse, recycle and disposal
5. Differentiate treatment methods of bioprocess industry waste
6. Suggest the appropriate treatment methods and waste management systems based on the available data on production process (case study)

Course Content

Lectures. Global environmental issues, the role and the importance of biotechnology in environmental protection. Waste management systems. Overview of national and EU legislation and regulations related to waste management of bioprocess industry. Waste classification and analysis of waste composition. Bioprocess industry solid waste treatment. Biological methods of solid waste treatment - status and trends. Case studies. Risk assessment and management of production waste involving the use of recombinant or pathogenic microorganisms. Bioprocess industry wastewater characteristics (production of microbial biomass, enzymes, organic solvents and acids, amino acids, antibiotics, vaccines, hormones, etc.). Physico-chemical and biological methods of wastewater treatment applied in the industrial environment. Waste gases treatment methods. Biological treatment of industrial waste gases (biofilters, bioscrubbers).

Seminar. Bioremediation, mycoremediation, phytoremediation. Treatment of wastewater contaminated with xenobiotics. The role of biosensors in environmental pollutants monitoring. GMO- benefits and risk assessment.

Exercises. Lignocellulosic waste degradation by white rot fungi. Biological treatment of wastewater: degradation of xenobiotics (synthetic dyes). Removal of pollutants from wastewater

by biosorption. **Field exercises**: Composting plant, biogas plant (anaerobic waste treatment) and wastewater treatment plants visits

Teaching Methods

Lectures; seminars, 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 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.
Classes	0.3	1-6	Attendance at classes	Keeping records	3	8
Seminar work	1.2	6	Writing a seminar paper	Presentation of seminar work	10	30
Exercises	0.5	3-6	Attendance at exercises	Laboratory exercises report	7	12
Final exam	2	1-6	Studying for the final exam	Written exam	30	50
Total	**4**				**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
Woodard & Curran Inc., Industrial Waste Treatment Handbook, 2nd Ed., Butterworth-Heinemann, 2006.	-	-

Singh RL, Principles and applications of Environmental Biotechnology for a Sustainable Future, Springer, Singapore, 2017.		yes

Additional Literature

1. Cheremisinoff NP: Handbook of solid waste management and waste minimization technologies. Butterworth Heinemann, Amsterdam; Boston, 2003.
2. Jördening H-J, Winter J: Environmental Biotechnology – Concepts and Applications, WILEY-VCH Verlag GmbH & Co. KGaA, Weinheim, 2005.
3. 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.