



Subject card

Subject name and code	Optics and laser technique, PG_00037289						
Field of study	Technical Physics						
Date of commencement of studies	October 2020	Academic year of realisation of subject			2022/2023		
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	Department of Atomic, Molecular and Optical Physics -> 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_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
	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

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> <p>TUTORIALS</p> <p>Solutions to some problems of optics and laser technique</p>														
Prerequisites and co-requisites															
Assessment methods and criteria	<table border="1"> <thead> <tr> <th data-bbox="456 1671 794 1697">Subject passing criteria</th> <th data-bbox="799 1671 1137 1697">Passing threshold</th> <th data-bbox="1142 1671 1481 1697">Percentage of the final grade</th> </tr> </thead> <tbody> <tr> <td data-bbox="456 1704 794 1731">written test (tutorials)</td> <td data-bbox="799 1704 1137 1731">50.0%</td> <td data-bbox="1142 1704 1481 1731">33.0%</td> </tr> <tr> <td data-bbox="456 1738 794 1765">Written test of knowledge (exam)</td> <td data-bbox="799 1738 1137 1765">50.0%</td> <td data-bbox="1142 1738 1481 1765">34.0%</td> </tr> <tr> <td data-bbox="456 1771 794 1839">Completing all laboratory exercises, reports, oral presentations</td> <td data-bbox="799 1771 1137 1839">100.0%</td> <td data-bbox="1142 1771 1481 1839">33.0%</td> </tr> </tbody> </table>			Subject passing criteria	Passing threshold	Percentage of the final grade	written test (tutorials)	50.0%	33.0%	Written test of knowledge (exam)	50.0%	34.0%	Completing all laboratory exercises, reports, oral presentations	100.0%	33.0%
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Example issues/ example questions/ tasks being completed	<ol style="list-style-type: none">1. Properties of the laser light.2. Methods of creation of short laser pulses.3. Line broadening mechanisms, the profiles4. Applications of lasers in medicine5. The Fabry-Perot resonator, the finesse
Work placement	Not applicable