GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	PHYSICS II, PG_00068176		
Field of study	Spatial Development		
Date of commencement of studies	October 2025	Academic year of realisation of subject	2027/2028
Education level	first-cycle studies	Subject group	Obligatory subject group 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 Classes are conducted in Polish, and in the case of foreign students, in Polish and English.
Semester of study	5	ECTS credits	3.0
Learning profile	general academic profile	Assessment form	assessment
Conducting unit	Division of Molecular Photophysics -> Institute of Physics and Applied Computer Science -> Faculty of Applied Physics and Mathematics -> Faculties of Gdańsk University of Technology		
Name and surname of lecturer (lecturers)	Subject supervisor	dr inż. Piotr Grygiel	
	Teachers		

Lesson types

Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
Number of study hours	15.0	15.0	0.0	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	40.0	75

Subject objectives

Mastering a specific body of knowledge in the field of general physics and developing the ability to reason in cause-effect categories based on the known laws of physics, in the context of engineering problems related to spatial management.

Learning outcomes

Course outcome	Subject outcome	Method of verification
[K6_W03] has knowledge in the field of mathematics and physics relating to issues related to space management, including the basic mathematical methods used in urban design, as well as analytical and design methods using information technology used in planning processes of settlement structures	Has elementary knowledge of the basics of physics relating to issues related to spatial management, including basic mathematical methods used in urban design, as well as analytical and design methods using IT techniques used in the processes of planning settlement structures.	[SW3] Assessment of knowledge contained in written work and projects
[K6_U01] has the ability to abstractly understand technical problems; applies basic mathematical and simulation methods in urban planning and spatial planning	Has the ability to understand technical problems in an abstract way; applies basic mathematical and simulation methods in urban design and spatial planning, using the knowledge of the basics of physics.	[SU3] Assessment of ability to use knowledge gained from the subject [SU5] Assessment of ability to present the results of task

Subject contents	Course content – lecture 1.Fluid mechanics: fluids, density, and pressure, measuring pressure, Pascal's principle and hydraulics, Archimedes' principle and buoyancy, fluid dynamics, Bernoulli's equation, viscosity and turbulence. 2. Oscillations: simple harmonic motion, energy in simple harmonic motion, pendulums, damped oscillations, forced oscillations, resonance. 3. Waves: traveling waves, mathematics of waves, energy and power of a wave, interference of waves, standing waves and resonance, sound waves, speed of sound, normal modes of a sound standing wave, sources of musical sounds. 4. The nature of light: propagation of light, law of reflection and refraction, total internal refraction. Huygens's principle, polarization. 5. Geometric optics and image formation: plane mirrors, spherical mirrors, images formed by refraction, thin lenses. 6. Optical instruments: eye, camera, simple magnifying devices, microscopes, telescopes. 7. Interference: Young's two-slit experiment, multi-slit interference, thin film interference. 8. Diffraction: single and double slit diffraction, diffraction gratings. 9. The theory of relativity: invariance of physical laws, relativity of simultaneity, time dilation, length contraction. Course content – exercises 1.Fluid mechanics: fluids, density, and pressure, measuring pressure, Pascal's principle and hydraulics, Archimedes' principle and buoyancy, fluid dynamics, Bernoulli's equation, viscosity and turbulence. 2. Oscillations: simple harmonic motion, energy in simple harmonic motion, pendulums, damped oscillations, forced oscillations, resonance. 3. Waves: traveling waves, mathematics of waves, energy and power of a wave, interference of waves, standing waves and resonance, sound waves, speed of sound, normal modes of a sound standing wave, sources of musical sounds. 4. The nature of light: propagation of light, law of reflection and refraction, total internal refraction. Huygens's principle, polarization. 5. Geometric optics and image formation: plane mirrors, spherical mirrors, images formed by refraction, thin lenses. 6. Optical instruments: eye, camera, simple magnifying devices, microscopes, telescopes. 7. Interference: Young's two-slit experiment, multi-slit interference, thin film interference. 8. Diffraction: single and double slit diffraction, diffraction gratings. 9. The theory of relativity: invariance of physical laws, relativity of simultaneity, time dilation, length contraction.
Prerequisites and co-requisites	Basic knowledge of high school physics. Knowledge of the mathematical apparatus at the level of engineering studies.

