GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Molecular Spectroscopy for Nanomaterials Investigation, PG_00069346		
Field of study	Nanotechnology		
Date of commencement of studies	October 2025	Academic year of realisation of subject	2026/2027
Education level	first-cycle studies	Subject group	
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	1.0
Learning profile	general academic profile	Assessment form	assessment
Conducting unit	Institute of Nanotechnology and Materials Engineering -> Faculty of Applied Physics and Mathematics -> Faculties of Gdańsk University of Technology		
Name and surname of lecturer (lecturers)	Subject supervisor	dr hab. inż. Agnieszka Witkowska	
	Teachers	dr hab. inż. Agnieszka Witkowska	

Lesson types

Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
Number of study hours	0.0	0.0	15.0	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	1.0	9.0	25

Subject objectives

The aim of the course is to introduce students to the practical aspects of molecular spectroscopy, familiarize them with the principles of preparing and conducting a spectroscopic experiment and with methods of interpreting spectra, with particular emphasis on the possibilities of applying these techniques in the study of nanostructured systems.

Learning outcomes

Course outcome	Subject outcome	Method of verification
[K6_W09] Has knowledge of the structure and operation of scientific instruments, measuring and test equipment and in the field of planning and conducting a physical experiment and critical analysis of its results.	Students gain the knowledge of the construction and operation of spectroscopic devices. They understand how to plan and conduct appropriate spectroscopic experiment, as well as how to analyze spectra and interpret the results obtained using this research method.	[SW1] Assessment of factual knowledge
[K6_U02] can analyze and solve simple scientific and technical problems based on possessed knowledge, applying analytical, numerical, simulation and experimental methods.	The student is able to solve a simple scientific problem related to the determination of structural parameters of materials and nanostructured systems using molecular spectroscopy methods.	[SU4] Assessment of ability to use methods and tools [SU1] Assessment of task fulfilment
[K6_U04] can plan and conduct experiments, critically analyze their results, draw conclusions and formulate opinions. Has laboratory experience.	The student is able to prepare and conduct a spectroscopic experiment and has the ability to properly analyze spectra and interpret the obtained results.	[SU4] Assessment of ability to use methods and tools [SU5] Assessment of ability to present the results of task

<table>
<tr><td>Subject contents</td><td>Course content – laboratory
1. FTIR spectroscopy:
Introduction to the construction and operating principles of an FTIR spectrometer; sample preparation; acquisition and analysis of spectra to investigate, for example, microplastics present in Antarctic waters or the functionalization of carbon nanotubes; preparation of a report.

2. UVVis spectroscopy:
Introduction to the construction and operating principles of a UVVis spectrometer; sample preparation and spectral measurements; analysis of spectra obtained, for example, for functionalized carbon nanotubes, semiconductor materials based on quantum dots, or titanium dioxide in order to determine its band gap energy; preparation of a report.

3. X-ray photoelectron spectroscopy (XPS):
Introduction to the construction and operating principles of an XPS spectrometer; sample preparation and spectral measurements for, for example, multiplier glasses with metallic nanoparticles embedded in the glass matrix, electrode materials for fuel cells and electrolyzers, or calcium-phosphate composites reinforced with carbon nanotubes; analysis of the obtained spectra; preparation of a report.</td></tr>
<tr><td>Prerequisites and co-requisites</td><td>Knowledge of basics of materials engineering, materials physics and modern physic</td></tr>
<tr><td>Assessment methods and criteria</td><td>
<table>
<tr><th>Subject passing criteria</th><th>Passing threshold</th><th>Percentage of the final grade</th></tr>
<tr><td>Completion of assigned laboratory exercises and submission of prepared reports</td><td>100.0%</td><td>100.0%</td></tr>
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</td></tr>
<tr><td>Recommended reading</td><td>
<table>
<tr><td>Basic literature</td><td>[1] J.Sadlej, Spektroskopia molekularna, WNT, Warszawa

[2] Z.Kęcki, "Podstawy spektroskopii molekularnej", PWN, Warszawa</td></tr>
<tr><td>Supplementary literature</td><td>[1] J.M.Hollas, Modern Spectroscopy, John Wiley & Sons, Ltd.

[2] P. Atkins, J.de Paula, Chemia fizyczna, Rozdz.16 Spektroskopia 1: widma rotacyjne i oscylacyjne; Rozdz. 17 Spektroskopia 2: przejścia elektronowe, PWN</td></tr>
<tr><td>eResources addresses</td><td></td></tr>
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<tr><td>Example issues/ example questions/ tasks being completed</td><td>FTIR spectral analysis of Baltic Sea water samples to identify the presence of microplastics.

Investigation of the functionalization of carbon nanotubes using FTIR spectroscopy.

Determination of metallic nanocluster size and shape using UV-Vis spectroscopy.</td></tr>
<tr><td>Practical activites within the subject</td><td>Not applicable</td></tr>
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