



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	<p>LECTURE</p> <p>Laser classes (safety)</p> <p>Properties of laser light (with the description of the following concepts: coherence, polarization, divergence angle)</p> <p>The Einstein coefficients</p> <p>The two-level system: laser rate equations, their solutions, conclusions</p> <p>Why is population inversion necessary in a laser?</p> <p>Line broadening mechanisms, what causes them? the profiles</p> <p>The three-level system: laser rate equations, their solutions,</p> <p>The four-level system: laser rate equations. Why the four-level system may be more efficient than the three level system?</p> <p>The laser resonator (cavity) and its role.</p> <p>The longitudinal modes of a resonator, free spectral range</p> <p>The transversal modes, the patterns</p> <p>The Gaussian beam, description, parameters</p> <p>Fabry-Perot resonator, the finesse</p> <p>Solid state lasers, operating principle, examples</p> <p>Gas lasers, operating principle, the CO₂ laser</p> <p>The Brewster window and its role</p> <p>Semiconductor laser, operating principle, differences between them and the LEDs (diodes)</p> <p>Q-switching</p> <p>Mode-locking</p> <p>Physical phenomena used in Q-switching and mode-locking</p> <p>Lasers in medicine</p> <p>Lasers in holography</p> <p>Other applications</p> <p>LABORATORY: EXERCISES</p> <p>1) Measurement of laser-excited emission spectra of dye solutions.</p> <p>2) Investigation of diffraction and interference of laser light.</p> <p>3) Investigation of the Debye-Sears effect (diffraction of the laser light on acoustic standing wave).</p> <p>4) Investigation of the electro-optic effect</p> <p>LABORATORY: PROBLEMS</p> <p>Construction and applications of modern laser systems</p>											
Prerequisites and co-requisites												
Assessment methods and criteria	<table border="1"> <thead> <tr> <th>Subject passing criteria</th> <th>Passing threshold</th> <th>Percentage of the final grade</th> </tr> </thead> <tbody> <tr> <td>Written test of knowledge</td> <td>50.0%</td> <td>51.0%</td> </tr> <tr> <td>Completing all laboratory exercises, reports, oral presentations</td> <td>100.0%</td> <td>49.0%</td> </tr> </tbody> </table>			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%
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Example issues/ example questions/ tasks being completed	<ol style="list-style-type: none"> Properties of the laser light. Methods of creation of short laser pulses. Line broadening mechanisms, the profiles Applications of lasers in medicine 											
Work placement	Not applicable											

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