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
Assessment of a written work on a given topic	50.0%	75.0%
Active participation in classes	0.0%	25.0%

Recommended reading

Basic literature	1. University Physics by Open Stax
Supplementary literature	1. David Halliday, Robert Resnick, Jearl Walker, Fundamentals of Physics, John Villey & Sons, 2001
eResources addresses	

Example issues/ example questions/ tasks being completed

1. It is dangerous to stand close to the tracks when a fast train is passing. Explain why atmospheric pressure will push a person standing near the tracks towards the train.
2. Some chimney flues are T-shaped, so that the upper, covered part allows gases to be extracted even with the slightest breeze. Explain how this design works using Bernoulli's equation for horizontal flow.
3. David rolled down the window of his car while driving on the motorway. A plastic bag lying on the floor then flew out of the window. Explain why.
4. During tropical cyclones, roofs are sometimes blown off and buildings explode outward after being hit by a tornado. Use Bernoulli's equation for horizontal flow to explain these phenomena.
5. Every few years, winds in Boulder, Colorado, reach speeds of 45.0 m/s when the jet stream descends towards the ground in early spring. Using Bernoulli's equation, calculate the approximate force acting on a roof with an area of 220 m^2. The typical air density for Boulder is 1.14 kg/m^3, and the average pressure is 8.8910^4 N/m^2. (Bernoulli's equation assumes laminar flow, so the result obtained can only be considered an approximation, as there is significant turbulence in the situation described).
6. Pendulum clocks measure time correctly thanks to the appropriate adjustment of the pendulum length. Suppose you are moving to another city where the acceleration due to gravity is slightly higher. Should you shorten or lengthen the pendulum in your new location so that your clock measures time correctly? Justify your answer.
7. Why are church roofs more likely to be damaged during earthquakes than residential buildings? Two students are holding the ends of a long string. Each of them produces a sine wave at their end. The waves move in opposite directions. What will the wave look like that results from the superposition of both waves at the point corresponding to half the length of the string?
8. Solar panels convert solar energy into electricity with an efficiency of 10.0%. If the average intensity of sunlight during the day is 70.00 W/m^2, what area should the panel have to generate 100 W of electricity? What is the maximum cost of the panels if the investment must pay for itself in 2 years and they are used 10 hours a day? Assume that 1 kW of energy costs 50 groszy.
9. A cable with a linear mass density of 0.2 kg/m is stretched between two poles. Its tension is 500.00 N. The distance between the poles is 20 m. The wind caused the cable to resonate and a standing wave with a length of 4.5 m was formed along it. The air temperature is T = 20°C. What is the frequency and length of the gust?
10. If a large fly flying 3.0 m away from you generates a noise of 40.0 dB, what noise level does 1000 flies generate at this distance, assuming that the interference has no significant effect?
11. If the sound intensity level is 0 dB at 1000 Hz, the maximum pressure (sound amplitude) is 109 atm, what is the maximum pressure for a sound with a level of 60 dB? What is the maximum pressure for a sound with a level of 120 dB?
12. The most common type of mirage is the impression that light from a distant object is reflected from a puddle of water that does not actually exist. Mirage are often observed in the desert or on hot asphalt when a layer of hot air is close to the surface of the ground. Explain how mirage are formed, considering that the refractive index is lower for air at higher temperatures.
13. Is it true that total internal reflection is responsible for the formation of rainbows? Explain this using quantities such as refractive indices and angles. Some of us have seen double rainbows; is it physically possible to observe a triple rainbow?
14. If the light-scattering particles are much smaller than the wavelength, the amount of scattered light is proportional to 1. Does this mean that light with a shorter wavelength is scattered more than light with a longer wavelength? How does this relate to the blue colour of the sky? Why is the setting sun red?
15. A ring with a colourless gemstone fell into the water. When submerged in water, the stone becomes invisible. Could it be a diamond? Explain.
16. If you want to see your whole body in a mirror (flat mirror), how tall does the mirror have to be? Does its size depend on your distance from the mirror? Make a drawing.
17. Come up with an arrangement of mirrors that allows you to see the back of your own head. What is the minimum number of mirrors required for this task?
18. Answer the following questions. (a.) How could you see the Earth many years older, while ageing much less yourself? (b.) Does this method allow you to travel into the past?
19. Relativistic effects, such as time dilation and length contraction, occur in cars and aeroplanes. Why do they seem so counterintuitive to us?
20. Explain why some objects appear black, others red, and still others white.
21. Describe what you observe when you heat a body from 1000 K to 1,000,000 K.
22. Explain the changes in the colour of light emitted by a body as it is heated.
23. Why do you think UV radiation causes sunburn, but visible light does not?

Note: it is possible to formulate your own topic for the assignment after consulting with the course instructor.

Practical activites within the subject

Not applicable

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