

## Subject card

|                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                          |                                         |                                     |         |                                                                                                                                                |     |
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| Subject name and code                       | Technology of soil remediation, PG_00117764                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                          |                                         |                                     |         |                                                                                                                                                |     |
| Field of study                              | Chemistry                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                          |                                         |                                     |         |                                                                                                                                                |     |
| Date of commencement of studies             | October 2025                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                          | Academic year of realisation of subject |                                     |         | 2025/2026                                                                                                                                      |     |
| Education level                             | Master's studies                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                          | Subject group                           |                                     |         | Obligatory subject group in the field of study<br>Optional subject group<br>Subject group related to scientific research in the field of study |     |
| Mode of study                               | full-time studies                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                          | Mode of delivery                        |                                     |         | at the university                                                                                                                              |     |
| Year of study                               | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                          | Language of instruction                 |                                     |         | Polish                                                                                                                                         |     |
| Semester of study                           | 2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                          | ECTS credits                            |                                     |         | 1.0                                                                                                                                            |     |
| Learning profile                            | academic                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                          | Assessment form                         |                                     |         | credit                                                                                                                                         |     |
| Conducting unit                             | Laboratory of Photocatalysis -> Department of Environmental Technology -> Faculty of Chemistry -> Rector                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                          |                                         |                                     |         |                                                                                                                                                |     |
| Name and surname of lecturer (lecturers)    | Subject supervisor                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                          | dr hab. inż. Ewelina Grabowska-Musiał   |                                     |         |                                                                                                                                                |     |
|                                             | Teachers                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                          |                                         |                                     |         |                                                                                                                                                |     |
| Lesson types                                | Lesson type                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Lecture                                                  | Tutorial                                | Laboratory                          | Project | Seminar                                                                                                                                        | SUM |
|                                             | Number of study hours                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 0.0                                                      | 0.0                                     | 15.0                                | 0.0     | 0.0                                                                                                                                            | 15  |
|                                             | E-learning hours included: 0.0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                          |                                         |                                     |         |                                                                                                                                                |     |
| Learning activity and number of study hours | Learning activity                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Participation in didactic classes included in study plan |                                         | Participation in consultation hours |         | Self-study                                                                                                                                     | SUM |
|                                             | Number of study hours                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 15                                                       |                                         | 2.0                                 |         | 8.0                                                                                                                                            | 25  |
| Subject objectives                          | <p>Familiarizing students with all issues mentioned in the lecture program content.</p> <p>To familiarize students with the main stages of the technological process used to remediate contaminated soils.</p> <p>To familiarize students with instrumental analysis techniques.</p> <p>Developing the ability to independently perform calculations necessary for the correct interpretation of analysis results<br/>Developing the ability to independently select the appropriate remediation technique for a given purpose.</p> |                                                          |                                         |                                     |         |                                                                                                                                                |     |

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|----------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------|
| Learning outcomes                                              | Course outcome                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Subject outcome                                                                                                                                                                                                                                                                                                                                                                              | Method of verification                                                                            |
|                                                                | [CHEMMU2_W05] Has extended knowledge in the field of the specialisation studied.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | It assesses selected properties of contaminated soil and assesses its effectiveness remediation of contaminated soils (by bioremediation and washing)                                                                                                                                                                                                                                        | [SW4] test/exam - oral or written<br>[SW1] oral statement/<br>conversation/discussion             |
|                                                                | [CHEMMU2_U01] Plans and implements chemical experiments of medium complexity.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Demonstrates the ability to carry out physicochemical and technological measurements, important for removing pollutants from the soil environment                                                                                                                                                                                                                                            | [SU4] test/exam - oral or written<br>[SU8] observation of student's independent or team work      |
|                                                                | [CHEMMU2_K01] Knows the limitations of her/his own knowledge; understands the need for further education and can inspire other people to do so.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | can independently search for additional literature and expand knowledge based on it                                                                                                                                                                                                                                                                                                          | [SK5] implementation of a problem task                                                            |
|                                                                | [CHEMMU2_W12] Knows the principles of occupational health and safety to the extent that allows independent work on a research and/or measurement position.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | applies safety rules in the workplace                                                                                                                                                                                                                                                                                                                                                        | [SW5] implementation of a problem task                                                            |
|                                                                | [CHEMMU2_K03] Understands the need for systematic work on various projects of a long-term nature and knows how to set priorities for the implementation of undertaken tasks.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Talks about environmental remediation technology issues in understandable language, using correct nomenclature                                                                                                                                                                                                                                                                               | [SK5] implementation of a problem task<br>[SK8] observation of student's independent or team work |
|                                                                | [CHEMMU2_W02] Has extended and in-depth knowledge in the field of basic chemistry.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Talks about environmental remediation technology issues in understandable language, using correct nomenclature                                                                                                                                                                                                                                                                               | [SW1] oral statement/<br>conversation/discussion<br>[SW5] implementation of a problem task        |
| Subject contents                                               | Sources and types of pollution. Characteristics of pollutants: pesticides and petroleum substances, heavy metals and radionuclides. Soil characteristics. Types of soil sorption. Spread of harmful substances in the environment. Characteristics of groundwater. The fate of pollutants in water and soil (chemical, biochemical and photochemical processes). The impact of pollutants on the physical and mechanical properties of soil. Soil reclamation - definitions and basic tasks of the process. Division of soil remediation methods. Physico-chemical methods of soil reclamation. Biological methods of soil reclamation. Thermal methods of soil reclamation. Stabilization and solidification In-situ and ex-situ groundwater purification methods. Methods of sealing waste landfills and types of insulating layers. |                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                   |
| Prerequisites and co-requisites                                | General chemistry, organic chemistry, inorganic chemistry, analytical chemistry, physical chemistry.<br><br>Knowledge of the basics of general chemistry, organic chemistry and physical chemistry, as well as knowledge of the basics of chemical analysis methods.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                   |
| Assessment methods and criteria                                | Subject passing criteria                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Passing threshold                                                                                                                                                                                                                                                                                                                                                                            | Percentage of the final grade                                                                     |
|                                                                | laboratory exercises                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 51.0%                                                                                                                                                                                                                                                                                                                                                                                        | 100.0%                                                                                            |
| Recommended reading                                            | Basic literature                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Kowalik P., Ochrona środowiska glebowego, PWN, Warszawa, 2001.<br>Zadroga B., Olańczuk-Neyman K., Ochrona i rekultywacja podłoża gruntowego, Wydawnictwo Politechniki Gdańskiej, 2001.<br><br>Greinert H., Ochrona gleb, Wydawnictwo Politechniki Zielonogórskiej, Zielona Góra, 1998.<br>Gworek B (red), Technologie rekultywacji gleb, Wydawnictwo Naukowe Gabriel Borowski, Warszawa 2004 |                                                                                                   |
|                                                                | Supplementary literature                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Szyk J., Ocieki ze składowisk odpadów komunalnych, Wydawnictwo Naukowe Gabriel Borowski, Warszawa 2003<br>Olszanowski A. (red.), Remediacja i bioremediacja zanieczyszczonych wód i gruntów oraz wykorzystanie modelowania i technik informatycznych w inżynierii, Wydawnictwo Politechniki Poznańskiej, 2001                                                                                |                                                                                                   |
|                                                                | eResources addresses                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                   |
| Example issues/<br>example questions/<br>tasks being completed | not specified                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                   |
| Work placement                                                 | Not applicable                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                   |

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