GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

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|---|---|---|---|
| Subject name and code | Instrumental Analysis , PG_00060866 | | |
| Field of study | Chemical Technology | | |
| Date of commencement of studies | October 2026 | Academic year of realisation of subject | 2028/2029 |
| Education level | first-cycle studies | Subject group | Obligatory subject group in the field of study<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 | 5 | ECTS credits | 3.0 |
| 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 | dr hab. inż. Mariusz Marć | |
| | 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**

The aim of the course is to familiarize students with the basic analytical techniques used in chemical technology, including instrumental methods for qualitative and quantitative analysis of chemical substances. Students will acquire the skills to compile analysis results, interpret data, and formulate conclusions in the context of technological processes, thus providing a solid foundation for the practical application of these techniques in the chemical industry and scientific research.

**Learning outcomes**

| Course outcome | Subject outcome | Method of verification |
|---|---|---|
| [K6_U03] Uses chemical knowledge to design compounds, perform physicochemical and analytical measurements, and obtain appropriate sources of information. | has knowledge of the functioning of analytical equipment and is able to determine the basic validation parameters of analytical procedures | [SU5] Assessment of ability to present the results of task<br>[SU4] Assessment of ability to use methods and tools |
| [K6_U01] Is able to independently plan the learning process and acquire, analyse and interpret information from various sources, also in English. | is able to take accurate and precise measurements in an analytical laboratory | [SU2] Assessment of ability to analyse information |
| [K6_W02] Possesses the chemical knowledge necessary to synthesize, analyze and evaluate the properties of compounds and processes used in chemical technology. | has knowledge of the use of analytical techniques in quantitative and qualitative analysis of chemical compounds.<br>He/she is able to select appropriate instrumental methods for the identification, determination, and characterization of the physical and chemical properties of selected groups of chemical compounds, including the determination of the parameters of chemical reactions and processes, taking into account the requirements of chemical technology. | [SW1] Assessment of factual knowledge |

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| Subject contents | Course content – lecture<br><br>Comprehensive information directly related to the topic of Instrumental Analysis. The following topics and issues will be discussed in the lectures:<br><br>• Specific characteristics of analytical methods based on relative measurement.<br>• Characteristics of analytical measurement systems.<br>• Types of signals, their position and magnitude, noise issues in comparative methods.<br>• Comparison of precision and accuracy of analytical methods.<br>• Elemental analysis of organic compounds, its usefulness and role in analytical chemistry.<br>• Spectroscopic methods of analysis, theoretical foundations.<br>• Qualitative and quantitative analysis using spectroscopic methods.<br>• Classification of methods and their principles of operation.<br>• Monochromators, detectors, atomization and excitation methods, and the influence of the matrix on the analytical result.<br>• Sources of errors and methods of their elimination.<br>• Flame photometry, stolloscopy, atomic and molecular absorption spectroscopy principles of operation, instrumentation, and methods of measurement and selection of optimal working conditions.<br>• Gas chromatography: theoretical foundations, column characteristics, selected detectors, qualitative and quantitative analysis.<br>• High-performance liquid chromatography (HPLC), column and thin-layer chromatography.<br>• Mechanisms of chromatographic processes, selectivity, and efficiency of chromatographic systems; types of phases; chromatographic instrumentation.<br>• Electroanalytical methods, basic physicochemical laws.<br>• Potentiometry, conductometry, coulometry, ion-selective electrodes, chronovoltammetry: theoretical foundations, measurement methods, and instrumentation.<br><br>Course content – laboratory<br><br>Topics of laboratory exercises:<br><br>1. Fundamentals of gas chromatography theory and practice, i.e., what influences retention time.<br>2. Calibration methods for gas chromatography systems how to relate the obtained signal to the analyte content in the sample.<br>3. Fundamentals of liquid chromatography what influences qualitative and quantitative analysis.<br>4. Determination of water content in MTBE sample using the Karl Fischer technique. |

5.
Atomic Emission and Absorption Spectrometry determination of sodium and potassium ion content in tap water.

6.
Molecular spectrophotometry determination of chromium and cobalt simultaneously.

7.
Application of electrochemical techniques in analytical practice comparison of two methods.

**Prerequisites and co-requisites**

Knowledge of the fundamentals of analytical, organic, and inorganic chemistry, as well as physics and mathematics

**Assessment methods and criteria**

| Subject passing criteria | Passing threshold | Percentage of the final grade |
|---|---|---|
| Lecture (written assessment of lecture content) | 50.0% | 50.0% |
| Laboratory (quizzes, tests, reports) | 50.0% | 50.0% |

