



## Subject card

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|---------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------|------------|-----|
| Subject name and code                       | Techniques for assessing the chemical quality of materials, PG_00066243                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                          |                                                                                                                                          |                                     |                                                                                                                                                  |            |     |
| Field of study                              | Chemistry                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                          |                                                                                                                                          |                                     |                                                                                                                                                  |            |     |
| Date of commencement of studies             | February 2027                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                          | Academic year of realisation of subject                                                                                                  |                                     | 2027/2028                                                                                                                                        |            |     |
| Education level                             | second-cycle studies                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                          | Subject group                                                                                                                            |                                     | Specialty subject group                                                                                                                          |            |     |
| 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                                                                                                                             |                                     | 3.0                                                                                                                                              |            |     |
| 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. Piotr Konieczka                                                                                                       |                                     |                                                                                                                                                  |            |     |
|                                             | Teachers                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                          |                                                                                                                                          |                                     |                                                                                                                                                  |            |     |
| Lesson types                                | Lesson type                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Lecture                                                  | Tutorial                                                                                                                                 | Laboratory                          | Project                                                                                                                                          | Seminar    | SUM |
|                                             | Number of study hours                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 15.0                                                     | 0.0                                                                                                                                      | 30.0                                | 0.0                                                                                                                                              | 0.0        | 45  |
|                                             | 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                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 45                                                       |                                                                                                                                          | 5.0                                 |                                                                                                                                                  | 25.0       | 75  |
| Subject objectives                          | To familiarize students with the methods and techniques used to assess the chemical quality of various types of materials. To develop the ability to select analytical methods appropriate to the type of material and the purpose of the study, prepare samples, perform analyses, and interpret results in the context of assessing material quality. To develop the ability to critically evaluate test results and draw conclusions regarding the composition, properties, and quality of the material under study. |                                                          |                                                                                                                                          |                                     |                                                                                                                                                  |            |     |
| Learning outcomes                           | Course outcome                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                          | Subject outcome                                                                                                                          |                                     | Method of verification                                                                                                                           |            |     |
|                                             | [K7_W02] identifies analytical techniques appropriate for solving specific analytical tasks – also in the production plant                                                                                                                                                                                                                                                                                                                                                                                              |                                                          | knows and understands the principles for selecting analytical methods used to assess the chemical composition and quality of materials.  |                                     | [SW3] Assessment of knowledge contained in written work and projects                                                                             |            |     |
|                                             | [K7_W05] defines the principles of sustainable development, national and European conditions for environmental management, in the field of intellectual property protection and patent law                                                                                                                                                                                                                                                                                                                              |                                                          | is familiar with the capabilities, limitations, and areas of application of selected instrumental techniques in materials research.      |                                     | [SW1] Assessment of factual knowledge                                                                                                            |            |     |
|                                             | [K7_K03] understands non-technical aspects and effects of the graduate's activities, including the impact of the chemical industry on the environment                                                                                                                                                                                                                                                                                                                                                                   |                                                          | is prepared to critically evaluate research findings and responsibly draw conclusions regarding the quality of the material under study. |                                     | [SK4] Assessment of communication skills, including language correctness<br>[SK5] Assessment of ability to solve problems that arise in practice |            |     |

