University of Gdańsk

Subject card

Subject name and code	Spectroscopy, PG_00182664						
Field of study	Physics						
Date of commencement of studies	October 2025		Academic year of realisation of subject		2026/2027		
Education level	Master'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	2		Language of instruction		Polish		
Semester of study	3		ECTS credits		7.0		
Learning profile	academic		Assessment form		exam		
Conducting unit	Rector						
Name and surname of lecturer (lecturers)	Subject supervisor		dr hab. Ryszard Drozdowski				
	Teachers						
Lesson types	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	30.0	0.0	60.0	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		85.0	175
Subject objectives	Advanced knowledge of the characteristic properties of spectral lines - atomic, molecular and those emitted by solids, knowledge of the operating principles of spectroscopic equipment components, familiarization with selected advanced issues of emission, absorption and solid state spectroscopy.						

Learning outcomes

Course outcome	Subject outcome	Method of verification
[FIZMU2_U09] can work independently or in a team	The student is able to: – use literature and original scientific works related to their specialization, published in English, – concisely present to the group the regularities of physical phenomena in various fields of physics, – present the assumptions, postulates, and limitations of physical theories, – present the achievements of experimental physics, with particular emphasis on the specialization covered by their master's thesis, – use computer programs for an attractive audiovisual presentation of the discussed topic, – ask questions and engage in critical and substantive discussions.The student is able to: – use literature and original scientific works related to their specialization, published in English, – concisely present to the group the regularities of physical phenomena in various fields of physics, – present the assumptions, postulates, and limitations of physical theories, – present the achievements of experimental physics, with particular emphasis on the specialization covered by their master's thesis, – use computer programs for an attractive audiovisual presentation of the discussed topic, – ask questions and engage in critical and substantive discussions.	[SU1] oral statement/conversation/ discussion [SU2] presentation/project/paper/ report
[FIZMU2_U03] is able to make a critical analysis of the results of measurements, observations or theoretical calculations along with the assessment of the accuracy of the results	The student is able to: - use spectroscopic methods to analyze various physical processes - assess the significance of obtained results based on the parameters of the spectroscopic apparatus used - assess the impact of specific experimental factors on the quality of results	[SU1] oral statement/conversation/ discussion [SU2] presentation/project/paper/ report [SU4] test/exam - oral or written [SU5] implementation of a problem task
[FIZMU2_W06] has knowledge of the current directions of development of physics and fundamental dilemmas of modern civilization	The student knows: – the rules governing the use of other people's achievements, – various ways (oral or audiovisual) of presenting physics concepts.	[SW4] test/exam - oral or written [SW1] oral statement/ conversation/discussion [SW2] presentation/project/paper/ report
[FIZMU2_U06] is able to adapt the knowledge and methodology of physics, as well as the applied experimental and theoretical methods to related scientific disciplines	The student is able to: – use literature and original scientific papers on spectroscopy published in English, – concisely present the regularities of physical phenomena leading to the emission or absorption of light, – present the assumptions, postulates, and limitations of spectroscopic methods, – present the achievements of experimental physics, with particular emphasis on spectroscopy, – use computer programs for an attractive audiovisual presentation of the discussed topic, – ask questions and engage in critical and substantive discussions.	[SU1] oral statement/conversation/ discussion [SU2] presentation/project/paper/ report [SU4] test/exam - oral or written [SU5] implementation of a problem task