**Recommended reading**

Basic literature


1. A. Melnyk, K. Kuklińska, L. Wolska, ABC Chromatografii Gazowej, Wydawnictwo PG,
Gdańsk, 2014
2. M. Janicka, G. Bajger-Nowak, A. Kot-Wasik, Rozwiązywanie problemów w chromatografii
cieczowej, Wydawnictwo PG,
Gdańsk, 2012
3. Z. Witkiewicz, E. Śliwka, Chromatografia i techniki elektromigracyjne, Wydawnictwo Naukowe
PWN, 2017
4. A. Jakimska, W. Hewelt-Belka, K. Wilczewska, A. Kot-Wasik, Nowoczesna chromatografia
cieczowa, Wydawnictwo PG,
Gdańsk, 2014
5. Ocena i kontrola jakości wyników pomiarów analitycznych : praca zbiorowa / pod red. Piotra
Konieczki i Jacka Namieśnika, Wydawnictwa Naukowo-Techniczne, 2008
6. J. Minczewski, Z. Marczenko, Chemia analityczna, tom 3, wyd. 9 i 10, zm., PWN, Warszawa
2005.
7. D.A. Skoog, D.M. West, J.F. Holler, S.R.Crouch, Fundamentals of Analytical Chemistry, (VII
ed.), Saunders College Publishing, Philadelphia 1996, Podstawy Chemii Analitycznej, t. 1-2,
PWN, Warszawa 2006.
8. P. Konieczka P., Namieśnik J., Zygmunt B., Bulska E., Świtaj-Zawadka A., Naganowska A.,
Kremer E., Rompa M., Ocena i kontrola jakości wyników pomiarów analitycznych, WN-T,
Warszawa 2007.
9. Fizykochemiczne metody kontroli zanieczyszczeń środowiska, [red.] J. Namieśnik i Z.
Jamrógiewicz, WN-T, Warszawa 1998.
10. A. Cygański, Metody spektroskopowe w chemii analitycznej, WNT, Warszawa 1993.
11. M. Pinta, Absorpcyjna spektrometria atomowa. Zastosowania w chemii analitycznej, PWN,
Warszawa 1977.
12. Z. Marczenko, Spektrofotometryczne oznaczanie pierwiastków, PWN, Warszawa 1979.
13. A. Cygański, Metody elektroanalityczne, WN-T, Warszawa 1995.
14. Z. Witkiewicz, Podstawy chromatografii, WN-T, Warszawa 2000.
15. Z Witkiewicz, J. Hetper, Chromatografia gazowa, WN-T, Warszawa 2001.
16. B. Bobrański, Analiza ilościowa związków organicznych, PWN, Warszawa 1979.
17. Chromatografia cieczowa, [red.] M. Kamiński, CEEAM, Gdańsk 2004.
18. Spektrometria atomowa, [red.] E. Bulska, K. Pyrzyńska, Malmut, Warszawa 2007.

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| | Supplementary literature | 1. M. Jarosz, E. Malinowska, Pracownia chemiczna. Analiza instrumentalna, wyd. 2 uzup.,<br>WSiP, Warszawa 1999.<br>2. W. Szczepaniak, Metody instrumentalne w analizie chemicznej, PWN, Warszawa 1999.<br>3. K. Danzer, E. Than, D. Moloch, Analityka. Przegląd systematyczny, WN-T, Warszawa 1993.<br>4. J. Czermiński i współautorzy, Metody statystyczne dla chemików, PWN, Warszawa 1986.<br>5. G.W. Ewing, Metody instrumentalne w analizie chemicznej, PWN, Warszawa 1980.<br>6. T.H. Gouw, Nowoczesne metody instrumentalne analizy, WN-T, Warszawa 1976.<br>7. H.W. Willard, L.L. Merritt, J.A. Dean, F.A. Settle, Instrumental Methods of Analysis,<br>Wadsworth, Belmont 1981.<br>8. Z. Marczenko, Spektrofotometryczne oznaczanie pierwiastków, PWN, Warszawa 1979.<br>9. A. Cygański, Metody elektroanalityczne, WN-T, Warszawa 1995.<br>10. Z. Galus, Teoretyczne podstawy elektroanalizy chemicznej, PWN,Warszawa 1977.<br>11. Metody analitycznej spektrometrii atomowej, [red.] W. Żyrnicki, J.Borkowska-Burnecka, E.<br>Bulska, E. Szmyd, Malmut, Warszawa 2010. |
| | eResources addresses | |
| Example issues/ example questions/ tasks being completed | 1. Describe what potentiometric titration is. What is the purpose of the potentiometric measurement system in such<br>titration and what are the advantages of its use?<br>2. What are the characteristics of conductometric methods and what are their applications?<br>3. What is mineralization and what is its basic classification?<br>4. List 5 mineralization methods and describe one of them.<br>5. Explain the principle of operation of a splitless dispenser (dispensing without flow division).<br>6. What is the solvent effect and in which type of dispensing is it used? | |
| Practical activites within the subject | Not applicable | |

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