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| Subject contents                                               | <p>Course content – lecture</p> <p>1. Chemical Quality of Materials – 2 hours. The concept of material quality. Parameters characterizing composition and chemical properties. Quality criteria. Selection of a method based on the type of material and the purpose of the analysis.</p> <p>2. Sample collection and preparation – 2 hours. Sample representativeness, homogenization, grinding, mineralization, extraction, and dissolution. Sources of errors and contaminants.</p> <p>3. Spectroscopic techniques in material evaluation – 3 hours. Application of atomic and molecular spectroscopy to identify and determine the components of materials. Capabilities and limitations of the methods.</p> <p>4. Chromatographic and separation techniques – 2 hours. Assessment of the chemical composition of materials containing organic components. Identification and determination of contaminants.</p> <p>5. Electrochemical techniques and other instrumental methods – 2 hours. Selection of methods for determining specific properties and components of materials.</p> <p>6. Evaluation of test result quality – 2 hours. Precision, accuracy, selectivity, limits of quantification, uncertainty, and criteria for accepting results.</p> <p>7. Strategies for comprehensive material quality assessment – 2 hours. Combining results obtained using different techniques. Comparison of materials. Assessment of compliance with specifications. Case studies.</p> <p>Course content – laboratory</p> <p>Proposed modules:</p> <p>1. Preparation of materials for analysis – 5 hours<br/>Homogenization, dissolution/mineralization, or extraction, and evaluation of the impact of sample preparation on the results.</p> <p>2. Evaluation of the elemental composition of the material – 5 hours<br/>Application of a selected atomic spectrometry technique. Determination of major and/or trace elements.</p> <p>3. Spectroscopic identification and evaluation of material – 5 h<br/>Application of, for example, FTIR, UV-Vis, or another available spectroscopic technique to identify the material, its components, or changes in quality.</p> <p>4. Evaluation of organic components – 5 hours<br/>Application of a chromatographic or spectroscopic technique to evaluate the composition or contaminants in a material.</p> <p>5. Comparative evaluation of material quality – 5 hours<br/>Analysis of several samples of the same type, comparison of results, and identification of quality differences.</p> <p>6. Comprehensive evaluation of an unknown material – 5 hours<br/>Selection of a technique, performing the analysis, compiling the results, and formulating a final quality assessment.</p> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                               |
| Prerequisites and co-requisites                                | Knowledge of the fundamentals of analytical chemistry, instrumental analysis, and statistical analysis of results. Basic knowledge of spectroscopic, electrochemical, and chromatographic methods, as well as the principles of sample preparation for analysis.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                               |
| Assessment methods and criteria                                | Subject passing criteria                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Passing threshold                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Percentage of the final grade |
|                                                                | Lecture: assessment test                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 60.0%                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 50.0%                         |
|                                                                | laboratory reports                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 60.0%                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 50.0%                         |
| Recommended reading                                            | Basic literature                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | <ul style="list-style-type: none"><li>• Skoog D.A., Holler F.J., Crouch S.R., <i>Principles of Instrumental Analysis</i>, Cengage Learning.</li><li>• Harris D.C., Lucy C.A., <i>Quantitative Chemical Analysis</i>, Macmillan Learning.</li><li>• Rouessac F., Rouessac A., <i>Chemical Analysis: Modern Instrumentation Methods and Techniques</i>, Wiley.</li><li>• Szczepaniak W., <i>Metody instrumentalne w analizie chemicznej [Instrumental Methods in Chemical Analysis]</i>, PWN, Warsaw.</li></ul>                                                                                                                                                                                                                                                                                                                                                             |                               |
|                                                                | Supplementary literature                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | <ul style="list-style-type: none"><li>• Rouessac F., Rouessac A., <i>Chemical Analysis: Modern Instrumentation Methods and Techniques</i>, Wiley.</li><li>• Miller J.N., Miller J.C., <i>Statistics and Chemometrics for Analytical Chemistry</i>, Pearson.</li><li>• Mester Z., Sturgeon R. (eds.), <i>Sample Preparation for Trace Element Analysis</i>, Elsevier.</li><li>• Current <b>ISO/EN standards</b> concerning sampling, sample preparation, chemical analysis and quality assessment of materials.</li><li>• Current scientific publications in the fields of analytical chemistry, instrumental analysis and materials characterization, particularly from journals such as <i>Analytical Chemistry</i>, <i>Analytica Chimica Acta</i>, <i>Talanta</i>, <i>Spectrochimica Acta Part A/B</i>, and <i>Journal of Analytical Atomic Spectrometry</i>.</li></ul> |                               |
|                                                                | eResources addresses                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                               |
| Example issues/<br>example questions/<br>tasks being completed | Sampling and preparation of material samples<br>Selection of analytical techniques based on material type<br>Assessment of the elemental composition of materials<br>Spectroscopic identification of materials<br>Determination of organic components and contaminants<br>Comparative evaluation of material quality<br>Evaluation of the quality and reliability of analytical results<br>Evaluation of material compliance with requirements/specifications<br>Interpretation of results obtained using various techniques<br>Comprehensive evaluation of the quality of an unknown material                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                               |
| Practical activities within the subject                        | Not applicable                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                               |

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