



## Subject card

Subject name and code	Surface Phenomena and Industrial Catalytic Processes, PG_00049339						
Field of study	Chemical Technology						
Date of commencement of studies	February 2024	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		
Semester of study	2	ECTS credits			5.0		
Learning profile	general academic profile	Assessment form			assessment		
Conducting unit	Department of Physical Chemistry -> Faculty of Chemistry						
Name and surname of lecturer (lecturers)	Subject supervisor		dr hab. inż. Adam Kloskowski				
	Teachers						
Lesson types and methods of instruction	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	30.0	15.0	0.0	30.0	0.0	75
	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	75		15.0		35.0	125
Subject objectives	The aim of the course is to familiarize the student who already knows a number of detailed solutions in the field applications of surface phenomena and catalysis in industrial processes with general principles allowing for the creative application of these phenomena.						
Learning outcomes	Course outcome		Subject outcome		Method of verification		
	K7_U09		The student can use the acquired knowledge to analyze surface processes, including those related to colloid solutions. He is able to choose appropriate measurement techniques and analyze their results.		[SU4] Assessment of ability to use methods and tools [SU2] Assessment of ability to analyse information		
	K7_W05		The student will score wide knowledge of the issues kinetics and heterogeneous catalysis with in-depth consideration analysis of chemical transformations in based on the knowledge of the issues surface physicochemistry.		[SW1] Assessment of factual knowledge		
	K7_U06		The student is able to solve problem tasks related to broadly understood processes running at the interface. Has the ability practical use knowledge gained in the analysis the course of processes catalytic.		[SU3] Assessment of ability to use knowledge gained from the subject [SU4] Assessment of ability to use methods and tools		

Subject contents	<p><b>LECTURE:</b>  Theoretical foundations of surface phenomena: surface tension, adsorption. Methods determination of surface tension. Work of cohesion and adhesion. The surface tension of the solutions i its modification. The use of capillary phenomena and surface tension in technology (flotation, foam). Physical adsorption and chemisorption. Gibbs, Langmuir, Freundlich, BET adsorption isotherms, Frumkin, Tiomkin. Types and classification of adsorbents; their production on an industrial scale. Applications of activated carbons, silica gels and aluminogels in technology. Chemically modified activated carbons (iodized, silvered), their characteristics and industrial applications. Molecular sieves (zeolites and carbon screens). Homogeneous and heterogeneous catalysis. Adsorption as a preliminary stage of catalysis heterogeneous. Basic types of heterogeneous catalysts (contacts), their desired characteristics and components. The main theories of catalysis and mechanisms of surface reactions. Designing, receiving, operation and examples of applications of heterogeneous catalysts. Kinetics of controlled processes transport. The importance of adsorption in electrochemical processes. Electrocatalysis. Surface engineering - modern techniques of surface modification in the preparation of catalysts. Selected research techniques surface.</p> <p><b>EXERCISES:</b>  Performing calculations in the field of surface tension, adsorption and kinetics of controlled reactions transport and catalytic reactions.</p> <p><b>Design/Lab:</b>  Independent, critical study by students of selected issues in the field of application of phenomena surface and catalysis in industrial practice using the BIOVIA-Material software Studio.</p>														
Prerequisites and co-requisites	knowledge of general, inorganic, organic and physical chemistry at the first-cycle level														
Assessment methods and criteria	<table border="1" data-bbox="448 692 1487 831"> <thead> <tr> <th data-bbox="448 692 794 730">Subject passing criteria</th> <th data-bbox="794 692 1141 730">Passing threshold</th> <th data-bbox="1141 692 1487 730">Percentage of the final grade</th> </tr> </thead> <tbody> <tr> <td data-bbox="448 730 794 768"></td> <td data-bbox="794 730 1141 768">50.0%</td> <td data-bbox="1141 730 1487 768">50.0%</td> </tr> <tr> <td data-bbox="448 768 794 806"></td> <td data-bbox="794 768 1141 806">50.0%</td> <td data-bbox="1141 768 1487 806">33.0%</td> </tr> <tr> <td data-bbox="448 806 794 831"></td> <td data-bbox="794 806 1141 831">70.0%</td> <td data-bbox="1141 806 1487 831">17.0%</td> </tr> </tbody> </table>			Subject passing criteria	Passing threshold	Percentage of the final grade		50.0%	50.0%		50.0%	33.0%		70.0%	17.0%
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Recommended reading	Basic literature	<ol style="list-style-type: none"> <li>1. J. Ościk, Adsorpcja, WNT, Warszawa 1979.</li> <li>2. E. T. Dutkiewicz, Fizykochemia powierzchni, WNT, Warszawa 1998.</li> <li>3. B. Grzybowska-Świerkosz, "Elementy katalizy heterogenicznej", Wydawnictwo Naukowe PWN, Warszawa 1993.</li> <li>4. F. Próchnik, "Kataliza homogeniczna", Wydawnictwo Naukowe PWN, Warszawa 1993.</li> <li>5. M. Ziółek, I. Nowak, "Kataliza heterogeniczna. Wybrane zagadnienia", Wydawnictwo UAM, Poznań 1999.</li> <li>6. M. Najbar (red.), "Fizykochemiczne metody badań katalizatorów kontaktowych", Wydawnictwo Uniwersytetu Jagiellońskiego, Kraków 2000.</li> </ol>													
	Supplementary literature	<ol style="list-style-type: none"> <li>1. P.C. Niemenz, R. Rajagopalan, Principles of Colloid and Surface Chemistry, Marcel Dekker, Inc., New York, Basel, Hong Kong 1997.</li> <li>2. J. Hagen, S. Hawkins Industrial Catalysis: A Practical Approach, John Wiley &amp; Son, Ltd; 1999.</li> <li>3. R. I. Wijngaarden, K. R. Westerterp, A. Kronberg, Industrial Catalysis. Optimizing of Catalysts and Processes, Wiley-VCH Verlag 1998.</li> <li>4. A. Wieckowski (red.), Interfacial Electrochemistry, Marcel Dekker, New York 1999.</li> </ol>													
	eResources addresses	Adresy na platformie eNauczanie:													
Example issues/ example questions/ tasks being completed	<p>Methods of measuring surface tension.</p> <p>The influence of the size of the interface area on the rate of heterogeneous reaction</p> <p>Physical adsorption and chemisorption</p> <p>isotherms, isobars and adsorption isosteres</p> <p>Adsorption theories</p> <p>Porous materials</p> <p>Instrumental methods of surface analysis</p>														
Work placement	Not applicable														