GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Photophysics and photochemistry of nanomaterials, PG_00063347						
Field of study	Nanotechnology						
Date of commencement of studies	October 2024		Academic year of realisation of subject	2025/2026			
Education level	first-cycle studies		Subject group	Obligatory subject group in the field of study Subject group related to scientific research in the field of study			
Mode of study	Full-time studies		Mode of delivery	at the university			
Year of study	2		Language of instruction	Polish			
Semester of study	4		ECTS credits	3.0			
Learning profile	general academic profile		Assessment form	assessment			
Conducting unit	Institute of Nanotechnology and Materials Engineering -> Faculty of Applied Physics and Mathematics -> Wydziały Politechniki Gdańskiej						
Name and surname of lecturer (lecturers)	Subject supervisor		dr inż. Marta Prześniak-Welenc				
	Teachers						
Lesson types and methods of instruction	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	30.0	0.0	15.0	0.0	0.0	45
	E-learning hours included: 0.0						
	eNauczanie source addresses: Moodle ID: 1310 Fotofizyka i fotochemia nanomateriałów https://enauczanie.pg.edu.pl/2025/course/view.php?id=1310						
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	45		5.0	25.0	75	
Subject objectives	The aim of the course is for students to acquire basic knowledge of physical and chemical processes induced by electromagnetic radiation affecting nanomaterials.						

Learning outcomes	Course outcome	Subject outcome	Method of verification
	[K6_K05] can present effects of their own work, provide information in a clear manner, communicate and self-evaluate, and give constructive feedback on the work of others.	Can clearly and comprehensibly present the results of photophysical and photochemical studies, interpret the obtained spectra and measurement results, perform self-assessment of the achieved outcomes, and provide constructive feedback on the work of others.	[SK1] Assessment of group work skills [SK2] Assessment of progress of work
	[K6_U01] can learn independently, obtain information from literature, databases and other properly selected sources	Can independently acquire and analyze information from scientific literature, databases, and other reliable sources related to photophysics and photochemistry, to expand knowledge and independently solve research problems.	[SU3] Assessment of ability to use knowledge gained from the subject [SU4] Assessment of ability to use methods and tools
	[K6_W01] has knowledge of materials science and understands its key role in the progress of civilization	Has knowledge of materials science and understands its key role in civilizational progress, particularly in the development of modern photoactive materials and technologies based on photophysical and photochemical phenomena, applied in areas such as environmental photocatalysis, renewable energy, and nanotechnology.	[SW1] Assessment of factual knowledge
	[K6_W05] has knowledge of inorganic and organic chemistry, physical chemistry and chemical thermodynamics.	Has knowledge of inorganic and organic chemistry, physical chemistry, and chemical thermodynamics, enabling the understanding of photophysical and photochemical phenomena.	[SW1] Assessment of factual knowledge

Subject contents

Lecture:

Photophysics:

Maxwell's equations and the electromagnetic wave spectrum.
Optical oscillator. Molecular vibrational energy levels and vibrational optical transitions.
Excited states in a diatomic molecule. Electronic, vibrational, and rotational excitations. FranckCondon principle.
Optical absorption and emission. Oscillator strength and transition dipole moment. LambertBeer law.
Singlet and triplet states. Selection rules for optical transitions.
Jablonski diagram.
Electronic excitation energy transfer processes. Förster and Dexter mechanisms.
Optical properties of nanomaterials: semiconductor nanomaterials, metal oxides, and metallic nanoparticles.
Basics of optical spectroscopy. Measurement and characterization of spectra. Surface-enhanced Raman scattering (SERS).

Photochemistry:

Introduction to photochemistry.
GrotthussDraper law.
StarkEinstein law of photochemical equivalence.
Photochemical reactions (photoreduction, photooxidation) and photochemical reaction kinetics.
Photolysis and photocatalysis.
Concept and types of radicals.
Radical reactions in solutions and in the atmosphere.
Methods for radical investigation (EPR, ESR, scavenger test).
Photochemical processes on nanomaterials.
Application of photochemical phenomena in environmental protection.

Laboratory:

Photophysics:

- Recording luminescence spectra of quantum dots and oxide nanoparticles.
- Analysis of excited-state lifetimes using luminescence decay measurements.
- Investigation of the effect of external conditions (pH, temperature) on luminescence intensity and stability.

Photochemistry:

- Generation of radicals in photocatalytic processes (e.g., dye degradation in the presence of TiO).
- Identification of radicals using scavenger tests and spectroscopic techniques.
- Evaluation of photocatalytic degradation mechanisms based on the dominant types of reactive radicals.

Prerequisites and co-requisites

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
Laboratory - report	100.0%	40.0%
Lecture - written test	50.0%	60.0%

Recommended reading

Basic literature	J.Z. Zhang, Optical properties and spectroscopy of nanomaterials, World Scientific 2009. V. Balzani, P. Ceroni, A. Juris, Photochemistry and Photophysics: Concepts, Research, Applications Wiley ISBN: 978-3-527-33479-7
Supplementary literature	Articles from JCR list

	eResources addresses	
Example issues/ example questions/ tasks being completed	1. Discuss the GrotthussDraper law. 2. Describe ion-radical reactions (radical anions and radical cations). 3. Explain the difference between electrophilic and nucleophilic interactions. 4. Explain the difference between indirect and direct photolysis.	
Work placement	Not applicable	

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