

1.	<b>Field of study</b>	<b>Biotechnology</b>
2.	Faculty	Faculty of Natural Sciences
3.	Academic year of entry	2023/2024 (winter term), 2024/2025 (winter term)
4.	Level of qualifications/degree	first-cycle studies
5.	Degree profile	general academic
6.	Mode of study	full-time

<b>7. General information about the module</b>	
<b>Module name</b>	<b>Phytoremediation</b>
Module code	1BT_23_17
Number of the ECTS credits	2
Language of instruction	
Purpose and description of the content of education	The Phytoremediation module enables the student to become familiar with the physico-chemical methods of cleaning soils from heavy metals and phytoremediation as a method of environmental biotechnology. In the course of studying phytoremediation, the student will become introduced to the techniques used in phytoremediation (phytoextraction, phytostabilisation, rhizofiltration, phytodegradation, agromining and phytomining), phenomena occurring in the soil environment during phytoremediation, mechanisms of metal uptake by plants, plant resistance to heavy metals, the role of rhizosphere bacteria, ectomycorrhiza and arbuscular mycorrhiza in phytoremediation. In independently conducted experiments, the student acquires the ability to set up and run hydroponic cultures of plants, measure oxidative stress levels in plants and study the physiological state of plants using modern research equipment (e.g. fluorimeter, plant pigment meters, infrared gas analyser).
List of modules that must be completed before starting this module (if necessary)	not applicable

<b>8. Learning outcomes of the module</b>			
Code	Description	Learning outcomes of the programme	Level of competenc (scale 1-5)
1BT_23_17	The student defines and describes the basic physicochemical methods of cleaning soils from toxic elements. Presents phytoremediation as one of the methods of environmental biotechnology. Describes the processes occurring in soil during phytoremediation. Explains the mechanisms of uptake, accumulation and resistance of plants to heavy metals. Explains the phenomena occurring during plant growth stimulation by rhizosphere bacteria. Carries out experiments independently, describes the effects of the experiment, analyses the results, makes conclusions and presents them in the form of a report. Has the habit of updating specialist knowledge. Describes the role of arbuscular mycorrhiza and ectomycorrhiza as tools to support phytoremediation.	1BT_K01 1BT_K02 1BT_K03 1BT_K04 1BT_K05 1BT_U01 1BT_U02 1BT_U03 1BT_U04 1BT_U05 1BT_U06	2 5 3 2 5 4 3 2 4 4 4

		1BT_U07	4
		1BT_U08	2
		1BT_U09	4
		1BT_U11	1
		1BT_U12	1
		1BT_W02	5
		1BT_W06	2
		1BT_W08	2
		1BT_W09	3
		1BT_W11	3
		1BT_W13	3

9. Methods of conducting classes		
Code	Category	Name (description)
a02	Lecture methods / expository methods	Monographic lecture <i>an exhaustive discussion of one issue, usually related to the research interests of the person teaching the course or a thorough presentation of one selected issue</i>
a03	Lecture methods / expository methods	Description <i>a description of objects, phenomena, processes or people; it involves specifying the structure and characteristic features of the object, phenomenon, or process being described; it is usually accompanied by a demonstration of the described object or by its models, drawings, tables, charts, etc.; a description may take the form of an explanation, classification, justification or comparison</i>
b02	Problem-solving methods	Lecture-discussion <i>transmission of content involving interaction with the lecture audience; discussion of lecture-related issues is one of its elements or constitutes its follow-up</i>
b04	Problem-solving methods	Activating method – discussion / debate <i>an exchange of views supported by substantive arguments leading to a clash of different views, a compromise or the identification of common positions; it proceeds according to previously agreed-upon rules regarding the time, manner and turn-taking as well as the principles of civil discourse; a discussion is not a competition but aims at finding the best solutions or presenting different points of view; its varieties include brainstorming, Oxford-style debate, panel discussion, decision tree, conference discussion; a debate is an orderly dispute between supporters and opponents of a viewpoint, usually specialists in the field or pre-selected representatives of a group dealing with a common problem</i>
b07	Problem-solving methods	Activating methods: a case study <i>a comprehensive description of a phenomenon connected with the selected discipline; reflecting the reality, presenting the 'what', 'where' and 'how' of the phenomenon, i.e., all of its key aspects to be discussed in class; used as a reproduction, presentation, discussion or diagnosis of factors that shape the phenomenon or interact with it; an in-depth qualitative analysis and evaluation of a selected phenomenon</i>
b08	Problem-solving methods	Activating method – peer learning <i>learning through the exchange of knowledge in a group/team/pair of students, i.e., in the so-called learning cell; a kind of mutual learning; an approach focused on student activity under the guidance of the person teaching the course; a learning situation where students with a similar level of experience learn from one another</i>
b09	Problem-solving methods	Activating method – flipped classroom

