DESCRIPTION OF THE COURSE OF STUDY

Course code	**0531-2CHEM-C09-CFII**	
Name of the course in	Polish	**Chemia fizyczna II**
	English	**Physical Chemistry II**

1. LOCATION OF THE COURSE OF STUDY WITHIN THE SYSTEM OF STUDIES

1.1. Field of study	Chemistry
1.2. Mode of study	Full-time studies
1.3. Level of study	Second-cycle studies
1.4. Profile of study*	General academic
1.5. Person/s preparing the course description	prof. dr hab. Piotr Słomkiewicz, dr Katarzyna Jedynak
1.6. Contact	piotr.słomkiewicz@ujk.edu.pl katarzyna.jedynak@ujk.edu.pl

2. GENERAL CHARACTERISTICS OF THE COURSE OF STUDY

2.1. Language of instruction	**English**
2.2. Prerequisites*	**physical chemistry at first-cycle level**

3. DETAILED CHARACTERISTICS OF THE COURSE OF STUDY

3.1. Form of classes		Lectures, laboratory exerices, seminar
3.2. Place of classes		Classes in the teaching room of the UJK
3.3. Form of assessment		Lecture - exam, laboratory exercises and seminar - credit with grade
3.4. Teaching methods		Lecture, use of audiovisual resources, discussion, demonstration Seminar, solving tasks and problems Laboratories, independent experiments
3.5. Bibliography	**Required reading**	1. Peter Atkins, Julio De Paul, James Keeler, Physical Chemistry, Oxford University Press, 2022 2. Finn Miller, Physical Chemistry, Willford Press 2017 3. Langdon Jamie, Physical Chemistry and Its Applications, Willford Press 2017 4. B.J. Jankiewicz, D. Jamiola, J. Choma, M. Jaroniec, Silica-metal core-shell nanostructures, Advances in Colloid and Interface Science, 2012, 170(1-2), 28-47.
	Further reading	1. Hofmann Andreas, Physical Chemistry Essentials, Springer International Publishing AG 2018 2. H. Jankowska, A. Świątkowski, J. Choma, Active Carbon, Horwood Ellis Ltd., Chichester 1991.

4. OBJECTIVES, SYLLABUS CONTENT AND INTENDED LEARNING OUTCOMES

4.1. Course objectives ***(including form of classes)***

Lecture:

C1. Teaching the student issues of physical chemistry II

C2. Understanding the relationship between physicochemical laws and specific problems

Seminar:

C3. Acquiring the ability to independently solve physicochemical tasks and problems

C4. Ability to apply basic calculation methods to typical physical chemistry problems

Laboratory exercises:

C5. The student can perform laboratory tasks independently and correctly prepare measurement results

C6. Principles of operation and operation of basic physicochemical equipment

C7. Ability to analyze the results obtained during measurements

4.2. Detailed syllabus ***(including form of classes)***

Lecture:

1. Introduction – surface characteristics.
2. Adsorption equilibrium.
3. Adsorption isotherms - Henry, Langmuir, Freundlich, BET, Dubinin-Raduszkiewicz, Jaroniec-Choma.
4. Adsorption and desorption rate.
5. Surface mobility.
6. Catalytic activity of the surface.

7. Adsorption and catalysis. Langmuir-Hinshelwood mechanism. Eley-Rideal mechanism.
8. Examples of catalytic reactions. Catalytic activity. Hydrogenation. Oxidation. Cracking and reforming.
9. Colloidal systems.
10. Basic concepts.
11. Division of colloidal systems.
12. Molecular masses of colloids.
13. Obtaining colloids.
14. Kinetic properties.
15. Optical properties.
16. Electrokinetic properties.
17. Popularity of colloidal systems.
18. Nanostructures.
19. General information about core-shell nanostructures.
20. Preparation of silica and carbon nanoparticles.
21. Modification of silica and carbon nanoparticles.
22. Preparation of metallic coatings of silica-metallic and carbon-metallic nanostructures.
23. Characterization of silica-metallic and carbon-metallic nanostructures.
24. Application of silica-metallic and carbon-metallic nanostructures

Seminar:
Computational methods used in tasks and problems in the field of adsorption equilibria, catalysis and adsorption, colloidal systems and nanoporous materials.

