University of Gdańsk

Subject card

Subject name and code	Fundamentals of Chromatography, PG_00188306		
Field of study	Podstawy chromatografii (Wykład)		
Date of commencement of studies	October 2026	Academic year of realisation of subject	2027/2028
Education level	Bachelor's studies	Subject group	Obligatory subject group in the field of study 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	2	Language of instruction	Polish
Semester of study	4	ECTS credits	2.0
Learning profile	academic	Assessment form	exam
Conducting unit	Faculty of Chemistry -> Rector		
Name and surname of lecturer (lecturers)	Subject supervisor	dr Klaudia Godlewska	
	Teachers		

Lesson types

Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
Number of study hours	30.0	0.0	0.0	0.0	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

- Students will be introduced to the basics of chromatography (understanding the principles of separation, phase partitioning) and key techniques (GC, HPLC).
- Students will be introduced to chromatographic equipment: structure, principles of operation, operating parameters, and factors influencing separation.
- Students will be introduced to the basics of mass spectrometry: ionization, mass analyzers, and spectral interpretation.
- Students will be introduced to hyphenated techniques (GC-MS, LC-MS): their capabilities, limitations, and applications.
- Students will be trained in analytical method selection, including choosing the appropriate technique for a given sample type and research problem.
- Students will gain an understanding of sample preparation methods, including extraction and purification techniques, and their impact on the quality of analytical determinations.
- Students will be introduced to the basics of method validation: assessing the quality of results, sensitivity, selectivity, and precision.
- Students will be introduced to the application of chromatography and spectrometry in forensics: drug analysis, toxicology, and chemical trace analysis.

Learning outcomes	Course outcome	Subject outcome	Method of verification
	[AKRL3_W02] The graduate knows and understands, at an advanced level, the analytical methods used in forensic laboratories, in particular spectroscopic, chromatographic and electroanalytical methods.	• Students understand the basic principles of chromatography and its applications in forensic analysis. • Students distinguish between the main chromatographic techniques (GC, LC) and understand their limitations and range of applications. • Students know the structure and operation of detectors, including mass spectrometers. • Students distinguish between qualitative and quantitative analysis in chromatography. • Students know the techniques of preparing samples for chromatographic analyses and is able to select the appropriate method depending on the type of sample and compounds being tested. • Students understand the concept of combined techniques (GC-MS, LC-MS) and their advantages in the analysis of complex samples. • The student is able to select the appropriate technique for a specific analytical problem. • Students perform basic interpretation of chromatograms. • Students are able to assess the quality of results and identify potential sources of analytical error.	[SW4] test/egzamin - ustny lub pisemny
	[AKRL3_K01] The graduate is ready to critically evaluate their own knowledge, understand its importance for solving cognitive and practical problems, and to seek expert opinions when necessary.	• The student understands the importance of reliability, accuracy, and responsibility when performing chromatographic, spectrometric, and hybrid analyses in the context of laboratory and forensic work. • The student is aware of the consequences of misinterpreting analytical data and is able to responsibly communicate results, considering their potential impact on evidentiary proceedings and expert decisions. • The student appreciates the value of teamwork in the analytical laboratory and is able to collaborate during sample preparation, method optimization, and result interpretation.	[SK8] obserwacja samodzielnej lub zespołowej pracy studenta

Subject contents	An introduction to chromatography as one of the key analytical techniques used in forensic laboratories. A treatment of the most important types of chromatography: liquid chromatography and gas chromatography, covering the properties of mobile and stationary phases and their range of applications. Description of the design and operation of instrumentation components such as pumps, injectors, columns, detectors, temperature programmers, and flow control systems. Principles of selecting separation conditions in liquid and gas chromatography, and the impact of operating parameters on selectivity, efficiency, and analysis time. An introduction to basic chromatographic detection methods. A review of sample preparation techniques used in forensic analysis, including extraction and purification techniques and their impact on quality of the results. An outline of the fundamentals of analytical method validation, including the assessment of precision, accuracy, sensitivity, selectivity, and repeatability, as well as a discussion of principles for ensuring the reliability and quality of chromatographic results in laboratory practice. An overview of combined techniques, particularly LC-MS and GC-MS, aimed at understanding the benefits of combining chromatography with mass spectrometry and the applications of such systems in the identification and determination of trace amounts of substances in forensic chemistry. Selected examples of practical applications of chromatography in forensic analysis include the identification of drugs, toxic substances, and organic compounds in biological and environmental traces, as well as the analysis of microtraces.
Prerequisites and co-requisites	Completed courses: general chemistry, organic chemistry, and analytical chemistry. Knowledge of basic concepts in general chemistry, organic chemistry, analytical chemistry, and instrumental analysis methods.

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
Active participation in the course	0.0%	10.0%
Written exam	51.0%	90.0%

Recommended reading	Basic literature	Skoog, D.A., Holler, F.J., Crouch, S.R., Principles of Instrumental Analysis, 8th Edition, Cengage, 2018 Poole, C.F., Gas Chromatography, 7th Edition, Elsevier, 2012 Poole, C.F., Liquid Chromatography: Principles, Techniques, and Applications, 3rd Edition, Elsevier, 2011 Berger, T., & Fekete, S., *Introduction to Chromatography in Forensic Science*, Elsevier, 2018 Harris, D.C., Quantitative Chemical Analysis, 9th Edition, W.H. Freeman, 2016 Emiliani, C., Fekete, S., & Berger, T., Chromatography: A Science for the 21st Century, Elsevier, 2020
	Supplementary literature	Snyder, L.R., Kirkland, J.J., Dolan, J.W., Introduction to Modern Liquid Chromatography, 3rd Edition, Wiley, 2010 Poole, C.F., *Gas Chromatography and Mass Spectrometry: A Practical Guide*, 2nd Edition, Wiley, 2004 Meyer, V.R., *Practical High-Performance Liquid Chromatography*, 6th Edition, Wiley, 2010
	eResources addresses	

Example issues/ example questions/ tasks being completed	Discuss the differences between GC and LC and indicate when each technique is used. Identify the impact of chromatographic parameters (stationary phase type, temperature, gradient, flow rate) on the separation of mixtures. Interpret basic chromatographic parameters (retention time, resolution, column efficiency). Example task: Propose chromatographic conditions for the analysis of a simple mixture (e.g., dyes, amino acids, volatile compounds). Question: What characteristics of a compound determine whether it is better analyzed by GC or LC? Task: Assess the reliability of results and identify potential sources of error (e.g., sample preparation, analyte stability, impurities). Example applications of combined techniques (LC-MS, GC-MS) in forensic analysis.
Work placement	Not applicable

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