Course outcome	Subject outcome	Method of verification
[FIZMU2_K01] knows the limitations of his own knowledge and skills; can formulate questions precisely; understands the need for further education and other	The student is aware of/ understands: – the need to cite sources used in preparing a speech/presentation, and is able to cite sources appropriately, – the need to obtain permission from the author of drawings, tables, graphs, etc. to use them, and knows how to request such permission from the author, – the ethics of using the scientific and artistic achievements of others, - the need to popularize reliable knowledge in society.	[SK1] oral statement/conversation/ discussion [SK2] presentation/project/paper/ report [SK4] test/exam - oral or written
[FIZMU2_U01] is able to apply the scientific method in solving physical problems, conducting experiments and reasoning	The student is able to: - apply spectroscopic methods to study physical phenomena - adapt knowledge from spectroscopy to related scientific disciplines (biology, chemistry, medicine, pharmacy)	[SU1] oral statement/conversation/ discussion [SU2] presentation/project/paper/ report [SU4] test/exam - oral or written [SU5] implementation of a problem task
[FIZMU2_W01] has advanced knowledge of general physics and in-depth knowledge of various areas of physics; knows the history of the development of physics and its importance for the progress of exact and natural sciences, cognition of the world and social development	The student knows: - the history of discoveries concerning the structure of atoms and molecules, - the history of the development of advanced mathematical descriptions of atoms and molecules, - the enormous possibilities of exploring the world using spectroscopic methods, - the significant importance of spectroscopy in everyday life.	[SW4] test/exam - oral or written [SW1] oral statement/ conversation/discussion [SW2] presentation/project/paper/ report
[FIZMU2_K02] is aware of the conclusive role of experiment in the verification of physical theories; is aware of the scientific method in the accumulation of knowledge	The student is aware/understands: - that the theoretical description of the phenomenon being studied must reflect the actual experimental conditions, - that experimental results are the basis for accepting the theoretical description of the phenomenon, taking into account the measurement uncertainties occurring during the measurements	[SK1] oral statement/conversation/ discussion [SK2] presentation/project/paper/ report [SK4] test/exam - oral or written [SK5] implementation of a problem task

Subject contents

Advanced quantum description of spectral line formation, taking into account their shape (profiles: Lorentzian, Gaussian, Voigt).
Intensity, transition probabilities, Einstein coefficients.
Spectroscopic equipment spectrographs (prismatic, grating), interferometers (Michelson, Mach-Zehnder, Fabry-Pérot), light detectors (photoresistors, photodiodes, photocells, and photomultipliers), spectral tubes, and lasers as tunable coherent light sources.
Selected methods of absorption and emission spectroscopy (photoacoustic, optogalvanic, ionization, Stark, Rydberg states, magnetic resonance, double resonance: optical-radio, optical-microwave, optical-optical), laser Raman spectroscopy.
Selected topics in high-resolution laser spectroscopy. Applications of spectroscopy (photochemistry, isotope separation, atmospheric research, biology, medicine, astrophysics).

Prerequisites and co-requisites

Knowledge of quantum mechanics.

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
exam	51.0%	50.0%
project	51.0%	50.0%

Recommended reading	Basic literature	W. Demtroder, Spektroskopia laserowa, PWN 1993 J. Sadlej, Spektroskopia molekularna, WNT 2002 A. Z. Kęcki, Podstawy spektroskopii molekularnej, PWN 1998 Z. Leś, Podstawy fizyki atomu, PWN SA 2015 H. Haken, H.C. Wolf, "Atomy i kwanty, wprowadzenie do spektroskopii atomowej", PWN Warszawa 1997 H. Haken, H.C. Wolf, "Fizyka molekularna z elementami chemii kwantowej", PWN Warszawa 1998 F. Kaczmarek, Wstęp do fizyki laserów, PWN 1978 Włodzimierz Kołos Chemia kwantowa PWN 1978
	Supplementary literature	G. K. Woodgate, "Struktura atomu", PWN Warszawa 1974 R. Eisberg, R. Resnick, "Fizyka kwantowa atomów, cząsteczek, ciał stałych, jąder i cząstek elementarnych", PWN Warszawa 1983 L. I. Schiff, "Mechanika kwantowa", PWN Warszawa 1987 L. I. Liboff, Wstęp do mechaniki kwantowej", PWN Warszawa 1987 J. Ginter, "Wstęp do fizyki atomu, cząsteczki i ciała stałego", PWN Warszawa 1986
	eResources addresses	
Example issues/ example questions/ tasks being completed		
Work placement	Not applicable	

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