KAPITAŁ LUDZKI
NARODOWA STRATEGIA SPÓJNOŚCI

Projekt współfinansowany przez Unię Europejską w ramach Europejskiego Funduszu Społecznego

UNIA EUROPEJSKA
EUROPEJSKI
FUNDUSZ SPOŁECZNY

Course title	ECTS code
Graduate study lecture – Selected problems of physical chemistry”	13.3.0477

Name of unit administrating study

Faculty of Chemistry

Studies

faculty	field of study		
Wydział Chemii	Chemia	type	drugiego stopnia
		form	stacjonarne
		specialty	chemia biomedyczna, chemia i technologia środowiska, analityka i diagnostyka chemiczna, chemia obliczeniowa
		specialization	wszystkie

Teaching staff

dr hab. Karol Krzymiński, profesor uczelni; dr hab. Piotr Storoniak, profesor uczelni

Forms of classes, the realization and number of hours

Forms of classes

Lecture

The realization of activities

classroom instruction

Number of hours

Lecture: 30 hours

ECTS credits

3
Classes: 30 hours
Consultations: 5 hours
Student's own work: 40 hours
TOTAL: 75 hours - 3 ECTS

The academic cycle

2022/2023 summer semester

Type of course

obligatory

Language of instruction

polish

Teaching methods

multimedia-based lecture

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

Final evaluation

Graded credit

Assessment methods

- Written exam with closed questions (test) and open problems
  Oral exam (correction term)
- assignment work – project or presentation

The basic criteria for evaluation

1. Positive assessment from each of the thematic blocks (minimum 50% of scored points for each block).
The final grade is the arithmetic average of the grades obtained from the two thematic blocks.
“Luminescence processes" - written test consisting of several open questions checking the knowledge and skills of applying knowledge to solve problems in the scope of the content of lectures. Points obtained are converted into grades in accordance with the applicable study regulations.
"Thermodynamics of natural changes": written test consisting of 10 test questions checking the knowledge and skills of applying knowledge to solve problems in the scope of the lecture program. Points obtained are converted into grades in accordance with the applicable study regulations.
Oral test - supplementing the written exam for students who obtained below 50% of the possible points, necessary to pass written test.
3. Attendance at lecture blocks at a minimum level of 75%.

Method of verifying required learning outcomes

Required courses and introductory requirements

A. Formal requirements

Completed courses in the following subjects implemented at the bachelor level: mathematics, physics, general chemistry, physical chemistry.

B. Prerequisites

Student possesses a chemical knowledge and demonstrates interest in physicochemical problems that allows to understand more complex problems in this field. She/he is able to acquire, analyze, evaluate and process information from various sources, including scientific core texts, Internet and other media. Acquires knowledge in a research way - observes, verifies, draws conclusions and generalizes.

Aims of education

The course familiarizes students with the problems included in the program of lectures. Acquires or deepen knowledge concerning luminescence processes of organic substances and chemical thermodynamics, with emphasis on processes occurring in nature. It is also targeted on understanding the origin of the phenomenon of emissive processes occurring chemical and natural systems (fluo-, phospho-, chemi- and bioluminescence), how to measure, quantify and use them in practice. Understanding the processes occurring in the natural environment and developing a sense of responsibility for his protection. Illustration of complex physicochemical problems involving modern multimedia techniques. Implementing students to select and evaluate acquired information. Developing self-education skills by analyzing information and data from various sources.

Course contents

Contents

The course consists of the two thematic blocks, selected according to research areas carried out in the lecturers' parent research unit. : "Thermodynamics of natural processes" and "Luminescence processes".

"Thermodynamics of natural processes": Thermodynamic functions of state. Criteria of spontaneous changes on the example of phenomena occurring in the natural environment. Thermodynamic description of chemical and physical changes (single and multi-component phase equilibria liquid-vapor, solid-liquid, solid-vapor, liquid-liquid and the influence of various factors on phase equilibria). Relationships among the structure of chemical compounds and their physical and chemical properties (reactivity).

Luminescence processes": the physical principles and practical aspects of luminescence phenomena. Nature and laws of absorption of electromagnetic radiation. Classification of electronic transitions. Formation and measurement of electron absorption spectra (splitting spectra into components, parameters of absorption bands). Electronic excitation and decay of excited states. Electronic and oscillatory states. Franck-Condon state. Selection rules and types of electronic transitions (spin, symmetry, overlap). The concept of chromophore and auxochrome groups. Radiant (emissive) transitions. Kinetics of radiative and radiationless transitions. Photochemical laws and rules. Radial transitions (fluorescence, phosphorescence, life times). Jablonski's diagram. Specialized devices for investigation of emission processes. Fluorescence emission and fluorescence excitation spectra (definitions, measurement methods, determination of crucial parameters, uses in analytics). Quantum yield of fluorescence and it determination.

Fluorescence standards and their characteristics. Stokes shift. Time-resolved fluorescence spectra (registration method, applications). Phosphorescence (formation, measurement conditions). Dependence of emission parameters on the solvent (solvatochromia). Chemiluminescence (CL): physicochemical requirements, energy, quantum efficiency, examples of CL systems, applications. Bioluminescence (BL): review of BL organisms, natural functions, BL physicochemistry, examples of applications.

Bibliography of literature

A. Literature required to pass the course

Electronic materials provided by the lecturers

B. Additional/Extracurricular readings

1. P.W. Atkins, "Physical Chemistry", Polish Scientific Publishers PWN, Warsaw 2003.
2. P. Suppan, "Chemistry and light", PWN Scientific Publishing House, Warsaw 1997.
3. S. Paszyc, "Fundamentals of Photochemistry", PWN Scientific Publishing House, Warsaw 1992.
4. J. R. Lakowicz, "Principles of fluorescence spectroscopy", 3rd edition, Springer 2006, or earlier: Kluwer Academics Plenum Publ., New York 1999.
5. A. M. Garcia-Campana, W.R. G. Bayenes, "Chemiluminescence in Analytical Chemistry", Marcel Dekker, Inc., New York 2001.
6. A. Martin, Physical Pharmacy, 3rd ed, Lippincott Williams and Wilkins Publ. 1983 or newer (2005).
7. R.P. Schwarzenbach, P.M. Gschwend, D.M. Imboden, Environmental organic chemistry, John Wiley & Sons, Inc. New York 1993.

The learning outcomes (for the field of study and specialization)

Knowledge

Student:

knows and understands the principles of interaction of electromagnetic radiation with matter;

• distinguishes between basic types of luminescence phenomena, is able to characterize them and indicate practical applications;

• knows and understands the basic photochemical laws;

• can characterize types of radial and non-radiative processes occurring in excited organic molecules;

• distinguishes between types of electronic spectra, knows how to create bands in these spectra and how to determine the parameters of the bands; distinguishes spontaneous and forced processes;

	• describes, using thermodynamic concepts, the chemical and physical transformations that it deals with in everyday life; • explains the behavior of chemical substances under certain conditions based on their structure and knowledge of principles of thermodynamics.
	Skills
	Student possesses the ability to critically evaluate the results of conducted experiments, observations and / or theoretical calculations
	Social competence
	Student: demonstrates creativity and activity in obtaining information independently; demonstrates inquisitiveness and the ability to analyze original chemical works; understands the need for further education and deepening knowledge; presents interest in physicochemical problems.
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