GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Modeling of biochemical processes, PG_00069551						
Field of study	InfoBioChem						
Date of commencement of studies	February 2027		Academic year of realisation of subject	2026/2027			
Education level	second-cycle 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	blended-learning			
Year of study	1		Language of instruction	Polish			
Semester of study	1		ECTS credits	2.0			
Learning profile	general academic profile		Assessment form	assessment			
Conducting unit	Department of Pharmaceutical Technology and Biochemistry -> Faculty of Chemistry -> Faculties of Gdańsk University of Technology						
Name and surname of lecturer (lecturers)	Subject supervisor		dr hab. inż. Tomasz Laskowski				
	Teachers						
Lesson types	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	15.0	0.0	15.0	0.0	0.0	30
	E-learning hours included: 10.0						
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	18.0		50
Subject objectives	The aim of the course is to provide students with knowledge of the fundamentals of modeling chemical and biochemical processes, in particular kinetic description, mass balances, and methods for fitting models to experimental data. The course develops the ability to apply numerical methods and computational tools (Python) to the analysis, simulation, and interpretation of chemical and biochemical processes.						

Learning outcomes

Course outcome	Subject outcome	Method of verification
[K7_W01] knows and understands the methods, techniques, and tools used to solve bioinformatics tasks, including molecular modeling.	The student knows and understands the basic methods, techniques, and tools used in modeling chemical and biochemical processes and is able to indicate their application in solving bioinformatics tasks, including molecular modeling.	[SW1] Assessment of factual knowledge [SW3] Assessment of knowledge contained in written work and projects
[K7_K04] is ready to effectively organize their work time, including reliably meeting deadlines for completing specific tasks.	The student is ready to effectively organize their own work while carrying out tasks related to data analysis and modeling of chemical and biochemical processes, including reliable meeting of established deadlines.	[SK2] Assessment of progress of work [SK3] Assessment of ability to organize work
[K7_W02] has in-depth knowledge of omics science, including the principles of generating, analyzing, and interpreting omics data.	The student has advanced knowledge of the principles of generation, preprocessing, analysis, and interpretation of multidimensional omics data, and understands the capabilities and limitations of modeling methods used to describe chemical and biochemical processes based on such data.	[SW1] Assessment of factual knowledge [SW3] Assessment of knowledge contained in written work and projects
[K7_U02] is able to use IT tools for operations on nucleotide and protein sequences.	The student is able to use computational tools for operations on nucleotide and protein sequences in the preparation and preliminary analysis of data used in bioinformatics tasks and molecular modeling.	[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

Subject contents

Course content – lecture

Lecture topics include the fundamentals of modeling chemical and biochemical processes, including reaction kinetics, ordinary differential equations, mass balances, and ideal reactor models. The course also covers the basics of modeling equilibria and molecular interactions based on experimental data (including spectroscopic data), methods for fitting models to data, and elements of model quality assessment and interpretation using numerical tools and Python.

Course content – laboratory

Laboratory classes cover the practical application of numerical methods and Python to the analysis, simulation, and fitting of models of chemical and biochemical processes to experimental data. Students perform tasks related to modeling kinetics and equilibria, solving differential equations, assessing fit quality, and interpreting results in the context of processes and molecular interactions.

Prerequisites and co-requisites

Basic skills in Python.

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
project	60.0%	50.0%
lecture test	60.0%	50.0%

Recommended reading

Basic literature	Pauline M. Doran / Ross Carlson / Kate Morrissey, *Bioprocess Engineering Principles* (3rd ed., Elsevier, 2025) H. Scott Fogler, *Elements of Chemical Reaction Engineering* (Pearson)
Supplementary literature	-
eResources addresses	

Example issues/ example questions/ tasks being completed

- description of the kinetics of simple chemical and biochemical processes and interpretation of kinetic model parameters,
- formulation and analysis of mass balances for closed and flow systems,
- process modeling using ordinary differential equations and their numerical solution,
- analysis and comparison of ideal reactor models (e.g., batch, continuously stirred tank, plug flow),
- modeling of chemical and biochemical equilibria and simple molecular interaction systems,
- fitting mathematical models to experimental data (including spectroscopic data) and interpretation of fitted parameters,
- assessment of fit quality and comparison of models using selected statistical criteria,
- analysis of the impact of data quality (e.g., measurement noise) on the stability and reliability of model parameters,
- preparation and preliminary analysis of input data for modeling using computational tools,
- practical implementation of calculations, simulations, and result visualization in Python.

Practical activites within the subject	Not applicable

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