GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Optics and laser technique, PG_00037289		
Field of study	Optyka i technika laserowa		
Date of commencement of studies	October 2023	Academic year of realisation of subject	2025/2026
Education level	first-cycle studies	Subject group	Optional 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	3	Language of instruction	Polish
Semester of study	5	ECTS credits	4.0
Learning profile	general academic profile	Assessment form	assessment
Conducting unit	Katedra Fizyki Atomowej i Luminescencji -> Faculty of Applied Physics and Mathematics -> Wydziały Politechniki Gdańskiej		
Name and surname of lecturer (lecturers)	Subject supervisor	dr Mykola Shopa	
	Teachers	dr Mykola Shopa	

Lesson types

Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
Number of study hours	15.0	15.0	30.0	0.0	0.0	60

E-learning hours included: 0.0

eNauczanie source address: https://enauczanie.pg.edu.pl/moodle/course/view.php?id=7717

Moodle ID: 7717 Optyka i Technika Laserowa 25/26
https://enauczanie.pg.edu.pl/moodle/course/view.php?id=7717

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	35.0	100

Subject objectives

Introduction to the design, operation and use of lasers and optical elements applied in laser technique. The study of basic properties and applications of laser light.

Learning outcomes	Course outcome	Subject outcome	Method of verification
	[K6_U04] Can plan and conduct experiments, critically analyze their results, draw conclusions and form opinions. Has laboratory work experience.	The student is able to prepare and calibrate a measurement station, conduct an experiment according to the instructions, process data, identify sources of error and uncertainty, and prepare a report with the experimental results	[SU3] Ocena umiejętności wykorzystania wiedzy uzyskanej w ramach przedmiotu
	[K6_W02] Has systematized knowledge of the basics of physics, including mechanics, thermodynamics, electricity and magnetism, optics, atomic and particle physics, solid-state physics, nuclear and elementary particle physics.	The student is able to describe the physical laws of wave optics, electromagnetism and solid state physics necessary to understand the principles of operation of lasers and their interaction with matter	[SW1] Ocena wiedzy faktograficznej
	[K6_W08] Has knowledge of planning and conducting physical experiments, and critical analysis of its results.	The student explains the stages of experiment planning and knows the standards of research reliability: documentation of procedures, data management, reproducibility.	[SW1] Ocena wiedzy faktograficznej
	[K6_W12] Knows basic health and safety rules.	The student knows the health and safety rules and legal regulations regarding the safe operation of lasers.	[SW1] Ocena wiedzy faktograficznej
	[K6_W07] Has knowledge of the construction and operation of physical instruments, measurement and research equipment.	The student classifies laser devices and explains their construction and operating principles. Describes the basic interactions of laser radiation with matter.	[SW1] Ocena wiedzy faktograficznej

Subject contents	LECTURE Laser classes (safety) Properties of laser light (with the description of the following concepts: coherence, polarization, divergence angle) The Einstein coefficients The two-level system: laser rate equations, their solutions, conclusions Why is population inversion necessary in a laser? Line broadening mechanisms, what causes them? the profiles The three-level system: laser rate equations, their solutions, The four-level system: laser rate equations. Why the four-level system may be more efficient than the three level system? The laser resonator (cavity) and its role. The longitudinal modes of a resonator, free spectral range The transversal modes, the patterns The Gaussian beam, description, parameters Fabry-Perot resonator, the finesse Solid state lasers, operating principle, examples Gas lasers, operating principle, the CO_2 laser The Brewster window and its role Semiconductor laser, operating principle, differences between them and the LEDs (diodes) Q-switching Mode-locking Physical phenomena used in Q-switching and mode-locking Lasers in medicine Lasers in holography Other applications LABORATORY: EXERCISES 1) Measurement of laser-excited emission spectra of dye solutions. 2) Investigation of diffraction and interference of laser light. 3) Investigation of the Debye-Sears effect (diffraction of the laser light on acoustic standing wave). 4) Investigation of the electro-optic effect 5) Laser beam profile investigation 6) Investigation of the laser beam polarization state LABORATORY: PROBLEMS Construction and applications of modern laser systems TUTORIALS Solutions to some problems of optics and laser technique
Prerequisites and co-requisites	

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
Written test of knowledge (exam)	50.0%	34.0%
Completing all laboratory exercises, reports, oral presentations	100.0%	33.0%
written test (tutorials)	50.0%	33.0%

Recommended reading	Basic literature	1. K. Tyagarajan, A. Ghatak, Lasers fundamentals and applications. 2. F. Trager (Ed.), Springer Handbook of Lasers and Optics

	Supplementary literature	1. W. Demtroder, Laser spectroscopy 2. W. M. Steen, J. Mazumder, Laser material processing, Springer, 2010.
	eResources addresses	
Example issues/ example questions/ tasks being completed	1. Properties of the laser light. 2. Methods of creation of short laser pulses. 3. Line broadening mechanisms, the profiles 4. Applications of lasers in medicine 5. The Fabry-Perot resonator, the finesse	
Practical activites within the subject	Not applicable	

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