GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Laser technology, PG_00058943		
Field of study	Nanotechnology		
Date of commencement of studies	October 2022	Academic year of realisation of subject	2024/2025
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, Molekularnej i Optycznej -> Faculty of Applied Physics and Mathematics		
Name and surname of lecturer (lecturers)	Subject supervisor	dr hab. inż. Ryszard Barczyński	
	Teachers	dr hab. Mateusz Zawadzki dr hab. inż. Ryszard Barczyński	

Lesson types and methods of instruction

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

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

Introduction to the design, operation and use of lasers. The study of basic properties and applications of laser light.

Learning outcomes

Course outcome	Subject outcome	Method of verification
K6_W09	The student describes the construction and applications of basic types of lasers.	[SW1] Assessment of factual knowledge
K6_W03	The student knows and is able to analyze the laws that underlie the operation of lasers.	[SW1] Assessment of factual knowledge
K6_U04	The student conducts and analyzes experiments using lasers and their instrumentation.	[SU2] Assessment of ability to analyse information

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

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
Written test of knowledge	50.0%	51.0%
Completing all laboratory exercises, reports, oral presentations	100.0%	49.0%

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: Technika laserowa - Moodle ID: 39722 https://enauczanie.pg.edu.pl/moodle/course/view.php?id=39722

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

Work placement

Not applicable

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