



Subject card

Subject name and code	Waves and optics, PG_00020718						
Field of study	Technical Physics						
Date of commencement of studies	October 2024	Academic year of realisation of subject			2025/2026		
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	2	Language of instruction			Polish		
Semester of study	3	ECTS credits			5.0		
Learning profile	general academic profile	Assessment form			exam		
Conducting unit	Department of Physics of Electronic Phenomena -> Faculty of Applied Physics and Mathematics						
Name and surname of lecturer (lecturers)	Subject supervisor	dr hab. inż. Jędrzej Szmytkowski					
	Teachers						
Lesson types and methods of instruction	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		5.0		60.0	125
Subject objectives	Teach students and strengthen their knowledge about the nature of mechanical and electromagnetic waves, their generation, theoretical models and applications. Special attention is paid to optical waves and laws of optical geometry.						
Learning outcomes	Course outcome	Subject outcome			Method of verification		
	[K6_W02] has systematized knowledge of the basics of physics, including mechanics, thermodynamics, electricity and magnetism, optics, atomic and particle physics, solid-state physics, nuclear and elementary particle physics	The knowledge allows to analyze problems concerning waves and optics in the real world			[SW1] Assessment of factual knowledge		
	[K6_W01] understands the importance of physics and its applications in connection to civilization	Student knows how to separate wave phenomena in daily life			[SW1] Assessment of factual knowledge		
	[K6_U01] learns independently, obtains information from literature, databases and other properly selected sources	Student knows how to use literature and databases id waves and optics			[SU2] Assessment of ability to analyse information		

Subject contents	<p>LECTURES Introduction: kinds of waves, eye and ear as wave detectors, acoustic and electromagnetic spectra. Oscillations of simple physical systems: basic terms, mathematical pendulum, transverse and longitudinal oscillations of the mass on two springs, oscillations of electric circuits, simple harmonic oscillator, damped harmonic oscillator, beats. String. The Classical Wave Equation: uniform string, harmonic oscillations, dispersion relations. Wave motion: phase and group velocity, acoustic wave velocity in Newton's model and in adiabatic model, phase velocity of electromagnetic waves in a transmission line, Maxwell equations, wave equation for electromagnetic waves. Refractive index of waves: dependence of refractive index on frequency, normal and anomalous dispersion. Wave impedance and wave energy flux: mechanical impedance, generator output power, sound waves, sound intensity level, impedance and energy flux of electromagnetic wave, examples. Reflection of waves: amplitude and energy reflection coefficient at the interface of two media, transmission coefficient, Brewster angle, total internal reflection. antireflection coating. Polarization of wave: description of polarization, circular polarization, elliptical polarization, classical approach to superposition of oscillations perpendicular to each other, experimental methods of polarization of waves, polarization of waves by controlled emission, polaroid, double refraction in crystals, Nicole prism, slow and fast axis, quarter-wave plate, elastooptics, optical activity, Kerr and Faraday effect. Interference and diffraction: coherent sources of radiation, basics of interference, interference between two independent sources, dimensions of point source, angular width of a beam of travelling waves, Rayleigh criterion, superposition of N harmonic waves, diffraction pattern of a single slit, diffraction pattern of N narrow slits, diffraction grating, diffraction at space grating. Geometrical optics: Fermat's principle, Snell's law, mirrors, prisms, lenses, optical fibers, telescope, microscope, Abbe's law, resolving power, spectroscopes, refractometers, interferometers. Optical emission: Bohr's model, hydrogen optical spectrum, photon absorption and emission, atom excitation during collisions, ionization of atoms, forced emission and forced absorption, lasers, molecular spectra, black body radiation, Planck's formula, natural and artificial light sources, currents in glasses, filament and discharge tubes. Optical radiation detection: phenomena used for light detection, internal and external photoelectric effect, photomultiplier tubes, photodiodes and photovoltaic cells, thermal detectors, other methods of detection of thermal, optical and ionizing radiation, photometric units.</p> <p>EXERCISES Simple harmonic oscillator. Oscillations of systems with two degrees of freedom Beats. Damped harmonic oscillator. String. The classical wave equation. Dispersion relations. Wave motion. Phase and group velocity. Wave energy flux and impedance. Refractive index. Reflection of waves. Wave polarization. Interference and diffraction. Geometrical optics. Emission and detection of optical radiation.</p>														
Prerequisites and co-requisites	Course credit "Mechanics and heat"(07053) and "Mathematical analysis" (07053)														
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 exam</td> <td>65.0%</td> <td>30.0%</td> </tr> <tr> <td>Midterm colloquium</td> <td>45.0%</td> <td>40.0%</td> </tr> <tr> <td>Oral exam</td> <td>35.0%</td> <td>30.0%</td> </tr> </tbody> </table>			Subject passing criteria	Passing threshold	Percentage of the final grade	Written exam	65.0%	30.0%	Midterm colloquium	45.0%	40.0%	Oral exam	35.0%	30.0%
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Example issues/ example questions/ tasks being completed	<ol style="list-style-type: none"> 1. Simple gravity pendulum 2. Harmonic oscillator 3. Fermat's principle 														
Work placement	Not applicable														

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