GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Laser technology, PG_00058943		
Field of study	Technika laserowa		
Date of commencement of studies	October 2023	Academic year of realisation of subject	2025/2026
Education level	first-cycle studies	Subject group	Obligatory subject group in the field of study 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	2.0
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 hab. inż. Ryszard Barczyński	
	Teachers	dr hab. inż. Ryszard Barczyński dr hab. Mateusz Zawadzki	

Lesson types

Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
Number of study hours	15.0	0.0	15.0	0.0	0.0	30

E-learning hours included: 0.0

eNauczanie source addresses:

Moodle ID: 1940 Technika laserowa 2025
https://enauczanie.pg.edu.pl/2025/course/view.php?id=1940

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	5.0	15.0	50

Subject objectives

Familiarization with the structure, operation, and applications of lasers. Learning about the applications of lasers in various fields of science and technology. Investigation of the basic properties and applications of laser light.

Learning outcomes

Course outcome	Subject outcome	Method of verification
K6_U04	The student analyzes the results of measurements obtained independently while conducting experiments.	[SU2] Ocena umiejętności analizy informacji
K6_W09	The student understands the structure of various types of lasers and is able to assemble a measurement system using laser light.	[SW1] Ocena wiedzy faktograficznej
K6_W03	Students understand the operating principles of a laser and the conditions under which laser action occurs. They can explain the role of individual laser components in achieving this action.	[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 LABORATORY: PROBLEMS Construction and applications of modern laser systems
Prerequisites and co-requisites	None.
Assessment methods and criteria	

Subject passing criteria	Passing threshold	Percentage of the final grade
Completing all laboratory exercises, reports, oral presentations	50.0%	50.0%
Written test of knowledge	50.0%	50.0%

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 Laboratory: Study of the Debye-Sears effect (deflection of laser light on a standing ultrasonic wave),	
Practical activites within the subject	Not applicable	

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