University of Gdańsk

Subject card

Subject name and code	Theoretical Mechanics, PG_00182568		
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 Optional 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	2	Language of instruction	Polish
Semester of study	4	ECTS credits	4.0
Learning profile	academic	Assessment form	credit
Conducting unit			
Name and surname of lecturer (lecturers)	Subject supervisor	dr Denis Dobkowski-Ryłko	
	Teachers		

Lesson types	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	30.0	15.0	0.0	0.0	0.0	45
	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	45	0.0	55.0	100

Subject objectives	The aim of the course is to introduce students to the fundamental principles and methods of analytical mechanics from a geometric perspective, with particular emphasis on Lagrangian and Hamiltonian mechanics on manifolds and symplectic geometry. The course covers the analysis of dynamical systems with holonomic constraints, the Lagrangian and Hamiltonian formalisms, Noethers theorem, DAlemberts principle, and the canonical formalism. Additionally, the course provides an introduction to classical field theory and demonstrates the application of analytical mechanics methods to systems with infinitely many degrees of freedom, preparing students for further studies in theoretical and mathematical physics.

Learning outcomes	<table><tr><th>Course outcome</th><th>Subject outcome</th><th>Method of verification</th></tr><tr><td>[FIZL3_W06] knows and understands the principles of non-relativistic or relativistic mechanics</td><td>Knows and understands the fundamental concepts of analytical mechanics, including the Lagrangian and Hamiltonian formalisms on manifolds. Understands the geometric structure of classical mechanics, in particular the concepts of phase space and symplectic geometry. Has a basic knowledge of classical field theory and can identify the connections between analytical mechanics and systems with infinitely many degrees of freedom.</td><td>[SW4] test/exam - oral or written [SW3] text preparation/written work</td></tr><tr><td>[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</td><td>Possesses knowledge of the relationships between symplectic structures, the concept of curvature, and the conservation of physical quantities.</td><td>[SW4] test/exam - oral or written [SW3] text preparation/written work</td></tr><tr><td>[FIZL3_U03] can apply the formalism of classical physics to describe phenomena at the macroscopic level</td><td>Is able to apply methods of symplectic geometry to the analysis of mechanical systems and classical fields. Can use the canonical formalism and the Hamilton-Jacobi method to integrate Hamilton’s equations. Is capable of independently analyzing scientific literature in the fields of analytical mechanics, field theory, and geometric mechanics.</td><td>[SU3] text preparation/written work [SU4] test/exam - oral or written</td></tr></table>
Subject contents	Lagrangian mechanics on manifolds • Holonomic constraints • Lagrangian dynamical systems • Noether's theorem • D'Alembert's principle Symplectic geometry and hamiltonian mechanics • Symplectic structures on manifolds • Hamiltonian phase flows and their integral invariants • The Lie algebra of hamiltonian functions • Symplectic geometry Canonical formalism • The integral invariant of Poincare-Cartan and its application • Huygen's principle • The Hamilton-Jacobi method for integrating Hamilton's canonical equations Elements of classical field theory
Prerequisites and co-requisites	Passed exam in Classical Mechanics and Differential Geometry for Physicists
Assessment methods and criteria	<table><tr><th>Subject passing criteria</th><th>Passing threshold</th><th>Percentage of the final grade</th></tr><tr><td>Test</td><td>51.0%</td><td>80.0%</td></tr><tr><td>Homework</td><td>51.0%</td><td>20.0%</td></tr></table>
Recommended reading	<table><tr><td>Basic literature</td><td>Mathematical Methods of Classical Mechanics, V.I. Arnold Symplectic geometry and analytical mechanics, P. Libermann, C.M. Marle</td></tr><tr><td>Supplementary literature</td><td>Symplectic Geometry, V.I. Arnold, A.B. Givental</td></tr><tr><td>eResources addresses</td><td></td></tr></table>
Example issues/ example questions/ tasks being completed	
Work placement	Not applicable