University of Gdańsk

Subject card

Subject name and code	Claasical Mechanics, PG_00182299		
Field of study	Physics		
Date of commencement of studies	October 2026	Academic year of realisation of subject	2027/2028
Education level	Bachelor's 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	7.0
Learning profile	academic	Assessment form	exam
Conducting unit			
Name and surname of lecturer (lecturers)	Subject supervisor	dr hab. Michał Studziński	
	Teachers		

Lesson types	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	45.0	30.0	15.0	0.0	0.0	90
	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	90	0.0	85.0	175

Subject objectives	Understanding of the theoretical foundations of classical physics. In particular, the aim of the lecture is to go beyond Newtonian formalism and to introduce other methods for describing mechanical systems, such as the Lagrangian, Hamiltonian, and related formalisms.

Learning outcomes			
	Course outcome	Subject outcome	Method of verification
	[FIZL3_U08] can use numerical methods or software for symbolic calculations or simulations to describe and model physical phenomena and processes	The student is able to apply numerical methods or computer algebra software to model the motion of mechanical systems described in the Lagrangian and Hamiltonian formalisms and to analyze selected phenomena of classical mechanics.	[SU1] oral statement/conversation/discussion [SU4] test/exam - oral or written [SU5] implementation of a problem task [SU8] observation of student's independent or team work
	[FIZL3_W06] knows and understands the principles of non-relativistic or relativistic mechanics	The student knows and understands the fundamental principles of classical non-relativistic mechanics and selected topics in relativistic mechanics, including the Lagrangian, Hamiltonian, and Jacobi formalisms used to describe macroscopic systems.	[SW4] test/exam - oral or written [SW1] oral statement/ conversation/discussion [SW5] implementation of a problem task
	[FIZL3_W01] has advanced knowledge of physical concepts, principles and theories, understands their historical development and significance not only for physics, but also for other exact and natural sciences and cognition of the world	The student knows and understands advanced concepts, principles, and theories of classical mechanics, including the Lagrangian, Hamiltonian, and Jacobi formalisms; understands their historical development and their significance for physics and other natural sciences; and is also aware of the limitations of these theories in the context of modern physics, particularly in the areas of relativistic and quantum phenomena.	[SW4] test/exam - oral or written [SW1] oral statement/ conversation/discussion [SW5] implementation of a problem task
	[FIZL3_U03] can apply the formalism of classical physics to describe phenomena at the macroscopic level	The student is able to apply the formalism of classical mechanics, in particular the Lagrangian, Hamiltonian, and Jacobi formalisms, including selected relativistic elements, to describe and analyze phenomena and processes occurring in macroscopic systems.	[SU1] oral statement/conversation/discussion [SU4] test/exam - oral or written [SU5] implementation of a problem task [SU8] observation of student's independent or team work

Subject contents	-Constraints and their classification. Configuration space. Lagranges equations of the first kind and DAlemberts principle. -Lagrangian dynamics (including Lagranges equations of the second kind and the Lagrange equations for a charged particle). -Hamiltons variational principle. -Noethers theorem: conservation laws and symmetries of the Lagrangian function; Noethers theorem and conservation of energy; Noethers theorem and conservation of momentum. -Kinematics and dynamics of a rigid body (including: inertia tensor of a rigid body, principal axes of the inertia tensor, description of rigid-body motion, Eulers equations, Euler angles, precession). -Small oscillations. Harmonic oscillator. Small oscillations in systems with many degrees of freedom. Normal modes. -Hamiltonian dynamics. -Canonical transformations. -HamiltonJacobi theory (selected topics). -Perturbation theory in the Hamiltonian formalism (selected topics).
Prerequisites and co-requisites	Knowledge of the fundamentals of Newtonian mechanics together with the basics of algebra, vector analysis, and mathematical analysis at the level of an undergraduate physics course.

Assessment methods and criteria	Subject passing criteria	Passing threshold	Percentage of the final grade
	written exam (wykład)	51.0%	45.0%
	in-class written test (tutorials)	51.0%	35.0%
	in-class practical test (laboratory)	51.0%	20.0%
Recommended reading	Basic literature	- N. A. Lemos, Analytical Mechanics, Cambridge University Press - G. L. Kotkin and V. G. Serbo, Exploring Clasical Mechanics, Oxford University Press - P. Hamill, A Student's Guide to Lagrangians and Hamiltonians, Cambridge University Press	
	Supplementary literature	- Feynman, R. P., Leighton, R. B., & Sands, M. *The Feynman Lectures on Physics, Volume I: Mainly Mechanics, Radiation, and Heat.* Reading, Massachusetts: Addison-Wesley, 1964 (New Millennium Edition: Basic Books, 2015). - W. Greiner, Classical Mechanics, Point Particles and Relativity, Springer - H. Goldstein, Ch. Poole, J. Safko, Classical Mechanics, Addison Wesley	
	eResources addresses		
Example issues/ example questions/ tasks being completed	-Lagranges equations of the first and second kind derivation and applications. -Using Noethers theorem, demonstrate the relationship between translational symmetry and conservation of momentum. -Implement a simulation of small oscillations in a system with many degrees of freedom and identify the normal modes. -Discuss the significance of Eulers equations in describing the motion of a rigid body.		
Work placement	Not applicable		

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