Laboratory exercises:
During classes, the student performs laboratory exercises on adsorption processes (e.g. adsorption at the solid-solution interface), kinetics and catalysis, and properties of colloidal systems.

4.3 Intended learning outcomes

Code	A student, who passed the course	Relation to learning outcomes
within the scope of **KNOWLEDGE:**		
W01	Has extended knowledge of the physicochemistry of surface phenomena, colloids and core-shell nanostructures	CHEM2A_W02
W02	Knows experimental techniques appropriate for studying surface phenomena, colloids and core-shell nanostructures	CHEM2A_W02
W03	Knows the theoretical basis of methods for physicochemical characterization of porous solids, colloids and nanostructures	CHEM2A_W02
W04	Knows the principles of occupational health and safety to the extent that allows for independent work in a chemical laboratory	CHEM2A_W10
within the scope of **ABILITIES:**		
U01	Is able to plan experiments related to the study of phenomena occurring on the surface of porous solids, colloids and nanostructures	CHEM2A_U02
U02	Is able to critically evaluate the results of physicochemical studies of porous solids, colloids and nanostructure	CHEM2A_U09
U03	Is able to find the necessary information in professional literature, databases of scientific journals and other sources	CHEM2A_U09
within the scope of **SOCIAL COMPETENCE:**		
K01	Understands the need to systematically study articles in scientific and popular science journals	CHEM2A_K01

4.4. Methods to verify the achievement of the learning outcomes												
Teaching outcomes *(code)*	**Method of verification (+/-)**											
	Exam oral/written*			**Test***			**Project***			**Group work***		
	Form of classes			***Form of classes***			***Form of classes***			***Form of classes***		
	W	*C*	*...*	*W*	*K*	*L.*	*W*	*K*	*L*	*W*	*K*	*L*
W01	+				+	+						
W02	+				+	+						
W03	+				+	+						
W04												+
U01						+			+			+
U02					+	+			+			+
U03					+	+			+			+
K01	+											

delete as appropriate

4.5. Criteria of assessment of the intended learning outcomes		
Form of classes	**Grade**	**Criterion of assessment**
lecture (L) (including e-learning)	**3**	Exam - test, 51-60% correct answers
	3,5	Exam - test, 61-70% correct answers
	4	Exam - test, 71-80%correct answers
	4,5	Exam - test, 81-90%correct answers
	5	Exam - test, 91-100% correct answers
Seminar including e-learning)	**3**	Credit with grade - test, 51-60% correct answers
	3,5	Credit with grade - test, 61-70% correct answers
	4	Credit with grade - test, 71-80% correct answers
	4,5	Credit with grade - test ,81-90% correct answers
	5	Credit with grade - test, 91-100% correct answers
Laboratory exercises (including e-learning)	**3**	Credit with grade - test, 51-60% correct answers
	3,5	Credit with grade - test, 61-70% correct answers
	4	Credit with grade - test, 71-80% correct answers
	4,5	Credit with grade - test, 81-90% correct answers
	5	Credit with grade - test, 91-100% correct answers

5. BALANCE OF ECTS CREDITS – STUDENT'S WORK INPUT

Category	**Student's workload**	
	Full-time studies	**Extramural studies**
NUMBER OF HOURS WITH THE DIRECT PARTICIPATION OF THE TEACHER /CONTACT HOURS/	***75***	***50***
Participation in lectures	30	20
Participation in seminars	15	10
Participation in laboratories	30	20
INDEPENDENT WORK OF THE STUDENT/NON-CONTACT HOURS/	***75***	***90***
Preparation for the seminars, laboratories	35	40
Preparation for the lecture and exam	20	30
Preparation of reports	20	20
TOTAL NUMBER OF HOURS	***150***	***150***
ECTS credits for the course of study	**6**	**6**

Accepted for execution *(date and legible signatures of the teachers running the course in the given academic year)*

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