University of Gdańsk

Subject card

Subject name and code	Photochemistry and Photophysics. Theory and Application, PG_00191161		
Field of study	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
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	9.0
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	dr Marta Miotke-Wasilczyk	

Lesson types

Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
Number of study hours	30.0	30.0	30.0	0.0	0.0	90

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	90	0.0	0.0	90

Subject objectives

The aim of the lecture is to introduce students to the basic principles of photophysics and photochemistry concerning the interaction of UV-Vis radiation with molecular systems, with particular emphasis on the formation and dynamics of electronically excited states and photoluminescence phenomena. The lecture focuses on basic photophysical processes and selected photochemical processes. The main emphasis is placed on a coherent description of the electronic and vibrational states of molecules, developing the ability to interpret stationary and time-resolved spectroscopic measurements, and presenting contemporary applications of these photophysical concepts and methods in chemical and environmental analysis, molecular sensors, and functional systems that emit or respond to light.

Learning outcomes

Course outcome	Subject outcome	Method of verification
[FIZL3_W02] understands the role of physical experiments, mathematical theoretical models approximating reality and computer simulations in the methodology of scientific research; is aware of technological, equipment and methodological limitations in scientific research	Student: understands the basic applications of photochemistry and photophysics in chemical and environmental analysis, molecular sensors, and photoresponsive systems.	[SW1] oral statement/ conversation/discussion [SW5] implementation of a problem task
[FIZL3_W01] has advanced knowledge of physical concepts, principles and theories, understands their historical development and significance not only for physics, but also for other exact and natural sciences and cognition of the world; knows and understands fundamental dilemmas of the civilization	Student: -defines the basic laws 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's diagram, - explains the basic mechanisms of selected photochemical reactions	[SW4] test/exam - oral or written

Subject contents	• Fundamental principles of molecular photophysics and photochemistry: interaction of ultraviolet and visible radiation with molecular systems, excitation of electronic states, the origin of photophysical deactivation pathways, and lightinduced chemical reactions. • Description of molecular electronic states: ground and excited states, singlet and triplet, energylevel and potentialenergy surface representations, Jablonski diagram. • Stationary absorption spectroscopy in the UVvisible range: qualitative interpretation of band positions and shapes, extraction of basic molecular parameters, and practical aspects of measurements in solution. • Stationary emission spectroscopy: fluorescence and phosphorescence as radiative deactivation pathways, analysis of emission and excitation spectra, Stokes shift, the relationship between absorption and emission for simple molecular systems. • Photophysical relaxation processes and simple kinetic descriptions of excitedstate populations: radiative and nonradiative deactivation channels, lifetimes and quantum yields, and their use in characterizing excitedstate behavior. • Intermolecular photophysical processes: dynamic and static fluorescence quenching, formation and emission properties of excimers and exciplexes, and qualitative introduction to excitation energy transfer and photoinduced electron transfer. • Experimental methods in molecular photophysics: principles and limitations of steadystate UV-VIS and fluorescence measurements, typical experimental procedures and basic strategies, and conceptual overview of timeresolved techniques. • Selected applications of photophysical concepts and spectroscopic methods in chemical, environmental and pharmaceutical analysis, molecular sensing and probing, and simple examples of lightdriven or lightemitting functional systems.
Prerequisites and co-requisites	
Assessment methods and criteria	

Subject passing criteria	Passing threshold	Percentage of the final grade
	51.0%	40.0%
	51.0%	60.0%

Recommended reading	Basic literature	P. Atkins, J. de Paula, Physical Chemistry, W. H. Freeman and Company. J. R. Lakowicz, Principles of Fluorescence Spectroscopy, Springer.
	Supplementary literature	B. Wardle, Principles and Applications of Photochemistry, Wiley. B. Valeur, Molecular Fluorescence: Principles and Applications, Wiley.
	eResources addresses	
Example issues/ example questions/ tasks being completed		
Work placement	Not applicable	

Document generated electronically. Does not require a seal or signature.