SZKOŁA GŁÓWNA GOSPODARSTWA WIEJSKIEGO

Plants vs Environmental Pollution – Phytoremediation Technology

Educational subject description sheet

Basic information

Field of study Course Offer for exchange students - second cycle studies, including uniform master studies (MA programmes) **Speciality** - **Organizational unit** Course Offer for exchange students **Study level** second cycle studies, including uniform master studies (MA programmes) **Study form** full-time studies **Education profile** General academic	**Didactic cycle** 2024/25 **Subject code** PWMPWM2S_D.B100000.06336.24 **Lecture languages** english **Mandatory** Elective subjects **Block** Basic subjects **Disciplines**

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Teacher	Robert Popek, Arkadiusz Przybysz

Period	**Examination**	**Number of ECTS points**
Winter semester	Exam **Activities and hours** Lecture: 15 Laboratory exercises: 30	3

Goals

Code	Goal
C1	Introducing students to definitions, historical overview, limitations, and sections of phytoremediation.
C2	Imparting knowledge on the main pollutants of soil, water, and air, including their sources and environmental risks.
C3	Highlighting to students the advantages and disadvantages of plants used in phytoremediation, focusing on their morphological and physiological characteristics.
C4	Raising students' awareness of the problems associated with conventional environmental remediation methods and the benefits of phytoremediation as an alternative technology.
C5	Developing skills in analyzing contaminated soil and selecting appropriate plant species for phytoremediation of heavy and noble metals.
C6	Equipping students with the ability to use plants in phytoremediation of organic pollutants and understanding plant-microbe interactions.
C7	Introducing students to methods of air and water phytoremediation, including the selection of plant species and the environmental conditions affecting the efficiency of these processes.
C8	Enhancing students' practical skills in applying phytoremediation technologies in various contexts, such as urban areas, saline environments, and residential and office buildings.

Entry requirements

Student should (i) have basic knowledge from (botany, environment protection, soil science, biochemistry, plant physiology, (ii) be able to work in group and (iii) be familiar with laboratory work.

Subject's learning outcomes

Code	Outcomes in terms of	Effects	Examination methods
Knowledge – Student knows and understands:			
W1	the physiological and environmental bases on which phytoremediation is based.		Written exam, Presentation, Test (written or computer based)
W2	the main pollutants of soil, water and air.		Written exam, Presentation, Test (written or computer based), Assessment of activity during classes
W3	the advantages and disadvantages of plants used in phytoremediation.		Written exam, Presentation, Test (written or computer based)
Skills – Student can:			
U1	use horticultural plants in phytoremediation.		Presentation, Test (written or computer based), Assessment of activity during classes

Code	Outcomes in terms of	Effects	Examination methods
U2	adapt the most favorable phytoremediation variant for a contaminated area.		Presentation, Test (written or computer based), Assessment of activity during classes
Social competences – Student is ready to:			
K1	demonstrate responsibility in the assessment of environmental threats, taking into account the broadly understood social interest.		Written exam, Presentation, Assessment of activity during classes
K2	raise its qualifications and look for new technological solutions.		Written exam, Presentation, Assessment of activity during classes

Study content

No.	Course content	Subject's learning outcomes	Activities
1.	Definitions, historical overview, limitations and sections of phytoremediation. An attempt will be taken to compare phytoremediation to conventional environment remediation methods.	W1, W2, W3, K1, K2	Lecture
2.	Botanical families and species recommended for phytoremediation from all the climatic zones will be presented. The most important morphological and physiological characteristics of plants, that allow for their use in phytoremediation will be highlighted.	W1, W3, U1, U2, K1, K2	Lecture, Laboratory exercises
3.	Phytoremediation of heavy and noble metals: • Characteristics of the most important heavy and noble metals. Their sources and environmental risk. • Analysis of soil contaminated with heavy metals. • Selection of plants species. Plants defense mechanisms against heavy metals. • Hyperaccumulation – physiological basis and examples of plants. • Methods increasing efficiency of metals phytoremediation. •Role of bacteria and fungi in phytoremediation of heavy metals.	W2, W3, U1, U2, K1, K2	Lecture, Laboratory exercises
4.	Phytoremediation of organic pollutants: • Characteristics of the most important organic pollutants (BTEX, PAH, PCDD/Fs, PCB, TCE, TNT, petroleum). Their sources and environmental risk. • Degradation/accumulation of organic contaminates by plants and microorganisms. • Plants-microbes interactions as a key factor in phytoremediation of organics contaminants. • Environmental conditions affecting organics degradation.	W2, W3, U1, U2, K1, K2	Lecture, Laboratory exercises

