GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	CHEMICAL REACTORS ENGINEERING, PG_00064292		
Field of study	Chemical Technology		
Date of commencement of studies	February 2025	Academic year of realisation of subject	2024/2025
Education level	second-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	1	Language of instruction	Polish no comments
Semester of study	1	ECTS credits	2.0
Learning profile	general academic profile	Assessment form	assessment
Conducting unit	Department of Process Engineering and Chemical Technology -> Faculty of Chemistry -> Wydziały Politechniki Gdańskiej		
Name and surname of lecturer (lecturers)	Subject supervisor	dr hab. inż. Jacek Gębicki	
	Teachers	dr hab. inż. Jacek Gębicki mgr inż. Anna Grzegórska	

Lesson types and methods of instruction

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/moodle/course/view.php?id=45486

Moodle ID: 45486 INŻYNIERIA REAKTORÓW CHEMICZNYCH
https://enauczanie.pg.edu.pl/moodle/course/view.php?id=45486

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	3.0	17.0	50

Subject objectives

Introduce students to concepts related to the design of various types of chemical reactors. Familiarize students with design equations for specific reactors. Describe ideal and real reactors. Develop students' computational and design skills.

Learning outcomes

Course outcome	Subject outcome	Method of verification
[K7_K01] critically evaluates the content of cognitive and practical problems	The student is able to critically evaluate the problems associated with the selection of a chemical reactor for a given chemical reaction.	[SK5] Assessment of ability to solve problems that arise in practice
[K7_W04] recognises scientific, technological, organisational and economic opportunities and constraints in technology and related fields	The student is able to analyze the technical, technological and economic limitations encountered when designing various types of reactors.	[SW3] Assessment of knowledge contained in written work and projects
[K7_U03] designs innovative technological solutions for obtaining useful goods based on the state of the knowledge in accordance with the latest scientific literature	The student is able to perform calculations and designs using knowledge of design equations and heat transfer equations for various types of reactors.	[SU2] Assessment of ability to analyse information [SU1] Assessment of task fulfilment

Subject contents

The equilibrium constant of a chemical reaction and its dependence on temperature and pressure. Equilibrium shift. Chemical reaction rates for batch and flow processes. Temperature dependence of reaction rates and equilibrium conversion values. Ideal batch and flow reactors. Batch reactor design equation for a single chemical reaction. Batch reactor heat balance for isothermal and adiabatic processes. Isothermal and adiabatic processes in a flow reactor (tubular or tower). Flow tank reactor. Cascade of tank reactors. Graphical design. Fed-flow reactor. Systems of material balance equations. Residence time distribution functions for ideal and real reactors. Surface process in contact reactions. Effect of temperature and pressure.

Prerequisites and co-requisites

Knowledge of physical, organic, and inorganic chemistry. Knowledge of chemical engineering and chemical technology.

<table>
<tr><td>Assessment methods and criteria</td><td colspan="2">

Subject passing criteria	Passing threshold	Percentage of the final grade
2 tests on computational tasks	60.0%	34.0%
theoretical knowledge test - 2 tests	60.0%	66.0%

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<tr><td rowspan="3">Recommended reading</td><td>Basic literature</td><td>C.G. Hill, T.W.Root: Introduction to chemical engineering kinetics & reactors design 2nd ed., JohnWiley & Sons, Inc. 2014.

G.F. Froment, K.B. Bischoff, J. de Wilde: Chemical reactor analysis and design, JohnWiley & Sons, Inc. 2011.

U. Mann, Pronciples of chemical reactor analysis and design, New tools for industrial chemical reactor operations 2nd ed., JohnWiley & Sons, Inc. 2009.

W.L. Luyben, Chemical ractor design and control, JohnWiley & Sons, Inc. 2007.

A. Burghardt, Bartelmus G., Inżynieria reaktorów chemicznych, PWN 2001.

J. Szarawara, J. Piotrowski: Podstawy teoretyczne technologii chemicznej, WNT 2010.</td></tr>
<tr><td>Supplementary literature</td><td>PG library resources on reactor engineering, design and calculation</td></tr>
<tr><td>eResources addresses</td><td></td></tr>
<tr><td>Example issues/ example questions/ tasks being completed</td><td colspan="2">Problem 1. A certain reaction takes place at 300 K in 100 min. At what temperature will the same reaction take place in 10 min if the temperature coefficient for this reaction is 3.

Problem 2. Determine the degree of conversion after 10 min of the reactants remaining in a batch reactor. The reaction proceeds according to the formula A + 2B = C, and the reaction rate constant is 0.01 dm3/(mol*min). Additionally, assume that the initial concentrations of A and B were stoichiometric. The initial concentration of component B was 2 M.

Problem 3. In a continuous flow reactor, the reaction A + 2B = P takes place, the concentration of component A is 3 M, and the concentration of component B is 7 M. Calculate the reactor volume if the volumetric flow rate of the reactants is 100 l/min, the reaction is second-order with a reaction rate constant of 0.1 l/(M*min), and the final concentration of reactant B is 0.5 M.</td></tr>
<tr><td>Work placement</td><td colspan="2">Not applicable</td></tr>
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