GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Classical mechanics, PG_00037296		
Field of study	Technical Physics		
Date of commencement of studies	October 2026	Academic year of realisation of subject	2027/2028
Education level	first-cycle studies	Subject group	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	3	ECTS credits	5.0
Learning profile	general academic profile	Assessment form	exam
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	prof. dr hab. Radosław Szmytkowski	
	Teachers		

Lesson types

Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
Number of study hours	30.0	30.0	0.0	0.0	0.0	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	60.0	125

Subject objectives

Introduction to the fundamentals of classical mechanics

Learning outcomes

Course outcome	Subject outcome	Method of verification
[K6_U02] is able to analyse and solve complex and non-standard scientific and technical problems using appropriate analytical, computational, numerical, simulation or experimental methods.	Knows how to solve problems in classical mechanics.	[SU3] Assessment of ability to use knowledge gained from the subject [SU4] Assessment of ability to use methods and tools
[K6_W02] possesses structured knowledge of the fundamentals of physics, including mechanics, thermodynamics, electricity and magnetism, optics, atomic and molecular physics, solid-state physics, and nuclear and particle physics.	Possesses knowledge in classical mechanics.	[SW1] Assessment of factual knowledge

Subject contents

Course content – lecture

1. Position, velocity, acceleration, trajectory, distance traveled. Hodograph. Natural coordinate system. Frenet formulas.

2. Position, velocity, and acceleration in polar, cylindrical, and spherical coordinates. Lamé coefficients and Christoffel symbols. Position, velocity, and acceleration in arbitrary curvilinear coordinates.

3. Descriptions of motion in reference frames moving relative to each other. Poisson formulas, centripetal acceleration, Coriolis acceleration.

4. Linear momentum, force, and their moments with respect to a point. Newton's laws of dynamics. Work. Kinetic energy. Conservative forces. Potential energy. Principle of conservation of mechanical energy. Applications of the energy integral to determining the motion of a particle. Virial theorem.

5. Particle in a central force field. Conservation of angular momentum; planarity of the trajectory. Binet's formula. Energy integral for a central force field.

6. The Kepler-Coulomb (KC) problem. Empirical laws of Kepler. Proof of Kepler's second law. Derivation of the trajectory equation in polar and Cartesian coordinates. Conic sections. Proof of Kepler's first and third laws. Hodograph in the KC problem.

7. Hamilton's identity. The Laplace-Runge-Lenz (LRL) vector. Application of the LRL vector to determining the trajectory and hodograph in the KC problem.

Course content – exercises
Solving problems illustrating the topics presented during the lecture.

Prerequisites and co-requisites

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
Written exam	37.5%	100.0%

Recommended reading

Basic literature	1. H. C. Corben, P. Stehle, Classical mechanics, 2nd ed., Dover, New York, 1994 2. H. Goldstein, C. Poole, J. Safko, Classical mechanics, 3rd ed., Addison-Wesley, San Francisco, 2002 3. G. L. Kotkin, V. G. Serbo, Exploring classical mechanics, 2nd ed., Oxford University Press, Oxford, 2020
Supplementary literature	-
eResources addresses	

Example issues/ example questions/ tasks being completed

1. Solution of a problem in the kinematics of a particle.

2. Solution of a problem in the dynamics of a particle (one-dimensional motion).

3. Solution of a problem in the dynamics of a particle in a central force field.

4. Solution of a problem concerning the KeplerCoulomb problem.

Practical activites within the subject	Not applicable

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