INDBIOT-07:	**INSTRUMENTAL METHODS IN BIOTECHNOLOGY**
GENERAL INFORMATION	
Course Coordinator(s)	Daniela Čačić Kenjerić, PhD, full prof. Lidija Jakobek Barron, PhD, full prof.
Associate(s)	Ivana Tomac, PhD, postdoc. Petra Matić, BSc
Study Programme	Interdisciplinary Graduate Study Programme in English: Biotechnology
Course Status	Obligatory
Year of Study, Semester	2nd Year / 4th Semester
Credits (ECTS)	**4**
Teaching Method (number of classes)	Lectures 20; Seminars 15; Laboratory Exercises 15
Expected Number of Students in the Course	25-30
COURSE DESCRIPTION	
Course Aims	
Familiarity with analytical methods that can be used in biotechnology to determine concentrations of sample constituents and presence of contaminants.	
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-6; INDBIOT-3; INDBIOT-6; MEDBIOT-2	
Learning Outcomes at the Course Level	
After successful completion of lectures, seminars, laboratory exercises, and after passed exam, students will be able to: 1. Compare analytical methods suitable for the determination of a specific analyte 2. Present the selected analytical method 3. Point out the most appropriate, from all acceptable methods, for analyzing the selected component based on the given criteria 4. Solely complete an analysis of the selected real sample 5. Present the results obtained by analysis	
Course Content	
Lectures. Electroanalytical methods: conductometry, coulometry, potentiometry, voltammetric methods. Electrokinetic zeta potential. Chromatographic methods: high-performance thin layer chromatography (HPTLC), gas chromatography (GC), high-performance liquid chromatography (HPLC), supercritical fluid chromatography (SFC), capillary electrochromatography (CEC). Electrophoresis. Spectroscopy: visible (Vis), ultraviolet (UV), infrared (IR, FTIR) atomic absorption spectroscopy (AAS). Mass spectrometry (MS, MS/MS), ionization in MS systems (ESI, APCI, APPI, MALDI), analyzer types, fragmentation in MS systems. Nuclear magnetic resonance spectroscopy (NMR). Combined instrumental systems (GC-MS, (U)HPLC-MS, HPLC-FTIR). Quality assurance of the results obtained: validation of analytical methods. All techniques will be presented through a combination of theoretical principles, presentation of instrumental techniques and examples from biotechnology production. **Seminars.** Individual student tasks: selecting and presenting an analytical method for the analysis of a selected compound (groups of compounds) (description of the instrumental technique, analytical method parameters, expected results, application of the method for the analysis of specific samples)	

Laboratory exercises. Analysis of selected compounds (sampling, sample preparation, separation, physicochemical characterization). Instrumental techniques that will be used for that purpose are: electroanalytical techniques (conductometry, potentiometry, voltammetry), zetasizer for zeta-potential determination, high-performance liquid chromatography, UV/Vis spectroscopy, IR spectroscopy, and gas chromatography.

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.

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 (lectures, seminars, laboratory exercises)	0.5	1-5	Attendance at classes, seminars and laboratory exercises	Attendance records	5	20
Knowledge tests (partial tests)	2.5	1-3	Studying for the partial knowledge test	Written exam	30	50
Final exam	1	1-3	Studying for the final exam	Oral exam	15	30
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 awarded during class, seminar and laboratory exercise attendance are added to the grade points granted for the final exam. 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	Availability via

	copies in the library	other media
Skoog DA, Holler FJ, Crouch SR: Principles of Instrumental analysis, 7th Ed., Cengage Learning, USA, 2018.	-	-
Additional Literature		
Vitha MF: Spectroscopy: Principles and Instrumentation, 1st Ed., Wiley, 2017.		
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.		