GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Basics of chemical reactor engineering, PG_00060871						
Field of study	Chemical Technology						
Date of commencement of studies	October 2024			Academic year of realisation of subject		2026/2027	
Education level	first-cycle studies			Subject group		Obligatory subject group 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	6			ECTS credits		2.0	
Learning profile	general academic profile			Assessment form		assessment	
Conducting unit	Faculty of Chemistry -> Faculties of Gdańsk University of Technology						
Name and surname of lecturer (lecturers)	Subject supervisor			dr hab. inż. Jacek Gębicki			
	Teachers						
Lesson types	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	15.0	15.0	0.0	0.0	0.0	30
	E-learning hours included: 0.0						
	eNauczanie source address: https://enauczanie.pg.edu.pl/2025/user/index.php?id=4947						
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	To introduce students to concepts related to the technological classification of reactors, particularly the description of ideal reactors. To familiarize students with the relationships used to calculate reactant residence times and the degree of reactant conversion in reactors operating under isothermal and adiabatic conditions. To familiarize students with the design equations and heat balance in ideal reactors. To develop students' skills in basic calculations related to reactor theory.						

Learning outcomes

Course outcome	Subject outcome	Method of verification
[K6_W04] understands processes occurring in the life cycle of equipment and facilities and has knowledge of mechanical engineering, chemical apparatus, technical thermodynamics and chemical engineering and chemical reactor engineering necessary to analyse technological processes and correctly design installations and systems in the chemical industry	has knowledge of the theory of chemical reactors and knows the operating principle of basic types of reactors in the chemical industry.	[SW3] Assessment of knowledge contained in written work and projects
[K6_K01] understands the need for continuing education, and is aware of the opportunities to improve professional, personal and social competences	is ready to use the acquired knowledge to continuously improve their qualifications and develop their engineering skills.	[SK5] Assessment of ability to solve problems that arise in practice [SK1] Assessment of group work skills
[K6_U04] performs basic design calculations of selected processes and unit operations, is able to calculate and select the basic apparatus of chemical industry in a process line	able to perform basic calculations using knowledge of design equations and heat balance for various types of ideal reactors.	[SU1] Assessment of task fulfilment [SU3] Assessment of ability to use knowledge gained from the subject

Subject contents	Course content – lecture 1. Technological classification of reactors. Batch reactor. Perfectly mixed flow reactor. Plug flow reactor. 2. Isothermal and adiabatic processes. 3. Cascade of perfectly mixed flow reactors. Comparison of a perfectly mixed reactor cascade with a plug flow reactor. 4. Design of isothermal, perfectly mixed, or plug flow reactors. 5. The influence of conversion kinetics on the selection of reactor type for single reactions. Course content – exercises 1. Mole and mass fractions. Determining the degree of reaction conversion. Conversion and the stoichiometry of chemical reactions. 2. Kinetics of chemical reactions (reaction order, reaction rate constant). Dependence of reaction rate on temperature (Aarhenius equation). 3. Design equation for a batch reactor. Determining residence time and reactor volume. 4. Thermal effects of reactions, heat balance of a batch reactor. 5. Design of a batch reactor (kinetics, reaction order, residence time, reactor volume). 6. Design of a batch reactor (characterization of the reaction environment, material selection, heat). 7. Design of a batch reactor (selection of stirrer power and dimensions).		
Prerequisites and co-requisites	Knowledge of unit operations and processes, the structure and functioning of basic industrial plant components. Principles of conservation of mass, energy, and momentum. Mass and thermal process balancing.		
Assessment methods and criteria	Subject passing criteria	Passing threshold	Percentage of the final grade
	exercises - test	60.0%	20.0%
	exercises - project implementation	100.0%	20.0%
	lecture - 2 tests	60.0%	60.0%
Recommended reading	Basic literature	1. A. Burghardt, Bartelmus G., Inżynieria reaktorów chemicznych, PWN 2001. 2. J. Szarawara, J. Piotrowski: Podstawy teoretyczne technologii chemicznej, WNT 2010. 3. S. Kucharski, J. Głowiński: Podstawy obliczeń projektowych w technologii chemicznej, Oficyna Wydawnicza Politechniki Wrocławskiej, 2005	
	Supplementary literature	1. B. Tabiś, W. Żukowski: Przykłady i zadania z zakresu inżynierii reaktorów chemicznych, Politechnika Krakowska 2000 2. K. Schmidt-Szałowski i in.: Technologia Chemiczna, PWN 2013	
	eResources addresses		

Example issues/ example questions/ tasks being completed	Task 1. In a tank with a usable volume of 0.5 m3 and a stirred tank, the reaction A+B=C is carried out. The initial concentration of component A is 0.05 kmol/m3 and the concentration of component B is twice as high. The rate constant is 0.09 m3/(kmol*h). Determine the conversion rate of A. Task 2. The conversion rate A=2P is described by a first-order kinetic equation (k=2.5 h). Determine the average residence time of the reaction mixture in a cascade of four identical, perfectly mixed reactors if a conversion rate of a=0.9 is required. What residence time would be necessary to achieve this conversion rate in a single stirred reactor?
Practical activites within the subject	Not applicable

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