GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Modeling of technological processes, PG_00068132						
Field of study							
Date of commencement of studies	February 2026		Academic year of realisation of subject		2025/2026		
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	Part-time studies		Mode of delivery		at the university		
Year of study	1		Language of instruction		Polish		
Semester of study	1		ECTS credits		4.0		
Learning profile	general academic profile		Assessment form		assessment		
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 inż. Robert Aranowski				
	Teachers						

Lesson types	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	9.0	0.0	0.0	27.0	0.0	36
	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	36	10.0	54.0	100

Subject objectives	The aim of the course is to provide advanced knowledge and develop skills in modeling technological processes related to the production, processing, and recycling of materials. The student acquires competencies in the development of mathematical models (balance-based, kinetic, and transport models), their implementation in computational tools, and the critical interpretation of results in the context of process optimization and sustainable resource management.

Learning outcomes	Course outcome	Subject outcome	Method of verification
	[K7_U01] is able to obtain information from literature, databases and other properly selected sources, also in English; is able to integrate the obtained information, interpret it, draw conclusions and formulate and justify opinions	The student is able to obtain information from scientific literature, databases, and technical documentation (also in English), critically analyze and integrate this information in order to develop a model of a technological process used in materials technologies and recycling. The student formulates conclusions and justifies the adopted modeling assumptions.	[SU2] Assessment of ability to analyse information
	[K7_W04] has in-depth knowledge in the field of chemical sciences/ chemical engineering/materials engineering, enabling the description of the properties of materials, processes and technological operations involving them, taking into account recycling	The student possesses advanced knowledge enabling the development and interpretation of models of technological processes and unit operations applied in materials technologies and recycling (including mass and energy balance models, kinetic models, and transport models), taking into account their environmental aspects and resource efficiency.	[SW3] Assessment of knowledge contained in written work and projects
	[K7_U07] is able to plan and organize individual and team work	The student is able to plan and organize the implementation of a technological process modeling project, define the stages of work, assign tasks within a team, and establish a schedule, ensuring the timely and efficient completion of the task.	[SU1] Assessment of task fulfilment
	[K7_K01] understands the need for lifelong learning, is able to inspire and organize the learning process of others. is aware of his/ her own limitations and knows when to turn to experts, is able to set priorities appropriately for the implementation of tasks defined by himself/herself or others	The student understands the need for continuous improvement of competencies in the field of technological process modeling methods, is able to set priorities in project activities, and critically evaluates the limitations of the applied models, indicating the need for expert consultation when necessary.	[SK2] Assessment of progress of work

Subject contents	Course content – lecture 1. The role of modeling in the design and optimization of technological processes in materials engineering and recycling. 2. Classification of process models: balance-based, kinetic, empirical, and mechanistic models. 3. Modeling of unit operations (reactors, heat exchangers, separation processes). 4. Modeling of materials processing and recycling processes (e.g., thermal, hydrometallurgical, and mechanical processes). 5. Model validation and verification, sensitivity analysis, and uncertainty analysis. 6. Application of models in process optimization and environmental performance assessment. Course content – project 1. Selection and analysis of a technological process in the field of materials technologies or recycling. 2. Development of a process flow diagram and identification of key process variables. 3. Development of a mathematical model (mass and energy balances, elements of kinetics or transport phenomena). 4. Implementation of the model in a selected computational environment. 5. Analysis of simulation results (parameter influence, sensitivity analysis). 6. Interpretation of results in terms of technological and environmental efficiency. 7. Preparation of a project report and presentation of results.

Prerequisites and co-requisites	1. Knowledge of the fundamentals of chemical and materials engineering (mass and energy balances, reaction kinetics, basics of mass and heat transfer). 2. Basic knowledge of technological processes used in materials processing and recycling. 3. Ability to use computational tools (e.g., Excel, MATLAB/Octave, or similar environments). 4. Ability to analyze data and use scientific literature.

Assessment methods and criteria	Subject passing criteria	Passing threshold	Percentage of the final grade
		60.0%	40.0%
		60.0%	10.0%
		60.0%	40.0%
		60.0%	10.0%

Recommended reading	Basic literature	1. Hangos K. M., Cameron I. T., Process Modelling and Model Analysis, Academic Press, 2001, ISBN 9780121569310. 2. Bequette B. W., Process Control: Modeling, Design, and Simulation, Prentice Hall / Pearson, 2003, ISBN 9780133536409. 3. Biegler L. T., Grossmann I. E., Westerberg A. W., Systematic Methods of Chemical Process Design, Prentice Hall / Pearson, 1997, ISBN 9780134924229. 4. Fogler H. S., Elements of Chemical Reaction Engineering, 5th ed., Pearson, 2016, ISBN 9780133887518. 5. Incropera F. P., DeWitt D. P., Bergman T. L., Lavine A. S., Fundamentals of Heat and Mass Transfer, 7th ed., Wiley, 2011, ISBN 9780470501979.
	Supplementary literature	1. Worrell E., Reuter M. A. (eds.), Handbook of Recycling: State-of-the-art for Practitioners, Analysts, and Scientists, Elsevier, 2014, ISBN 9780123964595.
	eResources addresses	
Example issues/ example questions/ tasks being completed	1. Develop a mathematical model scheme for a selected recycling process and identify the key process variables. 2. Present the differences between a kinetic model and an equilibrium-based model, and indicate their respective ranges of applicability. 3. Discuss the importance of sensitivity analysis in technological process optimization. 4. Indicate which experimental data are necessary for the validation of a technological process model. 5. Propose a modeling strategy for a process with incomplete input data.	
Practical activites within the subject	Not applicable	

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