GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Optical spectroscopy in medicine, PG_00053364						
Field of study	Biomedical Engineering, Biomedical Engineering						
Date of commencement of studies	February 2026		Academic year of realisation of subject	2026/2027			
Education level	second-cycle studies		Subject group	Optional subject group Specialty subject group 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	2		ECTS credits	2.0			
Learning profile	general academic profile		Assessment form	assessment			
Conducting unit	Division Of Complex Systems Spectroscopy -> Institute Of Physics And Applied Computer Science -> Faculty Of Applied Physics And Mathematics -> Wydziały Politechniki Gdańskiej						
Name and surname of lecturer (lecturers)	Subject supervisor		dr hab. Tomasz Wąsowicz				
	Teachers		dr hab. Tomasz Wąsowicz				
Lesson types and methods of instruction	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	15.0	0.0	0.0	15.0	0.0	30
	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	30		2.0	18.0		50
Subject objectives	The main goal is introduction to the theoretical bases of optical spectroscopy (IR, VIS, UV, Raman) and its applications in biology and medicine.						

Learning outcomes

Course outcome	Subject outcome	Method of verification
[K7_W10] knows and understands, to an increased extent, the basic processes occurring in the life cycle of equipment, objects and technical systems, as well as methods of supporting processes and functions, specific to the field of study	Student can analyze the problem using proper setup	[SW1] Assessment of factual knowledge [SW3] Assessment of knowledge contained in written work and projects
[K7_U04] can apply knowledge of programming methods and techniques as well as select and apply appropriate programming methods and tools in computer software development or programming devices or controllers using microprocessors or programmable elements or systems specific to the field of study, making assessment and critical analysis of the prepared software as well as a synthesis and creative interpretation of information presented with it	Student can analyze the problem using proper computational methods	[SU2] Assessment of ability to analyse information [SU4] Assessment of ability to use methods and tools
[K7_K01] is ready to create and develop models of proper behaviour in the work and life environment; undertake initiatives; critically evaluate actions of their own, teams and organisations they are part of; lead a group and take responsibility for its actions; responsibly perform professional roles taking into account changing social needs, including: - developing the achievements of the profession, - observing and developing rules of professional ethics and acting to comply to these rules	Student can analyze the problem and its future biophysical application	[SK2] Assessment of progress of work
[K7_U02] can perform tasks related to the field of study as well as formulate and solve problems applying recent knowledge of physics and other areas of science	Student can perform an experiment, show results and formulate the conclusions, can answer the questions	[SU1] Assessment of task fulfilment [SU5] Assessment of ability to present the results of task

Subject contents

1. Introduction to "The optical spectroscopy" 2. The Bohr model of the atom. Emission and the absorption of the radiation 3. Hydrogen energies and spectrum vs. excitation spectrum of a multielectron atom 4. Stark effect. Zeeman effect. 5. Chemical bonding theory 6. Ultraviolet-visible spectroscopy 7. Vibrational and rotational spectroscopy 8. The Raman spectroscopy 9. Spectral instruments 10. Physical concepts and practical aspects of lasers 11. The optical proprieties of tissues 12. the physical concepts of spectroscopic methods and techniques applied to biophysics and medicine 12a. Photodynamic diagnostic of cancer and cancer therapy 12b. Spectral optical coherence tomography 12c. Medical applications of holography. MRI of the lungs using hyperpolarized noble gases. 12d. Fluorescence methods for molecular biology 12e. Other spectroscopic methods

Prerequisites and co-requisites

Student should know the fundamental concepts in Physics i.e. 1. Dynamics of circular motion 2. Simple harmonic motion 3. The wave motion 4. Electricity and magnetism 5. Black body radiation

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
Written exam	50.0%	70.0%
Project	50.0%	30.0%

Recommended reading

Basic literature	1. Spektroskopia optyczna w zastosowaniach biofizycznych i medycznych 2. H. Haken, H.C. Wolf Fizyka molekularna z elementami chemii kwantowej, PWN 1998 3. A.Z. Hrynkiewicz, E. Rokita (red.) Fizyczne metody badań w biologii, medycynie i ochronie środowiska , PWN 1999
Supplementary literature	1. M. Nałęcz (red.) Biocybernetyka i inżynieria biomedyczna 2000 Tom 2 Biopmiary, EXIT 2001 2. B. Kramer (red.) The art of measurement, VCH1988 3. R.M. Silverstein, F.X. Webster, D.J. Kiemle Spektroskopowe metody identyfikacji związków organicznych, PWN 2008 4. L. Piela Idee chemii kwantowej, PWN 2006 5. Z. Jóźwiak, G. Bartosz (red.) Biofizyka, PWN 2008 6.H. Haken, H.C. Wolf Atomy i kwanty, PWN 2002 7. INŻYNIERIA BIOMEDYCZNA Acta Bio-Optica et Informatica Medica journal
eResources addresses	Adresy na platformie eNauczanie:

Example issues/ example questions/ tasks being completed

Optical proprieties of tissues.
The techniques of optical spectroscopy in biology and medicine
Photodynamic method of diagnostics and cancer therapy.
Optical coherence thomography of the eye.

Work placement	Not applicable

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