GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Spectroscopic methods in nanotechnology, PG_00069742		
Field of study	Nanotechnology		
Date of commencement of studies	February 2025	Academic year of realisation of subject	2024/2025
Education level	second-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	1	Language of instruction	Polish
Semester of study	1	ECTS credits	5.0
Learning profile	general academic profile	Assessment form	exam
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. Leszek Wicikowski	
	Teachers		

Lesson types and methods of instruction

Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
Number of study hours	30.0	0.0	30.0	0.0	0.0	60

E-learning hours included: 0.0

eNauczanie source addresses:

Moodle ID: 1211 Metody spektroskopowe w nanotechnologii
https://enauczanie.pg.edu.pl/2025/course/view.php?id=1211

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	60	5.0	60.0	125

Subject objectives

The aim of the course is to discuss the basic theoretical and practical issues of spectroscopy and presentation of the various types of spectroscopic methods and ways to interpret spectra, with particular attention paid to the possibility of their use in the study of nanostructured systems

Learning outcomes

Course outcome	Subject outcome	Method of verification
[K7_W04] has practical and theoretical knowledge of physical and chemical experimental methods of nanotechnology.	The student has extended knowledge of the place of spectroscopy in the system of exact and natural sciences, knows and understands the theoretical basis of various types of spectroscopic measurements, knows the applications of various types of spectroscopic measurements, is able to use spectroscopic methods to analyze the structure and properties of materials, knows the basic aspects of the construction and operation of modern spectroscopic measurement equipment, knows, understands and is able to independently explain the mathematical description of basic phenomena and processes that influence the form of the measured spectra.	[SW3] Assessment of knowledge contained in written work and projects [SW1] Assessment of factual knowledge
[K7_U05] can plan and conduct experimental and critical research and analyze their results, draw conclusions and formulate reasoned conclusions – within their specialization.	The student knows and understands the theoretical basis of various types of spectroscopic measurements, knows the applications of various types of spectroscopic measurements, is able to draw conclusions, and characterize the structure of nanomaterials. The student is able to select spectroscopic techniques to solve a specific problem.	[SU5] Assessment of ability to present the results of task [SU3] Assessment of ability to use knowledge gained from the subject
[K7_K03] can cooperate and work as part of a team, adopting different roles. Can self-evaluate, and give constructive feedback on the work of others.	The student is able to conduct experiments in a spectroscopic laboratory and is able to collaborate in research teams. They can assess the contribution of laboratory group members and evaluate their work.	[SK5] Assessment of ability to solve problems that arise in practice [SK3] Assessment of ability to organize work [SK1] Assessment of group work skills
[K7_U02] has enhanced abilities in laboratory work.	The student is able to prepare samples for laboratory analysis using specific spectroscopic methods, using dedicated software, and accurately selecting experimental conditions.	[SU5] Assessment of ability to present the results of task [SU4] Assessment of ability to use methods and tools [SU1] Assessment of task fulfilment

Subject contents

Lectures:

Reminder of issues related to the EM radiation and matter (atom, molecule)
Interaction between EM radiation and matter
Spectrum, spectral line parameters and ways of spectrum registration
Rotational spectroscopy
Vibrational spectroscopy (IR)
Rotational-vibrational spectra
Raman spectroscopy, IR vs Raman spectra
Electron spectroscopy (UV-Vis)
Photoelectron spectroscopy (UPS, XPS)
Synchrotron radiation
X-ray absorption spectroscopy (XAS)

Lab exercises:

FTiR
UV-VIS
XPS

Prerequisites and co-requisites

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
Lab Exercises	50.0%	50.0%
Final Exam	50.0%	50.0%

Recommended reading	Basic literature	1. P. W. Atkins, Physical Chemistry 2. Z. Kęcki, Podstawy spektroskopii molekularnej, PWN, Warszawa 3. J.M.Hollas, Modern Spectroscopy, John Wiley & Sons, Ltd. 4. D.L.Pavia i in., Introduction to Spectroscopy, Brooks/Cole 5. P.Willmott, An Introduction to Synchrotron Radiation: Techniques and Applications, John Wiley & Sons, Ltd.
	Supplementary literature	1. H.Haken, H.Ch.Wolf, "Molecular Physics and Elements of Quantum Chemistry", Springer 2. P. Flowers et al., "Chemistry: Atoms First 2e", openstax 3. C.D.Wagner, W.M.Riggs et al. Handbook of photoelectron spectroscopy Perkin-Elmer Corporation 4. J .A Colon-Santana, "Quantitative Core Level Photoelectron Spectroscopy", Morgan & Claypool Publishers, 2015 5. G.Bunker, Introduction to XAFS, Cambridge Univ. Press
	eResources addresses	
Example issues/ example questions/ tasks being completed	Microwave CO spectrum shows a series of spectral lines spaced from each other by 3.8442 cm-1. Calculate the RCO bond length and determine the molecule rotation frequency (for *J*=1). What is the %T (transmittance) for a sample if its absorbance is 1.27? What is the value of the absorption coefficient?	
Work placement	Not applicable	

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