GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Thermodynamic calculations and kinetics of catalytic reactions , PG_00035161		
Field of study	Engineering and Technologies of Energy Carriers		
Date of commencement of studies	February 2023	Academic year of realisation of subject	2023/2024
Education level	second-cycle studies	Subject group	Optional subject group Subject group related to practical vocational preparation
Mode of study	Full-time studies	Mode of delivery	at the university
Year of study	1	Language of instruction	Polish
Semester of study	2	ECTS credits	3.0
Learning profile	practical profile	Assessment form	assessment
Conducting unit	Department of Physical Chemistry -> Faculty of Chemistry		
Name and surname of lecturer (lecturers)	Subject supervisor	dr hab. inż. Dorota Warmińska	
	Teachers	dr hab. inż. Dorota Warmińska dr hab. inż. Maciej Śmiechowski	

Lesson types and methods of instruction

Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
Number of study hours	15.0	0.0	30.0	0.0	0.0	45

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	45	3.0	27.0	75

Subject objectives

The aim of the course is to present the knowledge necessary to determine the possibility and direction of chemical processes, to estimate the thermal effects of chemical reactions and control their efficiency. In addition, the aim of the course is to present issues related to the kinetics of chemical reactions and to familiarize students in an extended form with the kinetics of heterogeneous and homogeneous catalysis and biocatalysis with a discussion of examples of applications of catalytic processes in industry.

Learning outcomes

Course outcome	Subject outcome	Method of verification
K7_U07	The student has the knowledge to help him propose a process improvement.	[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
K7_U06	The student is able to make an initial economic assessment of the activities undertaken.	[SU2] Assessment of ability to analyse information
K7_U05	The student is able to apply a system approach, also taking into account non-technical aspects.	[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

<table>
<tr><td>Subject contents</td><td>Lecture:
Energetics of chemical processes. Thermal effects of chemical reactions and their dependence on temperature. Criteria for the spontaneity of chemical reactions. Influence of temperature on the values of entropy change and enthalpy of free reaction. Van Krevelen and Chermin's procedure. Chemical equilibrium. The pressure equilibrium constant and its dependence on the standard enthalpy of free reaction. Assessment of the effect of pressure and temperature on reaction efficiency. Kinetics of chemical reactions. Basic concepts. Kinetic equations of simple irreversible reactions and complex: reversible, parallel and consecutive reactions. Influence of temperature on the rate constant: Arrhenius equation, theory of active collisions and the theory of the active complex. Mechanisms of complex reactions, steady state approximation. Catalysis. Basic concepts. Catalyst and its properties. Kinetics of homogeneous catalysis. Kinetics of acid-base catalysis: general and specific. Kinetics of auto-catalytic reactions. The use of transition metal complexes in homogeneous catalysis. Kinetics of enzymatic reactions. Heterogeneous catalysis. Basic concepts related to a heterogeneous catalyst. Stages of catalytic reaction. Adsorption. Mechanisms of heterogeneous catalytic reactions. Overview of the most important catalytic reactions used in industry.

Laboratory:

1. Autocatalysis. Kinetics of iodination of acetone catalyzed by hydrogen ions.
2. Acid-base catalysis. Kinetics of sucrose inversion.
3. Microheterogenic catalysis. Catalytic distribution of hydrogen peroxide.
4. Homogeneous catalysis. Determination of the rate of oxidation reaction of thiosulphate ions with iron ions (III) without a catalyst and in the presence of Cu2 + ions.
5. Practical application of catalysts in rafinery industry.</td></tr>
<tr><td>Prerequisites and co-requisites</td><td>basic knowledge in general chemistry, thermodynamics and chemical kinetics</td></tr>
<tr><td>Assessment methods and criteria</td><td>
<table>
<tr><th>Subject passing criteria</th><th>Passing threshold</th><th>Percentage of the final grade</th></tr>
<tr><td>performing 5 experiments and delivering the reports</td><td>100.0%</td><td>50.0%</td></tr>
<tr><td>writting test from lectures</td><td>50.0%</td><td>50.0%</td></tr>
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<tr><td>Recommended reading</td><td>
<table>
<tr><td>Basic literature</td><td>1. K. Pigoń, Z. Ruziewicz, Chemia Fizyczna, Wydawnictwo Naukowe PWN, Warszawa 2005.

2. P.W. Atkins, Chemia fizyczna, Wydawnictwo Naukowe PWN, Warszawa 2003.

3. M. Ziółek, I. Nowak, Kataliza heterogeniczna wybrane zagadnienia, Wydawnictwo Naukowe UAM, Poznań 1999.

4. B. Grzybowska - Świerkosz, Elementy katalizy heterogenicznej, Wydawnictwo Naukowe PWN, Warszawa 1993.

5. F. Pruchnik, Kataliza homogeniczna, Wydawnictwo Naukowe PWN 1993.</td></tr>
<tr><td>Supplementary literature</td><td>1. H. Buchowski, W. Ufnalski, Podstawy termodynamiki, Warszawa ,WNT 1994.

2. W. Turek, Z. Uziel, Wykłady i zadania obliczeniowe z kinetyki chemicznej i adsorpcji z elementami katalizy, Wydawnictwo Politechniki Śląskiej, Gliwice, 2010.</td></tr>
<tr><td>eResources addresses</td><td>Adresy na platformie eNauczanie:
Obliczenia termodynamiczne i kinetyka reakcji katalitycznych dla studentów kierunku ITNE_2023/2024 - Moodle ID: 33138 https://enauczanie.pg.edu.pl/moodle/course/view.php?id=33138</td></tr>
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<tr><td>Example issues/ example questions/ tasks being completed</td><td></td></tr>
<tr><td>Work placement</td><td>Not applicable</td></tr>
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