GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

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| Subject name and code | Certified reference materials, PG_00066098 | | |
| 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 | 2.0 |
| Learning profile | general academic profile | Assessment form | assessment |
| 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 | 0.0 | 15.0 | 0.0 | 30 |

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 | 30 | 5.0 | 15.0 | 50 |

**Subject objectives**

To familiarize students with the role of reference materials (RM) and certified reference materials (CRM) in chemical metrology, ensuring measurement consistency and quality control of chemical analysis results. To develop the skills necessary for the proper selection, evaluation, and use of CRMs in the analytical process, particularly during method validation, estimation of measurement uncertainty, and evaluation of the validity of results. To prepare students to critically analyze reference material certificates and independently design a method for applying CRMs to solve a specific analytical problem.

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**Learning outcomes**

| Course outcome | Subject outcome | Method of verification |
|---|---|---|
| [K7_U01] integrates and interprets information from literature, databases and other sources | is able to select the appropriate CRM for a specific analytical task, analyze its certificate, and use the CRM data to evaluate the validity of the method and the measurement result. | [SU1] Assessment of task fulfilment<br>[SU5] Assessment of ability to present the results of task |
| [K7_K01] is aware of the problems related to the profession of a chemist, is able to assess the effects of the activity performed | is aware of the importance of reliability, measurement traceability, and documented quality of chemical test results, as well as the need to critically evaluate the reference sources used. | [SK1] Assessment of group work skills<br>[SK4] Assessment of communication skills, including language correctness |
| [K7_W02] identifies analytical techniques appropriate for solving specific analytical tasks – also in the production plant | knows and understands the basic concepts of chemical metrology related to reference materials, in particular RM, CRM, certified value, uncertainty, homogeneity, stability, and measurement traceability. | [SW1] Assessment of factual knowledge |
| [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 principles of producing, characterizing, certifying, and using reference materials and understands their role in ensuring the quality of chemical measurement results. | [SW3] Assessment of knowledge contained in written work and projects |

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| Subject contents | Course content – lecture<br><br>7 blocks of 2 hours each + 1 hour for summary/assessment:<br>1. Fundamentals of chemical metrology – 2 hours. The concept of a measurement result, measurement traceability, measurement uncertainty, standards and reference materials in chemical measurements. The role of reference materials in the quality assurance system.<br>2. Reference materials and certified reference materials – 2 hours. Definitions of RM and CRM. Types of reference materials. Matrix materials, pure substances, standard solutions. Property values and their uncertainties.<br>3. Production of reference materials – 2 hours. Production planning, material preparation, ensuring homogeneity, short- and long-term stability testing, transport, and storage.<br>4. Characterization and certification of CRMs – 2 hours. Characterization strategies, primary methods, interlaboratory tests, assignment of reference values, uncertainty budget for the certified value.<br>5. CRM Certificate and Material Selection – 2 hours. Interpretation of the certificate, scope of application, commutability, matrix compatibility, concentration level, validity period, minimum sample weight. Criteria for selecting CRMs.<br>6. Use of CRMs in the laboratory – 2 hours. Validation and verification of analytical methods, assessment of method performance and bias, quality control, control charts, estimation of measurement uncertainty.<br><br>7. Manufacturers, Availability, and Quality Requirements – 2 hours. Competencies of reference material manufacturers; ISO 17034 and ISO/IEC 17025 requirements; CRM databases and catalogs; examples of materials used in environmental analysis, food, materials, pharmaceuticals, and biological samples.<br>8. Summary / Final Assessment – 1 hour.<br><br>Course content – project<br><br>As part of the 15-hour project, the student:<br>- defines the measurement problem and the requirements for the CRM;<br>- searches for available reference materials;<br>- establishes selection criteria and compares available CRMs;<br>- analyzes the certificate for the selected material in detail;<br>- evaluates the matrix compatibility, concentration range, uncertainty of the certified value, homogeneity, stability, and method of use;<br>- designs the use of the CRM in the analytical procedure;<br>- proposes a method for evaluating recovery/loading and the agreement of the obtained result with the certified value;<br>- determines the role of the CRM in ensuring measurement consistency and/or estimating uncertainty;<br>- prepares a project report and a brief presentation of the results. |
| Prerequisites and co-requisites | Basic knowledge of analytical chemistry and instrumental analysis. Knowledge of the fundamentals of statistics and the interpretation of chemical measurement results. Ability to search for and critically analyze scientific literature and technical information in Polish and English. |
| Assessment methods and criteria | |

| Subject passing criteria | Passing threshold | Percentage of the final grade |
|---|---|---|
| test - lecture | 60.0% | 40.0% |
| project report | 60.0% | 60.0% |

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| Recommended reading | Basic literature | • ISO 17034, *General requirements for the competence of reference material producers*.<br>• ISO Guide 35, *Reference materials — Guidance for characterization and assessment of homogeneity and stability*.<br>• ISO Guide 30, *Reference materials — Selected terms and definitions*.<br>• ISO Guide 33, *Reference materials — Good practice in using reference materials*.<br>• ISO/IEC 17025, *General requirements for the competence of testing and calibration laboratories*.<br>• Eurachem materials and guides on the quality of chemical measurements, measurement traceability, validation, and uncertainty. |
| | Supplementary literature | |
| | eResources addresses | |
| Example issues/ example questions/ tasks being completed | Analysis of a CRM Certificate<br>Selecting a CRM for an Analytical Problem<br>Evaluation of CRM Suitability and Comparison<br>Assessment of Result Conformity with the Certified Value<br>Use of CRMs in Method Validation<br>CRMs in Quality Control of Results<br>Assessment of CRM Homogeneity and Stability<br>Uncertainty of the Certified Value<br>Measurement traceabilityof CRMs<br>Criteria for Acceptance of Results Using CRMs | |
| Practical activites within the subject | Not applicable | |

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