GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Physics II, PG_00068211		
Field of study	Biomedical Engineering		
Date of commencement of studies	October 2025	Academic year of realisation of subject	2026/2027
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	2	Language of instruction	Polish
Semester of study	3	ECTS credits	3.0
Learning profile	general academic profile	Assessment form	assessment
Conducting unit	Division of Atomic Molecular and Optical Physics -> 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. Sebastian Bielski	
	Teachers	dr inż. Sebastian Bielski	

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	4.0	41.0	75

Subject objectives

This course introduces key physical phenomena and the quantities used to describe them, focusing on those relevant to biological processes and medical technologies. Students will also develop problem-solving skills by applying fundamental physics principles to engineering challenges.

Learning outcomes

Course outcome	Subject outcome	Method of verification
[K6_U02] can perform tasks related to the field of study in an innovative way as well as solve complex and nontypical problems, applying knowledge of physics, in changing and not fully predictable conditions	Students are able to independently analyze and solve problems related to selected physical phenomena and their associated quantities by applying appropriate physical laws.	[SU1] Assessment of task fulfilment
[K6_W02] knows and understands, to an advanced extent, selected laws of physics and physical phenomena as well as methods and theories explaining the complex relationships between them, constituting the basic general knowledge in the field of technical sciences related to the field of study	Students will understand fundamental physical principles related to waves, optics, electromagnetic fields, and diffusion, and will be able to explain their relevance to biomedical processes and technologies.	[SW1] Assessment of factual knowledge

Subject contents

Course content – lecture
Lecture:

1. Wave optics: diffraction; interference; polarization of light.
2. Lasers: spontaneous emission, stimulated emission and light absorption; general principle of laser operation; discussion of selected lasers (including CO2 laser and semiconductor laser); effect of laser beam on tissue; some applications of lasers (including medical applications).
3. Matter waves: de Broglie hypothesis; Davisson-Germer experiment.
4. Radiation sources.
5. Diffusion (in the context of substance concentration and temperature distribution): Fick's first and second laws.
6. Electric field: Coulomb's law; electric field E; superposition principle; potential energy of a system of charges; electric potential of a point charge and a system of charges; Gauss law.
7. Magnetic field in vacuum: Lorentz force; magnetic field B; Gauss' law for magnetism.
8. Magnetic field and electric current: Oersted's experiment; interaction of currents; field of a moving charge; Biot-Savart law; magnetic field of a straight current; effect of magnetic field on a current-carrying conductor; Ampères law; interaction of two parallel straight currents; application of the magnetic field in medicine; electromagnetic induction; electromotive force of induction; Faraday's law; generalized Ampère's law; Maxwells equations.

Tutorial:

The content will correspond to the topics covered in the lectures.

Prerequisites and co-requisites

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
Lecture: final test	50.0%	67.0%
tutorial: 2 tests	50.0%	33.0%

Recommended reading

Basic literature	1. Halliday D., Resnick R., Walker J., Fundamentals of physics 2. Openstax, University physics 3. Griffiths D. J. , Introduction to Electrodynamics 4. Orear J, Physics
Supplementary literature	1. Sidney B. Cahn, Boris E. Nadgorny, and Paul D. Scholten, A Guide To Physics Problems. 2. Jackson J. D., Classical Electrodynamics
eResources addresses	

Example issues/ example questions/ tasks being completed	Lecture: 1. A laser emits a beam with a diameter of 2 mm and a power of 628 mW. What is the average light intensity in this beam? 2. An electromagnetic wave reaches a given material (e.g., living tissue). Which field electric or magnetic interacts more strongly with the material? Assume that the velocities of charges in the material are much lower than the speed of light. A) The magnetic field B) The electric field C) Both fields interact with the material equally D) The electromagnetic wave does not interact with materials. 3. The intensity of light emitted by a candle or a bulb after passing through a polarizing sheet A) does not change B) is reduced to half C) is reduced to a quarter D) is reduced to 0 Tutorial: 1. A carbon dioxide laser used in surgery emits infrared radiation with a wavelength of 10.6 μm. In 1 ms, this laser raised the temperature of 1 cm^3 of flesh to 100°C and evaporated it. (a) How many photons were required? You may assume that flesh has the same heat of vaporization as water. (b) What was the minimum power output during the flash? 2. Determine the vector of the net force acting on an electric charge placed in the field generated by a given system of charges. 3. Determine the radius of the circular path of a charge moving at constant speed perpendicular to magnetic field B.
Practical activites within the subject	Not applicable

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