



## Subject card

|                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                          |                                         |                                     |                                                                                              |            |     |
|---------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------|-----------------------------------------|-------------------------------------|----------------------------------------------------------------------------------------------|------------|-----|
| Subject name and code                       | CHEMISTRY OF THE ATMOSPHERE AND WATER. CLIMATE CHANGES, PG_00064416                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                          |                                         |                                     |                                                                                              |            |     |
| Field of study                              | Chemistry                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                          |                                         |                                     |                                                                                              |            |     |
| Date of commencement of studies             | October 2024                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                          | Academic year of realisation of subject |                                     | 2026/2027                                                                                    |            |     |
| Education level                             | first-cycle studies                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                          | Subject group                           |                                     | 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                               | 3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                          | Language of instruction                 |                                     | Polish                                                                                       |            |     |
| Semester of study                           | 6                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                          | ECTS credits                            |                                     | 6.0                                                                                          |            |     |
| Learning profile                            | general academic profile                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                          | Assessment form                         |                                     | exam                                                                                         |            |     |
| Conducting unit                             | Department of Analytical Chemistry -> Faculty of Chemistry -> Faculties of Gdańsk University of Technology                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                          |                                         |                                     |                                                                                              |            |     |
| Name and surname of lecturer (lecturers)    | Subject supervisor                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                          | prof. dr hab. inż. Bożena Zabiegała     |                                     |                                                                                              |            |     |
|                                             | Teachers                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                          |                                         |                                     |                                                                                              |            |     |
| Lesson types                                | Lesson type                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Lecture                                                  | Tutorial                                | Laboratory                          | Project                                                                                      | Seminar    | SUM |
|                                             | Number of study hours                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 30.0                                                     | 0.0                                     | 60.0                                | 0.0                                                                                          | 0.0        | 90  |
|                                             | 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                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 90                                                       |                                         | 8.0                                 |                                                                                              | 52.0       | 150 |
| Subject objectives                          | The aim of the course is to familiarize students with the chemical processes occurring in the atmosphere and hydrosphere, the mechanisms of the formation and transformation of air and water pollutants, the impact of human activities on atmospheric composition and water quality, the chemical basis of climate change, methods for monitoring air and water quality, modern analytical techniques used in environmental studies, and the practical performance of environmental analyses together with the interpretation of the obtained results. |                                                          |                                         |                                     |                                                                                              |            |     |

