GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Experimentarium II, PG_00068089						
Field of study	Biomedical Engineering						
Date of commencement of studies	October 2025		Academic year of realisation of subject	2027/2028			
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	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 Chemistry and Technology of Functional Materials -> Faculty of Chemistry -> Faculties of Gdańsk University of Technology						
Name and surname of lecturer (lecturers)	Subject supervisor		dr hab. inż. Anna Schmidt				
	Teachers						
Lesson types	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	0.0	0.0	30.0	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		2.0	43.0		75
Subject objectives	Acquiring skills in designing and implementing simple technical solutions used in chemistry and biomedical engineering. Developing basic competencies in programming and operating microprocessor devices in laboratory applications. Developing skills in analyzing and evaluating the functioning of simple technical systems and their application in engineering practice. Practical application of instrumental techniques for the analysis of organic compounds. Independent planning of measurements and analysis of experimental data. Integration of knowledge in the field of organic chemistry with measurement and calculation methods.						

Learning outcomes

Course outcome	Subject outcome	Method of verification
[K6_U04] can apply knowledge of programming methods and techniques as well as select and apply appropriate programming methods and tools in computer software development or programming devices or controllers using microprocessors or programmable elements or systems specific to the field of study	Is able to use basic programming methods and tools to develop simple applications or control microprocessor-based devices in the context of issues related to organic and biomedical chemistry, such as measurement data analysis, visualization of chemical structures, or support of basic diagnostic processes.	[SU2] Assessment of ability to analyse information [SU3] Assessment of ability to use knowledge gained from the subject
[K6_U03] can design, according to required specifications, and make a simple device, facility, system or carry out a process, specific to the field of study, using suitable methods, techniques, tools and materials, following engineering standards and norms, applying technologies specific to the field of study and experience gained in the professional engineering environment	Is able to design and build a simple device, system, or process typical for organic and biomedical chemistry, using basic methods, tools, and materials, and applying appropriate engineering standards and technologies.	[SU2] Assessment of ability to analyse information [SU4] Assessment of ability to use methods and tools
[K6_U09] can carry out a critical analysis of the functioning of existing technical solutions and assess these solutions, as well as apply experience related to the maintenance of technical systems, devices and facilities typical for the field of studies, gained in the professional engineering environment	Is able to evaluate the functioning of basic technical solutions used in organic and biomedical chemistry, and apply practical experience gained during classes or internships related to the operation and maintenance of measurement devices and systems used in biomedical engineering.	[SU4] Assessment of ability to use methods and tools

Subject contents

Course content – laboratory
UV-Vis spectrum analysis of organic compounds. Measurement of absorption spectra of selected organic compounds. Comparison of molecular structure with spectral changes. Monitoring of organic reactions. Processing of time data and kinetic analysis of reactions. Discussion of the reaction mechanism based on measurement data. The effect of pH on the properties of organic compounds. Measurement of the pH of acid-base compounds (e.g., carboxylic acids, amino acids, phenols). Changes in pH during reactions (e.g., esterification, hydrolysis, neutralization). The effect of pH on the ionization and solubility of molecules. Testing the conductivity of organic solutions. Measuring the conductivity of selected organic compounds and their salts. Observing changes in conductivity during reactions (e.g., ester hydrolysis, ionic reactions). Correlation of conductivity with dissociation and chemical structure. Kinetic modeling of chemical reactions. Entering data from actual measurements (UV-Vis, pH, conductivity) into software (e.g., CAVS, COPASI). Calculating kinetic constants, studying the influence of parameters.

Prerequisites and co-requisites

Knowledge of techniques, instruments, and software used in organic and analytical chemistry.

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
Completion and reporting of all laboratory exercises	50.0%	100.0%

Recommended reading

Basic literature	1. Scientific editor Kocjan R., Analytical Chemistry Volumes 1-2, PZWL, Warsaw, 2021 2. Kołodziejczyk A., Natural Organic Compounds, PWN Scientific Publishers, Warsaw, 2013 3. McMurry J. Organic Chemistry, PWN Scientific Publishers, Warsaw, 2016
Supplementary literature	1. Vogel A. I., Organic Chemistry, Wydawnictwo Naukowe PWN, Warsaw, 2018 2. Kiemle D. J., Silverstein R. M., Webster F. X. Spectroscopic Methods for the Identification of Organic Compounds Wydawnictwo Naukowe PWN, Warsaw, 2012
eResources addresses	

Example issues/ example questions/ tasks being completed	Questions: • How can UV-Vis spectrophotometry be used to track the course of a reaction? • What conditions must be met for the UV-Vis method to be suitable for monitoring reactions? • What forms of molecules dominate at different pH values (using pKa)? • How does ionization affect the solubility of organic compounds in water? • Why do some organic compounds conduct electricity and others do not? • How does ionic dissociation affect conductivity? • How does conductivity change during ester hydrolysis? • What data is necessary for modeling reactions in programs such as COPASI? • What are the differences between first-order and second-order reactions in terms of kinetics? Tasks: • Prepare graphs of absorbance as a function of time and convert them to concentration. Calculate the reaction rate constant, e.g., of the first order. • Measure the pH of carboxylic acid solutions (e.g., benzoic acid) and amino acids. • Perform an esterification reaction and monitor pH changes over time. • Prepare a pH vs. time graph and discuss its relationship to the course of the reaction. • Determine the pKa of the compounds based on pH and UV-Vis changes. • Measure the conductivity of acetic acid, its salts, and esters in water. • Observe the change in conductivity during the hydrolysis of ethyl acetate in the presence of a base. • Plot a conductivity vs. time graph and discuss the effect of the reaction on conductivity. • Enter the UV-Vis measurement data (e.g., absorbance vs. time) into the CAVS or COPASI program. • Fit the data to a kinetic model. • Calculate the rate constants and evaluate the effect of temperature or pH on the reaction rate. • Build a model of the esterification reaction, taking into account equilibrium and acid catalysis.
Practical activites within the subject	Not applicable

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