GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Waves and optics, PG_00020718		
Field of study	Technical Physics		
Date of commencement of studies	October 2026	Academic year of realisation of subject	2027/2028
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 -> Faculties of Gdańsk University of Technology		
Name and surname of lecturer (lecturers)	Subject supervisor	dr hab. inż. Jędrzej Szmytkowski	
	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	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_U02] is able to analyse and solve complex and non-standard scientific and technical problems using appropriate analytical, computational, numerical, simulation or experimental methods.	The knowledge allows to analyze problems concerning waves and optics in the real world	[SU3] Assessment of ability to use knowledge gained from the subject
[K6_W02] possesses structured knowledge of the fundamentals of physics, including mechanics, thermodynamics, electricity and magnetism, optics, atomic and molecular physics, solid-state physics, and nuclear and particle physics.	Student has a good knowledge about oscillations, waves, acoustics and optics..	[SW1] Assessment of factual knowledge
[K6_U01] demonstrates the ability for lifelong independent learning, including acquiring information from literature, databases and other appropriate sources.	Student knows how to use literature and databases id waves and optics	[SU2] Assessment of ability to analyse information
[K6_W01] demonstrates an understanding of the civilisational significance of physics and its applications.	Student knows hao to seperate wave phenomena in daily life	[SW1] Assessment of factual knowledge

<table>
<tr><td>Subject contents</td><td>Course content – lecture
Oscillations of simple physical objects. Transverse and longitudinal oscillations of the system: mass-spring. Harmonic oscillator. Simple pendulum. Physical pendulum. Damped harmonic oscillator. Driven harmonic oscillator. Resonance. Electrical oscillations in RLC circuits. Superposition of perpendicular and paralel oscillations. Beats. Oscillations in two degrees of freedom. Waves. Wave equation. Propagation of wave in different enviromnments (solid, liquid, gas). String equation. Reflection and transmission of wave. Impedance. Interference. Standing wave. Wave packets. Phase and group velocities. Dispersion relations. Fourier analysis. Elements of acoustics. Doppler effect. Electromagnetic waves and their spectrum. Maxwell equations. Wave equation for EM waves. Refractive index and its relation with frequency. Impedance of EM wave. Poynting vector. Polarization of waves. Brewster angle. Fresnel equations. Interference of EM waves. Diffraction. Diffraction grating. Geometrical optics: Fermat rule. Snellius rule. Total internal reflection. Mirrors. Prisms. Lenses. Optical devices. Elements of photometry.
Course content – exercises
Solving exercises which illustrate problems given in the lecture.

Oscillations of simple physical objects. Transverse and longitudinal oscillations of the system: mass-spring. Harmonic oscillator. Simple pendulum. Physical pendulum. Damped harmonic oscillator. Driven harmonic oscillator. Resonance. Electrical oscillations in RLC circuits. Superposition of perpendicular and paralel oscillations. Beats. Oscillations in two degrees of freedom. Waves. Wave equation. Propagation of wave in different enviromnments (solid, liquid, gas). String equation. Reflection and transmission of wave. Impedance. Interference. Standing wave. Wave packets. Phase and group velocities. Dispersion relations. Fourier analysis. Elements of acoustics. Doppler effect. Electromagnetic waves and their spectrum. Maxwell equations. Wave equation for EM waves. Refractive index and its relation with frequency. Impedance of EM wave. Poynting vector. Polarization of waves. Brewster angle. Fresnel equations. Interference of EM waves. Diffraction. Diffraction grating. Geometrical optics: Fermat rule. Snellius rule. Total internal reflection. Mirrors. Prisms. Lenses. Optical devices. Elements of photometry.</td></tr>
<tr><td>Prerequisites and co-requisites</td><td>Course credit "Mechanics and heat"(07053) and "Mathematical analysis" (07053)</td></tr>
<tr><td>Assessment methods and criteria</td><td><table>
<tr><th>Subject passing criteria</th><th>Passing threshold</th><th>Percentage of the final grade</th></tr>
<tr><td>Written exam</td><td>50.0%</td><td>60.0%</td></tr>
<tr><td>Midterm colloguium</td><td>50.0%</td><td>40.0%</td></tr>
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<tr><td>Recommended reading</td><td><table>
<tr><td>Basic literature</td><td>1. Crawford F.C., Fale, PWN
2. Januszajtis A., Fizyka dla politechnik, część 3 "Fale", PWN
3. Szczeniowski Sz., Fizyka doświadczalna, cz. I i IV, PWN</td></tr>
<tr><td>Supplementary literature</td><td>1. Ginter J., Fizyka fal (dwa tomy), PWN</td></tr>
<tr><td>eResources addresses</td><td></td></tr>
</table></td></tr>
<tr><td>Example issues/ example questions/ tasks being completed</td><td>1. Simple gravity pendulum

2. Harmonic oscylator

3. Fermats principle</td></tr>
<tr><td>Practical activites within the subject</td><td>Not applicable</td></tr>
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