GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Optics and laser technique, PG_00037289						
Field of study	Technical Physics						
Date of commencement of studies	October 2022		Academic year of realisation of subject	2024/2025			
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	Division of Atomic, Molecular and Optical Physics -> Institute of Physics and Applied Computer Science -> Faculty of Applied Physics and Mathematics						
Name and surname of lecturer (lecturers)	Subject supervisor		dr Mykola Shopa				
	Teachers		dr Mykola Shopa				
Lesson types and methods of instruction	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						
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	The student gains experienc in the Laboratory of Laser Technology. The student performs experiments, analyzes and processes the results, estimates the uncertainties measured and calculated quantities. The student knows the structure and modern applications of laser systems.	[SU3] Assessment of ability to use knowledge gained from the subject
K6_W07	The student acquires knowledge about construction, operation and the application of lasers and optical components in laser technology.	[SW1] Assessment of factual knowledge
K6_W08	The student is able to plan a simple physical experiment and analyze its results.	[SW1] Assessment of factual knowledge
K6_W12	The student is able to use measuring instruments in laser lab, is aware of the dangers, knows and complies with health and safety rules.	[SW1] Assessment of factual knowledge
K6_W02	The student knows and understands the physical laws behind laser, laser applications and the phenomena tested in the laboratory. As part of the course, the student combines knowledge about the different areas of physics. The student solves simple tasks on optics and laser technology.	[SW1] Assessment of factual knowledge

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) Measurement of Stokes parameters 6) Laser beam profile experiment 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
Completing all laboratory exercises, reports, oral presentations	100.0%	33.0%
written test (tutorials)	50.0%	33.0%
Written test of knowledge (exam)	50.0%	34.0%

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	Adresy na platformie eNauczanie: Optyka i Technika Laserowa 24/25 - Moodle ID: 34385 https://enauczanie.pg.edu.pl/moodle/course/view.php?id=34385
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	
Work placement	Not applicable	

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