COURSE DESCRIPTION CARD - SYLLABUS

Course name
Surface phenomena and industrial catalysis [S2TCh2E-KiN>ZPiKP]

Course

Field of study
Chemical Technology

Year/Semester
1/1

Area of study (specialization)
Composites and Nanomaterials

Profile of study
general academic

Level of study
second-cycle

Course offered in
English

Form of study
full-time

Requirements
compulsory

Number of hours

Lecture
30

Laboratory classes
0

Other
0

Tutorials
0

Projects/seminars
0

Number of credit points

2,00

Coordinators

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Lecturers

Prerequisites

Basic knowledge of general chemistry, physical chemistry, thermodynamics, as well as chemical technology and chemical engineering, and also widely understood environmental protection; ability to obtain information from indicated sources.

Course objective

This lecture aims to present knowledge about surface phenomena at the interface: gas/liquid, liquid/liquid and liquid/solid as well as information about the kinetics of chemical reactions, homo- and heterogeneous catalysis and elements of biocatalysis discussing examples of applications of catalytic processes in industry and environmental protection. In addition, the lecture introduces elements of tribology and electrokinetics of sorption processes.

Course-related learning outcomes

Knowledge:

K_W4 - has improved knowledge of kinetics, thermodynamics, surface phenomena and catalysis of chemical processes
K_W6 - has improved knowledge of the newest chemical and material technologies, knows current trends in the development of chemical industrial processes
K_W14 - has knowledge of selected aspects of modern chemical knowledge

Skills:
K_U1 - has the ability to obtain and critically evaluate information from the literature, databases and other sources, and formulate opinions on this basis
K_U12 - has the ability to adapt knowledge about chemistry and related fields to solve problems in the field of chemical technology and planning new industrial processes
K_U15 - is able to critically analyze industrial chemical processes and introduce modifications and improvements in this area, using the acquired knowledge, including knowledge about the latest achievements of science and technology

Social competences:
K_K1 - is aware of the need for lifelong learning and professional development
K_K2 - is aware of the limitations of science and technology related to chemical technology, including environmental protection

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Written/oral credit graded on the basis of a points system (0-100 points)
3 50.1 -70.0 points
4 70.1 -90.0 points
5 90.1 -100 points

Programme content

Issues concerning surface phenomena at the interface: gas/liquid,
liquid/liquid and liquid/solid and kinetics of chemical reactions, homo- and heterogeneous catalysis and elements of biocatalysis.

Course topics

1. Surface phenomena in a fluid/fluid and fluid/solid system (qualitative and quantitative description of adsorption; adsorption isotherms; equilibrium and dynamics of the adsorption process)
2. Basic definitions and concepts of chemical catalysis: catalyst, its activity, selectivity and life span. Catalysts in homo- and heterogeneous catalysis. Enzymatic catalysis.
3. Heterogeneous catalysis (porous materials, characteristics and a role of heterogeneous catalyst components; support types; methods of applying the active substance; active centers; deactivation of the catalyst; heterogeneous catalysis steps; zeolites).
4. Mechanisms of surface reaction (Langmuir-Hinshelwood mechanism, Rideal mechanism).
5. Homogeneous catalysis (characteristics of catalysts in homogeneous catalysis and types of reactions in homogeneous catalysis; general and specific acid catalysis; general and specific basic catalysis; organometallic compounds).
6. Phase-transfer catalysis
7. Sorption and catalytic processes in environmental protection and tribology.
8. Kinetics of sorption processes.
9.Characteristics of selected catalytic industrial processes:
a) crude oil processing (catalytic cracking, hydrocracking, catalytic reforming),
b) oxidation of unsaturated hydrocarbons in the gas phase,
c) catalytic flue gas treatment,
d) photocatalysis and photoredox catalysis,
e) industrial biocatalysis,
e) organometallic compounds in industrial catalysis,
f) catalytic processes/technologies developed in Poland.
10. Selected aspects of electrocatalysis.

Teaching methods

Lecture: multimedia presentation illustrated with examples shown on a blackboard.

Bibliography

Basic:
1. M. Ziółek, I. Nowak, Kataliza heterogeniczna wybrane zagadnienia, Wydawnictwo Naukowe UAM, Poznań 1999.
2. B. Grzybowska -Świerkosz, Elementy katalizy heterogenicznej, Wydawnictwo Naukowe PWN 1993.
3. F. Pruchnik, Kataliza homogeniczna, Wydawnictwo Naukowe PWN 1993.
4. Z. Sarbak, Kataliza w ochronie Środowiska, Wydawnictwo Naukowe UAM, Poznań 2004.
5. E. T. Dutkiewicz, Fizykochemia powierzchni, WNT Warszawa 1998.
6. B. Roop Chand, G. Meenakshi, Adsorpcja na węglu aktywnym, WNT Warszawa 2009
7. W. Turek, Z. Uziel, Wykłady i zadania obliczeniowe z kinetyki chemicznej i adsorpcji z elementami katalizy, Wydawnictwo Politechniki Śląskiej 2010

Additional:
1. P.W. Atkins, Chemia fizyczna, Wyd. Nauk. PWN, Warszawa 2003.
2. Handbook of surfaces and interfaces of materials, Vol. I Surface and interface phenomena, ed. Hari Sihgh Nalva, San Diego, Academic Press 2001.
3. A. Chmiek, Biotechnologia: podstawy mikrobiologiczne i biochemiczne, Wydawnictwo Naukowe PWN 1998.
4. A. Burghardt, G. Bartelmus, Inżynieria reaktorów chemicznych, T. 1: Reaktory dla układów homogenicznych, T. 2.: Reaktory dla układów heterogenicznych, Wydawnictwo Naukowe PWN 2001

Breakdown of average student's workload

	Hours	ECTS
Total workload	50	2,00
Classes requiring direct contact with the teacher	30	1,00
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	20	1,00