No.	Course content	Subject's learning outcomes	Activities
5.	Air phytoremediation: • Main air pollutants: particulate matter, gases (NOx, SO2, CO, O3) and organics (benzene and formaldehyde). • Selection of plants species. Tolerance of plants to air pollutants. • Accumulation of particulate matter, role of wax in this process. • Environmental conditions affecting air phytoremediation.	W2, W3, U1, U2, K1, K2	Lecture, Laboratory exercises
6.	Phytoremediation of water. • Main water pollutants, their sources and environmental threats. • Ways of using plants for phytoremediation of contaminated water bodies.	W2, W3, U1, U2, K1, K2	Lecture, Laboratory exercises
7.	Indoor phytoremediation (residential buildings and offices).	W2, U1, U2, K1, K2	Lecture, Laboratory exercises
8.	Phytoremediation of urban and saline areas	W2, W3, U1, U2, K1, K2	Lecture, Laboratory exercises

Course advanced

Activities	Methods of conducting classes
Lecture	Lecture, Conversation lecture, Discussion, Presentation
Laboratory exercises	Presentation, Problem method, Design method, Analysis of source materials, Teamwork, Laboratory (experiment), learning by experiment, Observation, Field measurements, Field observations, Measurement

Activities	Examination method	Percentage
Lecture	Written exam	50%
Laboratory exercises	Test (written or computer based)	30%
Laboratory exercises	Assessment of activity during classes	5%
Laboratory exercises	Presentation	15%

Activities	Credit conditions
Lecture	The assessment of the learning outcomes consists of the assessment of the written completion of the lectures. The condition for passing the course is obtaining a minimum of 51% from item exam.
Laboratory exercises	The assessment of the learning outcomes consists of: 1 - the assessment of the written exam, 2 - active participation in classes, and 3 preparing a presenation about phytoremediation experiments. The condition for passing the course is obtaining a minimum of 51% from all activities.

Literature

Obligatory

1. Sherameti I., Varma Ajit. 2011. Detoxification of Heavy Metals. Springer-Verlag Berlin Heidelberg.
2. Tsao D.T. 2002. Advances in Biochemical Engineering Biotechnology – Phytoremediation. Springer-Verlag Berlin Heidelberg New York.
3. Bell J.N.B., Treshow M. 2002. Air Pollution and Plant Life. J. Wiley & Sons Ltd.

Optional

1. Kvesitadze G., Khatisashvili G., Sadunishvili T., Ramsden J.J. 2006. Biochemical Mechanisms of Detoxification in Higher Plants. Basis of Phytoremediation Springer-Verlag Berlin Heidelberg.
2. Morel J.-L., Echevarria G., Goncharova N. Phytoremediation of Metal-Contaminated Soils. Springer, Dordrecht, The Netherlands.
3. Gawroński S.W. Greger M., Gawrońska 2011. Plant taxonomy in metal phytoremediation. In: Eds. Sherameti I., Varma A. 2011. Detoxification of Heavy Metals, Springer-Verlag: 91-110.
4. McCutcheon S.C., Schnoor J.L. 2003. Phytoremediation: Transformation and Control of Contamination. J. Wiley & Sons Ltd.
5. Materials provided by lecturers.

Calculation of ECTS points

Activity form	**Activity hours***
Lecture	15
Laboratory exercises	30
Preparation of a multimedia presentation	15
Preparation for the test	15
Preparation for exercises	5
Self-study on the content covered in class	10
Student workload	**Hours** 90
Number of ECTS points	**ECTS** 3

* hour means 45 minutes