University of Gdańsk

Subject card

Subject name and code	Optics and Waves, PG_00182300					
Field of study	Physics					
Date of commencement of studies	October 2026		Academic year of realisation of subject		2027/2028	
Education level	Bachelor's 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	2		Language of instruction		Polish	
Semester of study	3		ECTS credits		4.0	
Learning profile	academic		Assessment form		credit	
Conducting unit	Institute of Experimental Physics -> Faculty of Mathematics, Physics and Informatics -> Rector					
Name and surname of lecturer (lecturers)	Subject supervisor	dr hab. Sebastian Mahlik				
	Teachers					
Lesson types	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	30.0	30.0	0.0	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	0.0	40.0	100	
Subject objectives	The aim of the course is to introduce students to the fundamental concepts and laws governing mechanical waves, electromagnetic waves, and optical phenomena in both geometrical and wave optics. Students will gain knowledge of the nature of light, its interaction with matter, and its applications in optical instruments and measurement techniques. The course is designed to develop skills in analyzing and interpreting wave phenomena as well as applying mathematical tools (Fourier analysis, wave equation) to the description of physical processes.					

<table>
<tr><td>Learning outcomes</td><td>

Course outcome	Subject outcome	Method of verification
[FIZL3_W01] has advanced knowledge of physical concepts, principles and theories, understands their historical development and significance not only for physics, but also for other exact and natural sciences and cognition of the world	The student possesses advanced knowledge of the concepts, principles, and physical theories related to mechanical waves, electromagnetic waves, and geometrical, wave, and photometric optics. The student understands the historical development of ideas concerning the nature of light (from wave theory and Maxwell’s equations to wave–particle duality) and the significance of these theories for physics, other natural and exact sciences, as well as for the broader understanding of the world.	[SW1] oral statement/ conversation/discussion [SW3] text preparation/written work
[FIZL3_U07] has the ability to quantitatively analyze vibrating and wave motion and describe optical and acoustic phenomena and the interaction of light with matter	The student is able to perform a quantitative analysis of oscillatory and wave motion and to describe and interpret optical phenomena in both geometrical and wave optics, as well as electromagnetic waves and their interaction with matter. The student can apply mathematical methods, including Fourier analysis and the wave equation, to the description of physical phenomena such as resonance, interference, diffraction, polarization, coherence, boundary wave effects, and the laws of photometry.	[SU1] oral statement/conversation/ discussion [SU3] text preparation/written work
[FIZL3_W08] has advanced knowledge in the field of phenomena and laws of geometric, wave and photometry optics	The student possesses advanced knowledge of the phenomena and laws of geometrical optics, wave optics, and photometry. The student understands the principles governing light propagation and refraction, the functioning of lenses, mirrors, and optical systems, the fundamental laws of interference, diffraction, polarization, and coherence of light waves, as well as the laws and units of photometry applied in optical measurements.	[SW1] oral statement/ conversation/discussion [SW3] text preparation/written work

</td></tr>
<tr><td>Subject contents</td><td>

1. **Fundamentals of wave theory:** harmonic oscillator (damped, driven), resonance and quality factor, vibrations and oscillations of systems, wave equation, plane and spherical waves, dispersion, phase and group velocity, Snells law, modulation, standing waves, Huygens principle, superposition, interference, diffraction, coherence of waves, holography, wave polarization (birefringence, Malus law), Fourier analysis of oscillations and systems.
2. **Electromagnetic waves:** Maxwells equations in the wave formalism, propagation in vacuum and in material media, electromagnetic spectrum, polarization of electromagnetic waves.
3. **Geometrical optics:** geometrical vs. wave optics, KirchhoffHuygens integral, Fermats principle, laws of reflection and refraction, lenses and mirrors (lens equation), optical systems and instruments (magnifying glass, microscope, telescope, refracting telescope), optical aberrations.
4. **Wave optics:** interference (Youngs double slit, Michelson interferometer), diffraction by slits and gratings, resolution of optical systems (Rayleigh criterion), polarization of light (linear, circular, elliptical, in anisotropic media).
5. **Photometry:** photometric quantities and units, laws of photometry (inverse square law, Lamberts law), measurement applications.

</td></tr>
<tr><td>Prerequisites
and co-requisites</td><td></td></tr>
<tr><td>Assessment methods
and criteria</td><td>

Subject passing criteria	Passing threshold	Percentage of the final grade
	51.0%	90.0%
	0.0%	10.0%

</td></tr>
</table>

<table>
<tr><td rowspan="3">Recommended reading</td><td>Basic literature</td><td>1. E. Hecht, Optics.
2. D. A. Steck, Classical and Modern Optics (online).J. Peatross, M. Ware, Physics of Light and Optics (online).Sz. Szczeniowski, Experimental Physics, Part IV: Optics, PWN, Warsaw 1983
3. D. Halliday, R. Resnick, Physics
4. M. Baj, G. Szeflińska, M. Szymański, D. Wasik, Problems and Exercises in Physics: Oscillations and Scalar Waves, PWN, Warsaw 1997.</td></tr>
<tr><td>Supplementary literature</td><td>-</td></tr>
<tr><td>eResources addresses</td><td></td></tr>
<tr><td>Example issues/ example questions/ tasks being completed</td><td colspan="2">n/a</td></tr>
<tr><td>Work placement</td><td colspan="2">Not applicable</td></tr>
</table>