GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Laser Technology, PG_00048086		
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	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	6	ECTS credits	2.0
Learning profile	general academic profile	Assessment form	assessment
Conducting unit	Department of Metrology and Optoelectronics -> Faculty of Electronics Telecommunications and Informatics -> Wydziały Politechniki Gdańskiej		
Name and surname of lecturer (lecturers)	Subject supervisor	dr hab. inż. Jerzy Pluciński	
	Teachers	dr hab. inż. Jerzy Pluciński	

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						

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 aim of the course is to acquaint students with the principle of the construction and operation of lasers, with their types and parameters and the rules of their safe use, as well as skills in measurement of laser beam parameters.

Learning outcomes

Course outcome	Subject outcome	Method of verification
[K6_U05] can plan and conduct experiments related to the field of study, including computer simulations and measurements; interpret obtained results and draw conclusions	He performs light interference experiments.	[SU1] Ocena realizacji zadania
[K6_U06] can analyse the operation of components, circuits and systems related to the field of study, measure their parameters and examine technical specifications	He measures the parameters of optical modulators used in laser technology, analyzes the operation of optical elements using the phenomenon of laser beam diffraction, makes measurements using lasers, including the optical properties of selected media.	[SU1] Ocena realizacji zadania
[K6_W02] knows and understands, to an advanced extent, selected laws of physics and physical phenomena as well as methods and theories explaining the complex relationships between them, constituting the basic general knowledge in the field of technical sciences related to the field of study	He explains the phenomenon of absorption, emission and stimulated emission, knows the Einstein equations describing these phenomena, knows the concept of population inversion.	[SW1] Ocena wiedzy faktograficznej
[K6_W03] knows and understands, to an advanced extent, the construction and operating principles of components and systems related to the field of study, including theories, methods and complex relationships between them and selected specific issues - appropriate for the curriculum	He compares the properties of the laser beam with optical radiation from other sources, explains the structure and operation of continuous and pulsed lasers, explains the methods of tuning lasers, describes the factors destabilizing the operation of lasers and discusses the principles of their stabilization. He lists the basic types of lasers and their typical parameters, presents laser safety classes.	[SW1] Ocena wiedzy faktograficznej

Subject contents

1. Introduction, historical background.
2. Properties of laser beam.
3. Temporal coherence of laser beam; coherence length, coherence time.
4. Spatial coherence of laser beam; laser beam divergence, beam focusing.
5. Main elements of lasers: optical amplifier, optical resonator; optical feedback.
6. Absorption, spontaneous emission, stimulated emission Einstein's coefficients.
7. Laser pumping: optical pumping, atom collisions, carrier injection into p-n junction, chemical reactions.
8. Light amplification in laser.
9. Setups of optical resonators configurations and applications.
10. Stability of optical resonators.
11. Longitudinal laser modes.
12. Transverse laser modes.
13. Tunable lasers.
14. Sources of laser beam fluctuations.
15. Passive methods of laser stabilization.
16. Laser frequency stabilization using maximum of amplification curve or Lamb dip.
17. Laser frequency stabilization using intrinsic or extrinsic absorption cell.
18. Laser frequency stabilization using Zeeman effect.
19. Lasers with switchable gain.
20. Q-switching lasers.
21. Mode-locking lasers.
22. Frequency sweep lasers.
23. Soliton lasers.
24. Type of lasers and its parameters.

Prerequisites and co-requisites

No requirements

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
Practical exercise	50.0%	40.0%
Midterm colloquium	50.0%	60.0%

Recommended reading	Basic literature	1. O. Svelto: Principles of Lasers, 4th Edition. Plenum Press, New York, 1998. 2. B. Ziętek: Lasery. Wyd. 2., Wydawnictwo Naukowe UMK. Toruń, 2015. 3. K. Barat: Laser Safety Management, CRC, Boca Raton, 2006. 4. B. E. A. Saleh, M. C. Teich: Fundamentals of Photonics, 2nd Edition. John Wiley & Sons, New York, 2007. 5. Control of Hazards to Health from Laser Radiation, Technical Bulletin Medical 254, Headquarters, Department of The Army, Washington, DC, 2006. 6. F. Täger: Springer Handbook of Lasers and Optics, Springer, Berlin, 2007.
	Supplementary literature	No requirements
	eResources addresses	
Example issues/ example questions/ tasks being completed		
Practical activites within the subject	Not applicable	

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