GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Classical mechanics and optical geometry, PG_00069494						
Field of study	Mathematics						
Date of commencement of studies	October 2026		Academic year of realisation of subject	2026/2027			
Education level	second-cycle studies		Subject group	Specialty subject group 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	1		Language of instruction	Polish			
Semester of study	1		ECTS credits	4.0			
Learning profile	general academic profile		Assessment form	assessment			
Conducting unit	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. Ewa Erdmann				
	Teachers		dr inż. Ewa Erdmann				
Lesson types	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	30.0	0.0	0.0	0.0	30.0	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	35.0	100	
Subject objectives	To familiarize students with the basics of classical mechanics and geometric optics.						

Learning outcomes

Course outcome	Subject outcome	Method of verification
[K7_U09] constructs mathematical models used in specific advanced applications of mathematics, can use stochastic processes as a tool for modeling phenomena and analyzing their evolution,constructs mathematical models used in specific advanced applications of mathematics, uses stochastic processes as a tool for modeling phenomena and analyzing their evolution, recognizes mathematical structures in physical theories	The student recognizes mathematical structures in calculation tasks concerning classical mechanics and geometrical optics	[SU5] Assessment of ability to present the results of task
[K7_K02] formulates questions to deepen own understanding of a given topic or find missing elements of reasoning, understands the need to clearly present selected achievements of higher mathematics to laymen.	The student is able to formulate precise questions and use appropriate sources of knowledge. He is able to prepare a presentation in Polish on the basic applications of mathematics in classical mechanics and optics	[SK3] Assessment of ability to organize work [SK4] Assessment of communication skills, including language correctness
[K7_U03] uses differential and integral calculus, elements of complex analysis, algebraic methods, applies them in typical practical	The student uses the acquired knowledge in solving calculation tasks concerning classical mechanics and geometrical optics	[SU3] Assessment of ability to use knowledge gained from the subject
[K7_W03] demonstrates knowledge advanced computation techniques, supporting the work of a mathematician and understand their limitations.	The student knows and understands the concepts, theories and theorems related to the application of mathematics in particle mechanics, particle systems and optics.	[SW1] Assessment of factual knowledge

Subject contents

Course content – lecture
Classical Mechanics

1. History and Division of Mechanics. Mathematical and Physical Models. Mechanics of a Material Point. Definition of a Material Point.
2. Kinematics of a Material Point. Coordinate Systems.
3. Complex Motion. Transformation of Velocity and Acceleration. Galilean Transformation.
4. Dynamics of a Material Point. Principle of Inertia. Mass and Force. Newton's Equations.
5. Principle of Conservation of Momentum. Principle of Conservation of Energy. Principle of Conservation of Angular Momentum.
6. Force in Relative Motion. Mechanics of a System of Material Points. Newton's Equations. Principle of Equal Action and Reaction.
7. D'Alembert's Principle. Configuration Space and Lagrange's Equations of the First Kind.
8. Generalized Coordinates and Momentum. Lagrange's Equations of the Second Kind.
9. Rigid Body Mechanics.
10. Angular momentum and kinetic energy of a rigid body. Moment of inertia of a rigid body. Moment of inertia tensor

Geometrical Optics
1. The nature of light, models of light, reflection and refraction of light at the boundary of two media, the laws of reflection and refraction.
2. Fermat's principle. Derivation of the law of reflection from Fermat's principle. Snell's law from Fermat's principle.Total internal reflection.
3. Classification of mirrors into plane, concave, and convex. Plane mirror. Convex and concave mirrors. The mirror equation. Interpretation of focal length. Ray tracing for a concave mirror. Sign conventions.
4. Introduction to wave optics. Polarization. Diffraction and interference phenomena. Diffraction grating

Course content – seminar
Preparing and presenting a scientific presentation on a selected topic related to the subject. Discussing the presentation topic with the group.

Prerequisites and co-requisites

Completion of required subjects during studies.

<table>
<tr><td>Assessment methods and criteria</td><td colspan="3"><table>
<tr><th>Subject passing criteria</th><th>Passing threshold</th><th>Percentage of the final grade</th></tr>
<tr><td>solving quizes</td><td>0.0%</td><td>25.0%</td></tr>
<tr><td>test</td><td>50.0%</td><td>50.0%</td></tr>
<tr><td>presenting a seminar</td><td>50.0%</td><td>25.0%</td></tr>
</table></td></tr>
<tr><td rowspan="3">Recommended reading</td><td>Basic literature</td><td colspan="2">Classical Mechanics

W. Rubinowicz, W. Królikowski, Mechanika teoretyczna

D. Halliday, R. Resnick, J. Walker, Podstawy fizyki

Optics

Cz. Bobrowski, Fizyka

E. Hecht, Optyka</td></tr>
<tr><td>Supplementary literature</td><td colspan="2">J. Taylor, Mechanika klasyczna

M. Wichtowski, Optyka liniowa</td></tr>
<tr><td>eResources addresses</td><td colspan="2"></td></tr>
<tr><td>Example issues/ example questions/ tasks being completed</td><td colspan="3">1. Derive the principle of conservation of energy of the point particle. Describe the conditions of its application.
2. Derive Lagrange's equations of the second kind from D'Alembert's principle.</td></tr>
<tr><td>Practical activites within the subject</td><td colspan="3">Not applicable</td></tr>
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