INDBIOT-E04: **EXTRACTION AND ISOLATION OF BIOACTIVE COMPOUNDS**	
GENERAL INFORMATION	
Course Coordinator(s)	Stela Jokić, PhD, full prof.
Associate(s)	Maja Molnar, PhD, assoc. prof. Martina Jakovljević, MSc
Study Programme	Interdisciplinary Graduate Study Programme in English: Biotechnology
Course Status	Elective
Year of Study, Semester	2nd Year / 4th Semester
Credits (ECTS)	**4**
Teaching Method (number of classes)	Lectures 20; Seminars 10; Exercises 15
Expected Number of Students in the Course	25-30
COURSE DESCRIPTION	
Course Aims	
This course aims to provide knowledge on various extraction processes and their applicability in extracting and isolating specific bioactive compounds from various plant-based materials, with emphasis on modern extraction and isolation techniques in laboratories and for industrial purposes.	
Prerequisites for Enrolment and the Entry Competencies Required for the Course	
-	
Learning Outcomes at the Programme Level Contributed by the Course	
INDBIOT-4; BIOTECH-3; BIOTECH-7; BIOTECH-8	
Learning Outcomes at the Course Level	
After successful completion of this course students are expected to be able to: 1. Classified the groups of bioactive compounds and compare the role of bioactive compounds and the importance of the process for the extraction and isolation of active compounds. 2. Compare the basic principle of various extraction, isolation, and purification techniques used on active compounds in laboratory and industrial conditions. 3. Define the modern extraction procedures and the devices used in the extraction process. 4. Differentiate the methods for the isolation of active compounds and define the identification methods. 5. Apply the appropriate extraction and isolation methods for the targeted active compounds in the original materials.	
Course Content	
Lectures. Role and significance of bioactive compounds. Preparation of plant-based materials for extraction (procedures of drying, milling, and others). Standard extraction procedure techniques. Distillation procedures for the isolation of volatile substances. Isolation and characterisation of essential oils. Modern extraction methods: Supercritical fluid extraction, Subcritical water extraction, Microwave assisted extraction, Ultrasound assisted extraction, Extraction using eutectic solvents. Production of dry extracts. Application of chromatographic techniques for the isolation and characterisation of active compounds. Chemical and analytical process control. **Seminars**. Operating principle of laboratory equipment used for standard and modern extraction procedures. Operating principle of chromatographic techniques used for identifying and quantifying natural compounds. Calculations of specific compounds in extracts based on the HPLC analysis. Application of GC/MS for the analysis of essential oils. **Laboratory exercises.** Preparing tinctures and macerates using standard extraction processes. Ultrasound and microwave assisted extraction of active compounds from plant-based materials. Extraction of various plant-based materials by applying supercritical CO_2 and subcritical water.	

Production of essential oils from medicinal plants. Production of extracts from marine organisms. Extraction using deep eutectic solvents. Production of dry extracts using the lyophilisation process and spray drying. Analysis of the extracts using chromatographic analyses (HPLC, GC-MS). Isolation of bioactive compounds using modern chromatographic methods**.** Investigating the antioxidation properties of the extracts.

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 hich 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	0.3	1-5	Attendance at classes	Keeping records	5	10
Seminars	1.2	2-4	Seminar work preparation	Presentation of seminar work	10	30
Laboratory exercises	0.5	5	Practical work	Laboratory exercises report	5	10
Final exam	2	1-5	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	Availability via

	copies in the library	other media
Rostagno MA, Prado JM: Natural Product Extraction Principles and Applications. RSC Publishing, 2013.		yes
Additional Literature		
Ibanez E, Cifuentes A: Green Extraction Techniques: Principles, Advances and Applications, Volume 76. Elsevier, 2017. Scientific papers demonstrating new methods for the extraction of active substances from various materials (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.		