		<i>anticipatory learning; work in class is based on previously studied material indicated by the person teaching the course; preparation outside the classroom serves the purpose of getting familiar with the issues whose knowledge is necessary for participating in the in-class discussion and the training in the related practical skills; the activity is based on the work of students under the guidance of the person teaching the course</i>
c06	Demonstration methods	<b>Demonstration-imitation</b> <i>a presentation of a model way of performing specific activities accompanied by a commentary; it aims at triggering imitation activities in an individual or in a group of participants observing the activities of the person teaching the course until the right habit is formed through regular exercise; the demonstration-imitation method is combined with a physical practice of activities/behaviours</i>
c07	Demonstration methods	<b>Screen presentation</b> <i>a presentation of synthetic image content using computer graphics, e.g., a series of slides or other multimedia forms, usually accompanied by a commentary; typical components of a screen presentation include text organized into bulleted points, charts, images and animations, sometimes sound effects or music; a multimedia illustration of course content presented in the form of a projected image</i>
d02	Programmed learning methods	<b>Working with a programmed textbook</b> <i>working with a textbook containing instructional material covering part of or the entire curriculum of the module as well as a formula for studying the content; includes working with a subject textbook, an atlas, a catalogue, a problem book, etc.</i>
d03	Programmed learning methods	<b>Working with another teaching tool</b> <i>e.g. using websites in any way or according to the rules set by the teacher; or making use of other subject-specific tools</i>
e01	Practical methods	<b>Laboratory exercise / experiment</b> <i>[also conducted as fieldwork] a method of practical application of knowledge; implemented in three stages: the recognition of a problem induced by the task content, the formulation of the problem and the attempt to solve it accompanied by the assessment of the effects; the goal is to acquire skills, abilities and habits, and to consolidate the acquired knowledge so that it becomes operational; the laboratory method assumes greater independence of learners than carrying out an experiment</i>
f01	Methods of self-learning	<b>Self-education</b> <i>a method which involves independent acquisition of knowledge, skills and social competences, extending their scope and quality; complementary to the learning process taking place in class; taking on the task of developing and adjusting qualifications on one's own; self-study</i>
f02	Methods of self-learning	<b>Individual work with a text</b> <i>searching for and acquiring new information using textbooks and other written sources (including their digital versions); searching for texts, selecting fragments for analysis/interpretation, using other texts to solve a problem related to the studied issue</i>

**10. Forms of teaching**

Code	Name	Number of hours	Assessment of the learning outcomes of the module	Learning outcomes of the module	Methods of conducting classes
1BT_23_17	lecture	15	course work	1BT_23_17	a02, a03, b02, c07, d02, d03, f01, f02
1BT_23_17	laboratory classes	15	course work	1BT_23_17	b04, b07, b08, b09, c06, c07, d02, d03, e01, f01, f02

**11. The student's work, apart from participation in classes, includes in particular:**

Code	Category	Name (description)	Is it part of the BUNA?
a02	Preparation for classes	Literature reading / analysis of source materials	Yes

		<i>reading the literature indicated in the syllabus; reviewing, organizing, analyzing and selecting source materials to be used in class</i>	
a03	Preparation for classes	Developing practical skills <i>activities involving the repetition, refinement and consolidation of practical skills, including those developed during previous classes or new skills necessary for the implementation of subsequent elements of the curriculum (as preparation for class participation)</i>	Yes
a05	Preparation for classes	Production/preparation of tools, materials or documentation necessary for class participation <i>developing, preparing and assessing the usefulness of tools and materials (e.g. aids, scenarios, research tools, equipment, etc.) to be employed in class or as an aid when preparing for classes</i>	Yes
b01	Consulting the curriculum and the organization of classes	Getting acquainted with the syllabus content <i>reading through the syllabus and getting acquainted with its content</i>	Yes
c01	Preparation for verification of learning outcomes	Determining the stages of task implementation contributing to the verification of learning outcomes <i>devising a task implementation strategy embracing the division of content, the range of activities, implementation time and/or the method(s) of obtaining the necessary materials and tools, etc.</i>	Yes
c03	Preparation for verification of learning outcomes	Implementation of an individual or group assignment necessary for course/phase/ examination completion <i>a set of activities aimed at performing an assigned task, to be executed out of class, as an obligatory phase/element of the verification of the learning outcomes assigned to the course</i>	Yes
d01	Consulting the results of the verification of learning outcomes	Analysis of the corrective feedback provided by the academic teacher on the results of the verification of learning outcomes <i>reading through the academic teacher's comments, assessments and opinions on the implementation of the task aimed at checking the level of the achieved learning outcomes</i>	Yes
d03	Consulting the results of the verification of learning outcomes	Review of internship documentation <i>an analysis of the portfolio of documentation obtained during internship, including professional internship, and other practical classes and studio sessions, as well as the documentation developed in order to obtain credit for such classes; verification of the description, necessary attachments, opinions and grades before submitting the portfolio for acceptance</i>	Yes

Information on the details of the module implementation in a given academic year can be found in the syllabus available in the USOS system: <https://usosweb.us.edu.pl>.