



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 2024	Academic year of realisation of subject			2024/2025		
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						
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_U05		The student is able to apply a system approach, also taking into account non-technical aspects.		[SU4] Assessment of ability to use methods and tools [SU3] Assessment of ability to use knowledge gained from the subject [SU2] Assessment of ability to analyse information		
	K7_U06		The student is able to make an initial economic assessment of the activities undertaken.		[SU2] Assessment of ability to analyse information		
	K7_U07		The student has the knowledge to help him propose a process improvement.		[SU4] Assessment of ability to use methods and tools [SU3] Assessment of ability to use knowledge gained from the subject [SU2] Assessment of ability to analyse information		

Subject contents	<p>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.</p> <p>Laboratory:</p> <ol style="list-style-type: none"> 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 refinery industry. 											
Prerequisites and co-requisites	basic knowledge in general chemistry, thermodynamics and chemical kinetics											
Assessment methods and criteria	<table border="1" data-bbox="448 831 1487 958"> <thead> <tr> <th data-bbox="448 831 794 864">Subject passing criteria</th> <th data-bbox="794 831 1141 864">Passing threshold</th> <th data-bbox="1141 831 1487 864">Percentage of the final grade</th> </tr> </thead> <tbody> <tr> <td data-bbox="448 864 794 898">writing test from lectures</td> <td data-bbox="794 864 1141 898">50.0%</td> <td data-bbox="1141 864 1487 898">50.0%</td> </tr> <tr> <td data-bbox="448 898 794 958">performing 5 experiments and delivering the reports</td> <td data-bbox="794 898 1141 958">100.0%</td> <td data-bbox="1141 898 1487 958">50.0%</td> </tr> </tbody> </table>			Subject passing criteria	Passing threshold	Percentage of the final grade	writing test from lectures	50.0%	50.0%	performing 5 experiments and delivering the reports	100.0%	50.0%
Subject passing criteria	Passing threshold	Percentage of the final grade										
writing test from lectures	50.0%	50.0%										
performing 5 experiments and delivering the reports	100.0%	50.0%										
Recommended reading	<table border="1" data-bbox="448 965 1487 1756"> <tbody> <tr> <td data-bbox="448 965 794 1480">Basic literature</td> <td colspan="2" data-bbox="794 965 1487 1480"> <ol style="list-style-type: none"> 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. Ziótek, 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 data-bbox="448 1480 794 1715">Supplementary literature</td> <td colspan="2" data-bbox="794 1480 1487 1715"> <ol style="list-style-type: none"> 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 data-bbox="448 1715 794 1756">eResources addresses</td> <td colspan="2" data-bbox="794 1715 1487 1756">Adresy na platformie eNauczanie:</td> </tr> </tbody> </table>			Basic literature	<ol style="list-style-type: none"> 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. Ziótek, 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. 		Supplementary literature	<ol style="list-style-type: none"> 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. 		eResources addresses	Adresy na platformie eNauczanie:	
Basic literature	<ol style="list-style-type: none"> 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. Ziótek, 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. 											
Supplementary literature	<ol style="list-style-type: none"> 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. 											
eResources addresses	Adresy na platformie eNauczanie:											
Example issues/ example questions/ tasks being completed												
Work placement	Not applicable											