GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Surface Phenomena and Industrial Catalytic Processes, PG_00064295		
Field of study	Chemical Technology		
Date of commencement of studies	February 2027	Academic year of realisation of subject	2027/2028
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 -> Faculties of Gdańsk University of Technology		
Name and surname of lecturer (lecturers)	Subject supervisor	prof. dr hab. inż. Adam Kloskowski	
	Teachers		

Lesson types

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	5.0	45.0	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_U07] takes into account ethical issues and regulations in research planning and product and process design	takes into account ethical issues and regulations in research planning and designing technological products and processes.	[SU1] Assessment of task fulfilment
[K7_K03] can interact and work in a group, taking on a variety of roles	is able to cooperate and work in a group, assuming different roles in it.	[SK1] Assessment of group work skills [SK3] Assessment of ability to organize work
[K7_U04] predicts the properties of the materials obtained and the course of processes involving them, based on knowledge of technology and related fields and computer methods of data analysis, modelling and simulation	predicts the properties of the obtained materials and the course of processes involving them based on knowledge of technology and related fields as well as computer methods of data analysis, modeling and simulation	[SU1] Assessment of task fulfilment [SU2] Assessment of ability to analyse information
[K7_W04] recognises scientific, technological, organisational and economic opportunities and constraints in technology and related fields	recognizes scientific, technological, organizational and economic possibilities and limitations in technology and related fields.	[SW1] Assessment of factual knowledge [SW3] Assessment of knowledge contained in written work and projects

Subject contents	Course content – lecture 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. Course content – exercises Performing calculations in the field of surface tension, adsorption and kinetics of controlled reactions transport and catalytic reactions. Course content – project The aim of the design labs is to acquire the skills of performing a quantitative relationship between chemical structure and catalytic activity (QSAR) for new chemical compounds and to learn about modern programming tools used for this purpose. The labs are divided into two thematic blocks: 1) Familiarizing students with the possibilities of using data analysis tools available in the ORANGE DATA MINING package 2) Carrying out modeling using the ORANGE package and other programs dedicated to QSAR issues (MOLDEN, MOPAC, RDKit)
Prerequisites and co-requisites	Knowledge of general, inorganic, organic and physical chemistry at the first-cycle level
Assessment methods and criteria	

Subject passing criteria	Passing threshold	Percentage of the final grade
Evaluation of the QSAR model and conclusions	70.0%	25.0%
2 quizzes from the exercises	50.0%	25.0%
Final test from the lecture + presentation (optional)	50.0%	50.0%

Recommended reading	Basic literature	1. J. Ościk, Adsorpcja, WNT, Warszawa 1979. 2. E. T. Dutkiewicz, Fizykochemia powierzchni, WNT, Warszawa 1998. 3. B. Grzybowska-Świerkosz, "Elementy katalizy heterogenicznej", Wydawnictwo Naukowe PWN, Warszawa 1993. 4. F. Próchnik, "Kataliza homogeniczna", Wydawnictwo Naukowe PWN, Warszawa 1993. 5. M. Ziółek, I. Nowak, "Kataliza heterogeniczna. Wybrane zagadnienia", Wydawnictwo UAM, Poznań 1999. 6. M. Najbar (red.), "Fizykochemiczne metody badań katalizatorów kontaktowych", Wydawnictwo Uniwersytetu Jagiellońskiego, Kraków 2000. 7. T. Puzyn, A. Mostrąg-Szlichtyng, N. Suzuki, M. Harańczyk, Metody Chemometryczne w ocenie ryzyka: Ilościowe zależności pomiędzy strukturą chemiczą a właściwościami (QSPR) dla nowych rodzajów zanieczyszczeń chemicznych. Chemometria w nauce i praktyce. Kraków, (2009). 8. M. Cronin, The Current Status and Future Applicability of Quantitative Structure- Activity Relationships (QSARs) in Predicting Toxicity. ATLA (2002) 30: 81-84. 9. J. Diao, Y. Li, S. Shi, Y. Sun, Y. Sun, QSAR Models for Predicting Toxicity of Polychlorinated Dibenzo-p-dioxins and Dibenzofurans Using Quantum Chemical Descriptors. Bull. Environ. Contam. Toxicol. (2010) 85:109115.
	Supplementary literature	1. P.C. Niemenz, R. Rajagopalan, Principles of Colloid and Surface Chemistry, Marcel Dekker, Inc., New York, Basel, Hong Kong 1997. 2. J. Hagen, S. Hawkins Industrial Catalysis: A Practical Approach, John Wiley & Son, Ltd; 1999. 3. R. I. Wijngaarden, K. R. Westerterp, A. Kronberg, Industrial Catalysis. Optimizing of Catalysts and Processes, Wiley-VCH Verlag 1998. 4. A. Wieckowski (red.), Interfacial Electrochemistry, Marcel Dekker, New York 1999.
	eResources addresses	
Example issues/ example questions/ tasks being completed	Methods of measuring surface tension. The influence of the size of the interface area on the rate of heterogeneous reaction Physical adsorption and chemisorption isotherms, isobars and adsorption isosteres Adsorption theories Porous materials Instrumental methods of surface analysis	
Practical activites within the subject	Not applicable	

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