| Learning outcomes               | Course outcome                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Subject outcome                                                                                                                                                                                                                                                                                                                                                         | Method of verification                                                                                        |
|---------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------|
|                                 | [K6_U07] is able to undertake accurate and precise analytical measurements, to synthesise simple and large-molecular chemical compounds, to purify and analyse their composition and to determine their structure using classical and instrumental methods                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Is able to independently design and perform simple experiments to determine the concentration of selected environmental pollutants. Is able to process and interpret the obtained results and, based on them, assess the environmental quality and the degree of contamination with reference to applicable standards and regulations.                                  | [SU1] Assessment of task fulfilment<br>[SU3] Assessment of ability to use knowledge gained from the subject   |
|                                 | [K6_W02] classifies acquired information, assessing its usefulness in solving the posed problems concerning the synthesis and analysis of selected groups of compounds, determining their physical and chemical properties, making measurements and determining the parameters of chemical reactions and processes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | has the knowledge necessary to: describe the physicochemical processes occurring in the atmosphere and hydrosphere; assess the impact of human activities on the chemical composition and quality of specific components of the environment; explain the chemical basis of the greenhouse effect and current climate changes                                            | [SW3] Assessment of knowledge contained in written work and projects<br>[SW1] Assessment of factual knowledge |
|                                 | [K6_K05] is aware of his/her social role as a graduate of a technical university, particularly in terms of communicating information and opinions to the public, and undertakes to communicate such information in an understandable way                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Understands the need to continuously expand and share knowledge about the environment and is able to use this knowledge to assess the significance of chemical processes occurring in the environment and their impact on environmental quality and human life, as well as to promote pro-environmental attitudes.                                                      | [SK4] Assessment of communication skills, including language correctness                                      |
|                                 | [K6_U09] is able to recognise hazards, counteract them and work with chemical reagents and basic technical apparatus in accordance with health and safety principles and the concept of sustainability                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Is able to identify hazards associated with working with chemical reagents and equipment used in the analysis of the atmosphere and water, and to select appropriate personal protective equipment. Is able to correctly classify chemical waste generated during laboratory experiments in accordance with safety regulations and environmental protection principles. | [SU4] Assessment of ability to use methods and tools<br>[SU2] Assessment of ability to analyse information    |
| Subject contents                | <p>Course content – lecture</p> <ul style="list-style-type: none"> <li>Structure and chemical composition of the atmosphere, hydrosphere, lithosphere, and biosphere.</li> <li>Factors shaping the Earth's climate; the Earth's energy balance and processes that disturb or influence it; the greenhouse effect.</li> <li>Atmospheric chemistry; sources and characteristics of environmental pollutants; natural and anthropogenic emission sources.</li> <li>Chemical transformations of air pollutants: photochemical reactions, hydrolysis, sorption, oxidation, and reduction.</li> <li>Air pollutants: particulate matter (PM), sulfur, nitrogen, and carbon oxides, heavy metals, volatile organic compounds (VOCs), atmospheric aerosols (primary and secondary), and their role in climate formation.</li> <li>The hydrosphere.</li> <li>Water pollutants: organic and inorganic substances, detergents, pesticides, heavy metals, and nutrients.</li> <li>Chemical transformations of water pollutants: photochemical reactions, hydrolysis, sorption, oxidation, and reduction.</li> </ul> |                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                               |
|                                 | <p>Course content – laboratory</p> <p>Laboratory classes develop practical skills in environmental sampling (from various environmental compartments, including air and water), sample preparation for analysis taking into account the chemical properties of the target pollutants and their concentration levels in the environment, determination of selected physicochemical parameters in environmental samples, and preparation of a laboratory report including the interpretation of the obtained results in the context of environmental quality and human health.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                               |
| Prerequisites and co-requisites | Students should have prior knowledge of general, inorganic, physical, and analytical chemistry, as well as the fundamentals of statistics and data analysis. They should also possess the knowledge necessary to understand the fundamental physicochemical processes occurring in the environment.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                               |

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| Assessment methods and criteria         | Subject passing criteria                                                             | Passing threshold                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Percentage of the final grade |
|                                         | Successful completion and positive evaluation of 13 individual laboratory exercises. | 60.0%                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 40.0%                         |
|                                         | Written examination and/or active participation in an academic debate.               | 60.0%                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 60.0%                         |
| Recommended reading                     | Basic literature                                                                     | 1. Seinfeld J.H., Pandis S.N., *Atmospheric Chemistry and Physics<br><br>2.P. O'Neill, Chemia środowiska, PWN, Warszawa 1997.<br><br>3. G.W. van Loon, S.J. Duffy, Chemia środowiska, PWN, Warszawa 2007<br><br>4. S.F. Zakrzewski, Podstawy toksykologii środowiska, PWN, Warszawa 1995.<br><br>5. B.J. Alloway, D.C. Ayres, Chemiczne podstawy zanieczyszczenia środowiska, PWN, Warszawa 1999.<br><br>6. M. Siemiński, Środowiskowe zagrożenia zdrowia, PWN, Warszawa 2007. |                               |
|                                         | Supplementary literature                                                             | 1. J. Namieśnik, J. Łukasiak, Z.Jamrógiewicz, Pobieranie próbek środowiskowych do analizy, PWN, warszawa 1995.<br>Charles J. Krebs, Ekologia, PWN Warszawa 1996.<br>2. Fizykochemiczne metody kontroli zanieczyszczeń środowiska, [red] J. Namieśnik i Z. Jamrógiewicz, WN-T, Warszawa 1998..                                                                                                                                                                                  |                               |
|                                         | eResources addresses                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                               |
|                                         | Example issues/<br>example questions/<br>tasks being completed                       | <ul style="list-style-type: none"><li>• Tropospheric ozone, its formation mechanism and impact on the environment.</li><li>• Albedo: definition and its influence on the Earth's energy balance.</li><li>• Chemical basis of climate change.</li><li>• Primary and secondary atmospheric aerosols.</li><li>• Hydroxyl radical and its role in the chemistry of the atmosphere and hydrosphere.</li><li>• Water pollution.</li></ul>                                            |                               |
| Practical activities within the subject | Not applicable                                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                               |

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