University of Gdańsk

Subject card

Subject name and code	Luminescent methods in research and industry, PG_00080820		
Field of study	Chemical Business		
Date of commencement of studies	October 2024	Academic year of realisation of subject	2027/2028
Education level	Bachelor's studies	Subject group	Optional subject group
Mode of study	full-time studies	Mode of delivery	at the university
Year of study	4	Language of instruction	Polish
Semester of study	7	ECTS credits	2.0
Learning profile	academic	Assessment form	credit
Conducting unit	Faculty of Chemistry -> Rector		
Name and surname of lecturer (lecturers)	Subject supervisor	dr inż. Beata Zadykowicz	
	Teachers		

Lesson types

Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
Number of study hours	30.0	0.0	0.0	0.0	0.0	30

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	30	5.0	15.0	50

Subject objectives

The aims of this course are to familiarize the students with the basic knowledge of luminescent methods and their applications in medicine, biotechnology, environmental protection and industry.

Learning outcomes

Course outcome	Subject outcome	Method of verification
[BCHINŻ_U01] On the basis of the acquired knowledge, identifies, analyses and solves engineering tasks and problems in broadly understood chemistry.	Student is able to plan experimental research of organic, inorganic or biological materials using the luminescent methods, and can apply the acquired knowledge to related scientific disciplines, in particular to organic, inorganic chemistry, polymer chemistry, spectroscopy and physical chemistry.	[SU4] test/exam - oral or written
[BCHINŻ_K01] Identifies the level of her/his own knowledge and skills as well as the need to update engineering knowledge, continuous professional training and personal development.	The student understands the role that luminescent methods play in the modern world and the need for further self-education in the field of luminescent methods.	[SK4] test/exam - oral or written
[BCHINŻ_W02] Enumerates basic laws and theories in chemistry, physics and mathematics necessary to formulate and solve simple engineering tasks.	Student has basic knowledge of concepts and principles regarding luminescent methods, has knowledge of the application of luminescent methods in medicine, biotechnology, environmental protection and industry, can present current directions of development of luminescent measurement methods.	[SW4] test/exam - oral or written
[BCHINŻ_W07] Describes the construction and operating principles of basic scientific, technological and control-measuring apparatus.	Student can discuss the methodology of measurements and the construction and of measuring apparatus in the field of luminescent methods.	[SW4] test/exam - oral or written

Subject contents	Luminescence - theoretical foundations, types of luminescence. Fluorescence spectroscopy - basic apparatus. Fluorescence quenching - basics, static and dynamic quenching. Measurements of fluorescence life time. The effect of the solvent on fluorescence spectra and fluorescence lifetimes. Fluorescent molecular probes. Fluorescence of proteins. Fluorescence in lipid membranes. The process of fluorescence resonance energy transfer (FRET). FRET applications in biological systems research. Fluorescent sensors. Photoinduced electron transfer (PET). Fluorescence analysis of organic, inorganic and hybrid materials. The use of fluorescent probes to study polymers. Fluorescence microscopy. Phosphorescence and delayed fluorescence - basics and methods of measurement. Phosphorescence suppression. Effectiveness of the quenching process. X-ray fluorescence (XRF) and its applications in the study of food products, in forensic science and in the preservation of arts. Photochromism, its examples and applications. Photochromic glass and masking materials. The use of photochromic materials in electronics. Photographic process, color photography. Photolithographic processes. Photovoltaic cells. Photochemistry in medicine - photodynamic therapy and diagnostics (PDT, PDD). Photochemistry in cosmetics. Types of photochemical reactions. Methods for studying photochemical reactions. Photopolymerization processes. Photoinitiators. Types of photopolymerization and their examples. Photostabilization of polymers. Photochemical reactors. Photochemical processes in industry, examples. Transformation and storage of solar energy. Chemiluminescence, reactions leading to the generation of radiation. Chemiluminescent probes and indicators as well as their application in medical, chemical and environmental analysis. Electrochemiluminescence. Electroluminescence - the basics. Electroluminescence application in electronics (LED, OLED). Triboluminescence. Thermoluminescence. Thermoluminescence dating in archeology.
Prerequisites and co-requisites	basic knowledge of physical chemistry and molecular spectroscopy

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
exam	51.0%	100.0%

Recommended reading

Basic literature	the lecture is original and based on numerous original publications, unpublished materials and own research
Supplementary literature	1. S. Paszyc, Podstawy fotochemii, PWN, Warszawa, 1992. 2. J. P. Simons, Fotochemia i spektroskopia, PWN, Warszawa, 1976. 3. J. A. Barltrop, J. D. Coyle, Fotochemia. Podstawy, PWN, Warszawa, 1987. 4. P. Suppan, Chemia i światło, PWN, Warszawa, 1997. 5. J. Najbar, A. Turek (eds), Fotochemia i spektroskopia optyczna, PWN, Warszawa, 2009. 6. J. Pączkowski (ed.), Fotochemia polimerów. Teoria i zastosowanie, Wyd. Uniwersytetu Mikołaja Kopernika, Toruń 2003. 7. P. Klan, J. Wirz, Photochemistry of Organic Compounds, John Wiley&Sons Ltd, 2009. C.E. Wayne, R.P.Wayne, Photochemistry, Oxford University Press, 2005.
eResources addresses	

Example issues/ example questions/ tasks being completed

1. **Select the correct answer regarding electronic excitation in organic molecules:**
- is the absorption of radiation from the gamma region;
- is the absorption of electromagnetic radiation, especially from the ultraviolet and visible regions;
- is the absorption of radiation from the microwave region;
- only radiation from the far infrared region leads to electronic excitation of molecules;
- all types of radiation can electronically excite a molecule if we expose it to radiation long enough.

1. **The source of radiation in the process of chemiluminescence and bioluminescence is/are most often:**
- fluorescence of the substrate undergoing a chemical reaction;
- vibrationally and rotationally excited molecules;
- a high-energy electrochemical process of a radical nature;
- fluorescence of the reaction product that is formed in the electronically excited state;
- fluorescence of a catalyst involved in a chemical reaction.

Work placement: Not applicable

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