



## Subject card

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|---|--|--|-------------------------------------|------------|---|---------|-----|
| Subject name and code                       | EXTRACTION TECHNIQUES FOR THE PREPARATION OF SAMPLES FOR ANALYSIS, PG_00064299   |  |                                     |            |   |         |     |
| Field of study                              | Chemical Technology  |  |                                     |            |   |         |     |
| Date of commencement of studies             | February 2025  | Academic year of realisation of subject                  |                                     |            | 2024/2025   |         |     |
| Education level                             | second-cycle studies   | Subject group  |                                     |            | Optional subject group<br>Specialty subject group<br>Subject group related to scientific research in the field of study |         |     |
| Mode of study                               | Full-time studies  | Mode of delivery   |                                     |            | at the university   |         |     |
| Year of study                               | 1  | Language of instruction                                  |                                     |            | Polish  |         |     |
| Semester of study                           | 1  | ECTS credits   |                                     |            | 5.0   |         |     |
| Learning profile                            | general academic profile   | Assessment form  |                                     |            | assessment  |         |     |
| Conducting unit                             | Department of Analytical Chemistry -> Faculty of Chemistry   |  |                                     |            |   |         |     |
| Name and surname of lecturer (lecturers)    | Subject supervisor   | prof. dr hab. inż. Agata Kot-Wasik                       |                                     |            |   |         |     |
|   | Teachers   | prof. dr hab. inż. Agata Kot-Wasik                       |                                     |            |   |         |     |
| Lesson types and methods of instruction     | Lesson type  | Lecture  | Tutorial                            | Laboratory | Project   | Seminar | SUM |
|   | Number of study hours  | 30.0   | 0.0                                 | 45.0       | 0.0   | 0.0     | 75  |
|   | 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  | 75   | 5.0                                 |            | 45.0  |         | 125 |
| Subject objectives                          | <p>The most time- and labor-consuming and most difficult stage of the entire analytical procedure is the stage of preparing the sample for analysis, which varies depending on the type of analytes being determined. Typical environmental, food, biological, etc. samples that are to be chemically analyzed usually require special preparation if their analysis is to provide reliable information about the concentration or amount of the analyte. Only a few types of samples can be analyzed immediately after collection, without preliminary preparation. Isolation and enrichment of substances found at the level traces and ultra traces, which is characteristic of modern analytics, unfortunately creates an opportunity to qualitative and quantitative changes in analytes, resulting in erroneous results. Sample preparation is therefore a very important, if not the most important and most difficult stage of the analysis.</p> <p>The main goal of sample preparation is the selective isolation of analytes. And this - in terms of theoretical foundations and analytical practice - is what the subject is about. During the course, basic issues related to preparation will be discussed samples for the analysis of trace contaminants, primarily from environmental, food, biological and plant materials. The main stages of the entire analytical procedure from the moment of sample collection to the determination of the analyte content in the isolated material will be presented. Particular attention will be paid to those sample preparation techniques that are currently most commonly used in laboratory practice - the student will learn their principle, scope of application and basic advantages and disadvantages. The course will also cover the use of modern techniques that have recently been used for the extraction of analytes, but which, according to the author of the course, deserve special attention. The following techniques should be mentioned: gas phase extraction (headspace analysis), solvent extraction (liquid-liquid), pressure-assisted extraction, microwaves, ultrasounds, supercritical fluid extraction, solid phase extraction and microextraction into the stationary phase, QuEChERS.</p> |  |                                     |            |   |         |     |

