University of Gdańsk

Subject card

Subject name and code	Photoluminescence in Medicine and Pharmacy, PG_00179271		
Field of study	Medical Physics		
Date of commencement of studies	October 2023	Academic year of realisation of subject	2025/2026
Education level	Bachelor's studies	Subject group	Obligatory subject group in the field of study Optional subject group
Mode of study	full-time studies	Mode of delivery	at the university
Year of study	3	Language of instruction	Polish
Semester of study	6	ECTS credits	1.0
Learning profile	academic	Assessment form	credit
Conducting unit	Division of Atomic and Molecular Physics -> Institute of Experimental Physics -> Faculty of Mathematics, Physics and Informatics -> Rector		
Name and surname of lecturer (lecturers)	Subject supervisor	dr Marta Miotke-Wasilczyk	
	Teachers		

Lesson types

Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
Number of study hours	15.0	0.0	0.0	0.0	0.0	15

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	15	0.0	0.0	15

Subject objectives

The aim of the course is to introduce students to the basic physicochemical aspects of the interaction of light with biological systems, with particular emphasis on photoluminescence effects.

The lecture is aimed at discussing fundamental photophysical processes (light absorption and emission) and selected photochemical processes (e.g., photosensitization, photoisomerization). The main emphasis will be placed on presenting and outlining current applications of these phenomena in medicine, medical physics, and pharmacy, including the basics of photodynamic therapy, selected methods of optical diagnostics, and the concept of light-controlled drug delivery systems.

Learning outcomes

Course outcome	Subject outcome	Method of verification
FIZMEDL3_W32	Student: -defines the basic principles and concepts related to the interaction of light (UV-Vis) with matter, -describes the key photophysical processes (absorption, fluorescence, phosphorescence) occurring as a result of molecular excitation, using Jabłoński diagram, -explains the basic mechanisms of selected photochemical reactions (photosensitization, photoisomerization) relevant in a biological context, -understands the principles of operation and basic applications of photoluminescence in the analysis of biomedical systems	[SW4] test/exam - oral or written
[FIZMEDL3_K01] knows the limitations of his own knowledge and understands the need for further education	The student discusses and expresses opinions on topics covered during the course, critically evaluates their knowledge of photoluminescence.	[SK4] test/exam - oral or written

Subject contents

1. **Physicochemical foundations of light-matter interactions.** Fundamentals of UV-Vis absorption spectroscopy (Lambert-Beer law) and methods for characterizing biomolecules (e.g., proteins, lipids, vitamin B12) and studying their interactions (e.g., with amyloids in the context of Alzheimer's disease).

2. **Photoluminescence processes.** Analysis of fluorescence and phosphorescence processes using the Jabłoński diagram and selected parameters such as quantum yield and lifetime. The use of fluorophores as probes for studying the microenvironment (pH, viscosity).

3. **Deactivation of excited states and the basics of photochemistry.** Analysis of non-radiative deactivation processes of excited states. Discussion of excited state quenching processes (Stern-Volmer equation) and excitation energy transfer mechanisms (FRET). The role of FRET in biological membrane investigations. Introduction to basic photochemical reactions using the example of the photoisomerization reaction mechanism in the process of vision.

4. **Applications of photochemical processes in medicine and pharmacy.** Discussion of the process of photosensitization and the generation of reactive oxygen species (ROS). Basics of photodynamic therapy (PDT), methods of optical medical diagnostics (e.g., fluorescence diagnostics), and the concept of light-controlled drug delivery systems (DDS).

Prerequisites and co-requisites

Assessment methods and criteria

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

Recommended reading

Basic literature	1. S. Paszyc, Podstawy fotochemii, PWN. 2. J. A. Barltrop, J. D. Coyle, Fotochemia. Podstawy, PWN. 3. P. Suppan, Chemia i Światło, PWN. 4. Resources provided by the tutors.
Supplementary literature	1. J. P. Simons, Fotochemia i spektroskopia, PWN. 2. W. Atkins, J. de Paula, J. Keeler, Chemia fizyczna, PWN. 3. Current scientific literature in the field of spectroscopy and biomedical research.
eResources addresses	

Example issues/ example questions/ tasks being completed

Work placement

Not applicable

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