KAPITAŁ LUDZKI
NARODOWA STRATEGIA SPÓJNOŚCI

Projekt współfinansowany przez Unię Europejską w ramach Europejskiego Funduszu Społecznego

UNIA EUROPEJSKA
EUROPEJSKI FUNDUSZ SPOŁECZNY

Course title

Physical chemistry

ECTS code

13.3.0390

Name of unit administrating study

Faculty of Chemistry

Studies

faculty	field of study		
Wydział Chemii	Chemia	type	pierwszego stopnia
		form	stacjonarne
		specialty	chemia biomedyczna, chemia kosmetyków, analityka i diagnostyka chemiczna, chemia żywności
		specialization	wszystkie

Teaching staff

prof. dr hab. Janusz Rak; dr hab. Artur Sikorski, profesor uczelni; mgr Vladyslav Ievtukhov; dr hab. Karol Krzymiński, profesor uczelni; dr hab. Piotr Storoniak, profesor uczelni; dr inż. Beata Zadykowicz; dr Magdalena Zdrowowicz-Żamojć; dr Lidia Chomicz-Mańka; mgr Anna Romanowska

Forms of classes, the realization and number of hours

Forms of classes

Auditorium classes, Laboratory classes, Lecture

The realization of activities

classroom instruction

Number of hours

Lecture: 30 hours, Laboratory classes: 45 hours, Auditorium classes: 30 hours

ECTS credits

8

classes - 105 h

tutorial classes – 15 h

student's own work – 80 h

Total: 200 h - 8 ECTS

The academic cycle

2023/2024 summer semester

Type of course

obligatory

Language of instruction

polish

Teaching methods

- conducting experiments
- multimedia-based lecture
- problem solving

Form and method of assessment and basic criteria for eveluation or examination requirements

Final evaluation

- Graded credit
- Examination

Assessment methods

written exam with open questions

The basic criteria for evaluation

Scoring in accordance with the UG regulations. Passing with no less than 51% of the maximum score. • Lecture: to qualify for the exam a student has to pass solving computational problems and doing experiments in laboratory. • Solving computational problems: a student hast to obtain at least 51% from each of two colloquia. The final score is an average of the two partial grades. Those who do not pass take another colloquium. • Doing experiments in laboratory: a student has to pass the entrance tests, adhere to the safety rules, obtain the correct results of experiments and carry out analysis of those results in writing (reports). The final score is an average comprising the grades of entrance tests and reports.

Method of verifying required learning outcomes

Required courses and introductory requirements

A. Formal requirements

general chemistry, basics of higher mathematics and physics

B. Prerequisites

Introductory requirements: general chemistry at the level of bachelor studies, basic concepts and principles in mathematics and physics, ability to carry out chemical and physical experiments, knowledge on the construction and operation of basic chemical equipment, ability of analyzing experimental data, basic principles of occupational health and safety in chemical laboratory.

Aims of education

Familiarization of students with: - description of reversible processes, - functioning of nature on the basis of thermodynamics, - physicochemical description of the adsorption phenomena, - phenomenological description of chemical changes on the ground of chemical kinetics, - description and applications of catalysis phenomena, - description and use of electrochemical processes. Acquisition of the ability to: - understand and quantitatively describe physical changes and chemical reactions, - use physicochemical data to prepare for studying of other subjects, - practical implementation of various physicochemical measurements, - prepare scientific reports describing the results, their analysis and critical interpretation.

Course contents

• Lecture:
- thermodynamics of reversible processes – basic concepts, thermodynamic laws
- phenomenological and molecular interpretation of energy and entropy
- thermodynamics – basic relationships, calculations, the fundamental equation
- equilibrium – thermodynamic criteria, equilibrium constant
- ideal and real solutions
- phase transition, phase equilibrium, phase diagrams; physicochemical basis of distillation, rectification, crystallization and extraction processes
- chemical kinetics – reaction rate, rate laws and rate constants, elementary and complex reactions
- homogenous and heterogeneous catalysis – mechanisms and significance
- electrochemical spontaneous and induced processes – electrochemical cells and electrolysis

• Solving computational problems:
- calculations regarding changes of internal energy, heat and work of physical processes and chemical reactions
- calculations regarding changes of entropy, thermodynamic free energy and free enthalpy of physical processes and chemical reactions
- determining the equilibrium constant
- calculations of free enthalpy on the base of the equilibrium constant
- phase equilibrium; Clausius–Clapeyron relation
- identifying the reaction order
- deriving the rate laws on the basis of reaction mechanism
- determining the kinetics of complex reactions
- deriving and using of the integrated rate laws
- calculations with the use of Arrhenius' equation, collision theory and transition state theory
- calculations regarding the relationships between electrical resistivity, conductivity, electrical mobility
- determining the ion transport numbers (transference numbers) – Hittorf method and moving boundary method
- using the standard electrode potentials to determine the equilibrium constant
- using the Nernst equation
- determining the ions' activity coefficients and electromotive force (emf) of working cell
- state functions for the working cell reactions

Doing experiments in laboratory:
- determining dissociation constant on the basis of spectroscopy measurements
- calculations based on the Lambert-Beer law
- applications of the spectroscopic measurements
- principle of operation of the UV-VIS spectrophotometer
- dipole moment vs. molecular geometry, methods of determining of dipole moment
- polarizability, molar refractivity, refractive index
- calorimetric measurements (heat of combustion, calorimetric bomb, plot of the dependence of the temperature vs time for calorimeter)
- phase diagrams, lever rule, fractional distillation of azeotropic and zeotropic mixtures

Bibliography of literature

Literature required to pass the course
- Peter Atkins, Julio de Paula - Physical Chemistry
- Peter Atkins, Julio de Paula - Physical Chemistry for the Life Sciences
- Gordon G. Hammes, Sharon Hammes-Schiffer - Physical Chemistry for the Biological Sciences

Extracurricular readings
- Howard de Voe - Thermodynamics and chemistry
- David Eisenberg, Donald Crothers - Physical chemistry : with applications to the life sciences
- Richard Masel - Chemical Kinetics and Catalysis

The learning outcomes (for the field of study and specialization)	Knowledge
	A student:

	• has knowledge on the basic laws and theories of physical chemistry, • knows how to properly describe the investigated physicochemical phenomena, using the language of higher mathematics, • identifies the equipment that he/she was exposed to during study and is able to explain its operation rules.
	Skills
	A student can: • carry out the planned experiments in the laboratory, • analyze and solve problems using the known laws and methods, • correctly draw conclusions from the results of the measurements and prove their correctness on the basis of the available literature, • solve calculation problems using appropriate theories and formulas.
	Social competence
	A student: • can work independently, • adhere to the safety rules during execution of experiments, • comply with the rules concerning the executed experiments, • can cooperate and interact in the group adopting various roles.

Contact

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