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| Learning outcomes  | Course outcome  | Subject outcome  | Method of verification  |
|  | [K7_W05] recognises the key developments in research, apparatus and technology in technology and related fields   | The student learns the directions of development of research and equipment in chemical technology, especially in chemical analysis                       | [SW3] Assessment of knowledge contained in written work and projects<br>[SW1] Assessment of factual knowledge                                     |
|  | [K7_U02] carries out experiments using properly selected techniques and apparatus, taking advantage of new developments in technology and related fields  | The student has basic knowledge enabling carrying out experiments using properly selected techniques and equipment using new achievements in technology. | [SU4] Assessment of ability to use methods and tools<br>[SU1] Assessment of task fulfilment<br>[SU2] Assessment of ability to analyse information |
|  | [K7_K01] critically evaluates the content of cognitive and practical problems   | he student has practice in critically assessing the content of problems related to the preparation of samples for testing                                | [SK2] Assessment of progress of work<br>[SK5] Assessment of ability to solve problems that arise in practice                                      |
| [K7_W01] defines the phenomena, processes and laws of nature used to produce consumer goods and provide services | The student has the ability to define phenomena and processes used during the isolation of analytes in the test material  | [SW3] Assessment of knowledge contained in written work and projects   |   |
| Subject contents   | <p>Lectures cover topics such as:</p> <p>Overview of sample preparation techniques. Passive vs. dynamic techniques.</p> <p>Extraction techniques used to isolate volatile substances from the matrix - gas phase extraction (static and dynamic), solid phase extraction, thermal desorption, microextraction into the stationary phase.</p> <p>Extraction techniques used to isolate substances from a liquid matrix - liquid-liquid extraction (LLE), solid phase extraction (SPE, dSPE), stationary phase microextraction (SPME), distillation techniques.</p> <p>Extraction techniques used for semi-liquid matrices - solvent extraction from a sample mixed with MSPD filler. Extraction using a mobile sorption element of the Twister TM type. QuEChERS extraction.</p> <p>Extraction techniques used to isolate analytes from solid samples with a solvent: classic cold and warm extraction (shaking, in a Soxhlet apparatus) and modern techniques (ultrasonic-assisted UAE, microwave-assisted MAE, at elevated temperature and pressure ASE, supercritical fluid SFE). Extract purification. Derivatization. Sequential extraction. New solutions in the field of sample preparation for analysis (solvent-free techniques, principles of white chemistry, combined techniques, automation). Laboratory classes cover topics such as: Optimization and comparison of techniques for the isolation of volatile substances from samples using HS and DHS headspace analysis. Isolation of analytes from liquid (aqueous) samples using the SPME technique - gas and liquid phase analysis. Extraction of medium-volatile analytes from solid samples using a Soxhlet apparatus and ultrasonic-assisted UAE extraction. Isolation of analytes from water samples using LLE and SPE techniques - comparison. Extraction of contaminants from food samples (strawberries, tomatoes, kiwi) using the QUECHERS technique. The course includes a trip to the accredited research laboratory Hamilton J.S. in Gdynia to learn about the sample preparation techniques used.</p> |  |   |
| Prerequisites and co-requisites  | Knowledge of the basics of general chemistry, organic chemistry and chemical and instrumental analysis.   |  |   |
| Assessment methods and criteria  | Subject passing criteria  | Passing threshold  | Percentage of the final grade   |
|  | laboratory experiments  | 60.0%  | 50.0%   |
|  | lecture   | 60.0%  | 50.0%   |

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| Recommended reading  | Basic literature   | <p>Pawliszyn J. Sampling and sample preparation for field and laboratory: fundamentals and new directions in sample preparation. Elsevier, 2002.</p> <p>Namieśnik J., Jamrógiewicz Z., Pilarczyk M., Torres L. Przygotowanie próbek środowiskowych do analiz. WNT, Warszawa, 2000.</p> <p>Stepnowski P., Synak E., Szafranek B., Kaczyński Z. Techniki separacyjne. Wydawnictwo UG 2010.</p> <p>Kot-Wasik et all, Przygotowanie Próbek do analizy, skrypt - wydawnictwo Politechniki Gdańskiej</p> |
|  | Supplementary literature   | Somenath Mitra; Sample preparation techniques in analytical chemistry, Wiley, 2003.  |
|  | eResources addresses   | <p>Podstawowe</p> <p><a href="https://www.agilent.com/cs/library/primers/public/5991-3326EN_SPHB.pdf">https://www.agilent.com/cs/library/primers/public/5991-3326EN_SPHB.pdf</a> - Material regarding the preparation of samples for chromatographic analysis</p> <p>Uzupełniające</p> <p>Adresy na platformie eNauczenie:</p>   |
| Example issues/<br>example questions/<br>tasks being completed | <p>Passive techniques vs. dynamic techniques - basic advantages and disadvantages.Extraction techniques used to isolate volatile substances from the matrix - gas phase extraction (static and dynamic), solid phase extraction, thermal desorption, microextraction into the stationary phase - principles of analyte isolation, basic parameters used for optimization, main problems.Extraction techniques used to isolate substances from a liquid matrix - liquid-liquid extraction (LLE), solid phase extraction (SPE, dSPE), stationary phase microextraction (SPME), distillation techniques - comparison of the scope of applicability, basic advantages and disadvantages of the techniques.Extraction techniques used for semi-liquid matrices - solvent extraction from a sample mixed with MSPD filler. Extraction using a mobile sorption element of the Twister TM type. QuEChERS extraction.Extraction techniques used to isolate analytes from solid samples with a solvent: classic cold and warm extraction (shaking, in a Soxhlet apparatus) and modern techniques (ultrasound-assisted UAE, microwaves MAE, at elevated temperature and pressure ASE, supercritical fluid SFE) - technical solutions, parameters to be optimized, main areas of application.Purification of the extract - purpose and problems to be faced.Solvent-free techniques, environmentally friendly techniques, white chemistry assessment - principles.</p> |  |
| Work placement   | Not applicable   |  |

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