



Subject card

Subject name and code	Process Analytic Methods , PG_00054879						
Field of study	Biotechnology						
Date of commencement of studies	October 2025		Academic year of realisation of subject		2026/2027		
Education level	first-cycle studies		Subject group		Optional subject group 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		6.0		
Learning profile	general academic profile		Assessment form		exam		
Conducting unit	Department of Process Engineering and Chemical Technology -> Faculty of Chemistry -> Faculties of Gdańsk University of Technology						
Name and surname of lecturer (lecturers)	Subject supervisor		dr hab. inż. Patrycja Makoś-Chelstowska				
	Teachers						
Lesson types	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	15.0	0.0	60.0	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		15.0		60.0	150
Subject objectives	The objective of this course is to familiarize students with physicochemical and instrumental analytical methods used in the quality control of raw materials, process streams, and products of the biotechnology industry (with a particular focus on biofuels and technical bioproducts), as well as to develop practical skills in method selection, validation, and data interpretation in accordance with normative guidelines (PN-EN, ISO) and regulatory requirements (Good Laboratory Practice – GLP, quality management systems).						

Learning outcomes	Course outcome	Subject outcome	Method of verification
	K6_U09	is able to independently select and apply chromatographic (GC-FID/ TCD, HPLC) and spectroscopic (UV-Vis, FTIR) techniques for the qualitative and quantitative analysis of raw materials, reaction mixtures, and bioproducts, as well as perform key separation processes and sample preparation procedures in accordance with normative standards.	[SU1] Assessment of task fulfilment [SU2] Assessment of ability to analyse information [SU3] Assessment of ability to use knowledge gained from the subject [SU4] Assessment of ability to use methods and tools [SU5] Assessment of ability to present the results of task
	K6_W02	knows and is able to explain the physicochemical and spectroscopic principles underlying analytical techniques and utilizes the laws of physical chemistry (thermodynamics, kinetics, surface phenomena, and phase equilibria) to explain separation mechanisms and the behavior of bioproducts and biofuels during analytical and technological processes.	[SW3] Assessment of knowledge contained in written work and projects [SW1] Assessment of factual knowledge
	K6_W09	knows and explains the theoretical foundations, operating principles, and instrumentation of key analytical methods (specifically gas chromatography GC, liquid chromatography HPLC, UV-Vis spectrophotometry, and FTIR spectroscopy), and describes the mechanisms and selection criteria for separation techniques (extraction, filtration, distillation, crystallization) used in the quality assessment and purification of bioproducts and biofuels.	[SW1] Assessment of factual knowledge [SW3] Assessment of knowledge contained in written work and projects
Subject contents	Course content – lecture - The role of Quality Control (QC) in the bioeconomy and the biofuel sector - Standardisation and quality specifications for biofuels - Representative sampling of solid, liquid, and gaseous materials - Sample preparation of solid, liquid, and gaseous matrices for analysis - Isolation, resolution, and separation of analytes - Determination of basic physicochemical and technical parameters of solid, liquid, and gaseous samples - Analytical measurements using spectroscopic, chromatographic, electroanalytical, X-ray, and other instrumental methods - Evaluation and quality control of measurement results		
	Course content – laboratory - Analysis of basic physicochemical properties of liquid biofuels (i.e., density, kinematic and dynamic viscosity, surface tension, flash point, cloud point, acid value, and total contamination). - Monitoring and analytics of wastewater and post-reaction waste in biotechnological facilities. - Application of UV-Vis and FTIR-ATR spectroscopy in the structural characterisation and purity assessment of bio-oils and bioproducts. - Determination of purity and impurity content in bioethanol and technical-grade ethanol. - Analytical monitoring of biochemical processes – analysis of alcoholic, acidic, and alkaline fermentation products. - Chromatographic analysis of fatty acid methyl ester (FAME) profiles and biodiesel purity (GC-FID). - Qualitative and quantitative composition analysis of biogas, biomethane, biohydrogen, and off-gases using gas chromatography. - Determination of the calorific value and gross calorific value (heat of combustion) of biofuels and biomass. - Practical training under industrial conditions – field lab session at an accredited quality control laboratory or a biofuel/biotechnology industrial plant.		
Prerequisites and co-requisites	The student is expected to have foundational knowledge of: - analytical measurement techniques, - general principles of physical, inorganic, and organic chemistry, - chemical technology and unit operations, - basic physicochemical properties of solid, liquid, and gaseous matrices.		
Assessment methods and criteria	Subject passing criteria	Passing threshold	Percentage of the final grade
	Lecture - written exam	60.0%	60.0%
	Laboratory - written entrance tests and laboratory reports	60.0%	40.0%

Recommended reading	Basic literature	W. Szczepaniak, <i>Instrumental Methods in Chemical Analysis (Metody instrumentalne w analizie chemicznej)</i>, PWN, Warsaw, 1997. J. Piotrowski et al., <i>Measurements (Pomiary)</i>, WNT, Warsaw, 2012. J. Namieśnik et al., <i>Environmental Sampling for Analysis (Pobieranie próbek środowiskowych do analizy)</i>, PWN, Warsaw, 1995. Z. Witkiewicz, <i>Fundamentals of Chromatography (Podstawy chromatografii)</i>, WNT, Warsaw, 2005. T. Lipiec, Z. Szmal, <i>Analytical Chemistry with Elements of Instrumental Analysis (Chemia analityczna z elementami analizy instrumentalnej)</i>, PZWL Medical Publishing, Warsaw, 1976. J. Berčík, <i>Physical and Physicochemical Methods of Analysis (Fizyczne i fizykochemiczne metody analizy)</i>, WNT, Warsaw, 1981. B. Klepaczek-Filipiak, J. Łoin, <i>Chemical Laboratory: Technical Analysis (Pracownia chemiczna, Analiza techniczna)</i>, 2nd ed., WSiP, Warsaw, 1998. Z. Łada, C. Różycki, <i>Analytical Chemistry Laboratory: Technical and Instrumental Analysis (Pracownia chemii analitycznej, Analiza techniczna i instrumentalna)</i>, 6th ed., WSiP, Warsaw, 1990. A. Pandey, C. Larroche, et al., <i>Biofuels: Alternative Feedstocks and Conversion Processes for the Production of Biofuels and Biochemicals</i>, Academic Press / Elsevier. - Standards and Normative Documents
	Supplementary literature	- Skoog D.A., Holler F.J., Crouch S.R., <i>Principles of Instrumental Analysis</i>. - Harris D.C., <i>Quantitative Chemical Analysis</i>. - Robinson J.W., Frame E.M.S., Frame G.M., <i>Instrumental Analytical Chemistry: An Introduction</i>. - Berčík J., <i>Fizyczne i fizykochemiczne metody analizy</i>.
	eResources addresses	
Example issues/ example questions/ tasks being completed	- Discuss the principle of determining free and total glycerol content in FAME esters using high-temperature gas chromatography in accordance with the PN-EN 14105 standard. What is the significance of sample derivatisation? - Compare the application of UV-Vis spectrophotometry and FTIR-ATR spectroscopy in assessing the quality and purity of bioproducts. Identify the infrared absorption bands characteristic of the ester group in biodiesel. - Determine the kinematic viscosity of a biodiesel (FAME) sample using an Ubbelohde viscometer at 40°C. Based on the measured flow time and the capillary constant, calculate the kinematic viscosity and evaluate its compliance with the PN-EN 14214 standard.	
Practical activities within the subject	Not applicable	

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