



## Subject card

Subject name and code	Mechanics and heat, PG_00072270						
Field of study	Technical Physics						
Date of commencement of studies	October 2026	Academic year of realisation of subject				2026/2027	
Education level	first-cycle studies	Subject group				Obligatory subject group in the field of study 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				10.0	
Learning profile	general academic profile	Assessment form				exam	
Conducting unit	Department of Physics of Electronic Phenomena -> Faculty of Applied Physics and Mathematics -> Faculties of Gdańsk University of Technology						
Name and surname of lecturer (lecturers)	Subject supervisor	dr hab. inż. Waldemar Stampor					
	Teachers						
Lesson types	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	60.0	60.0	0.0	0.0	0.0	120
	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	120	5.0	125.0	250		
Subject objectives	<p>The main objective of the course is:</p> <ul style="list-style-type: none"> <li>- gain some knowledge in the field of classical mechanics and thermodynamics,</li> <li>- acquire the ability to think in terms of cause-and-effect relationships and limitations imposed by the basic laws of physics,</li> <li>- acquire skills encountered in the professional work of an engineer.</li> </ul>						
Learning outcomes	Course outcome	Subject outcome			Method of verification		
	[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.	Has knowledge of basic physics, including classical mechanics and phenomenological thermodynamics			[SW1] Assessment of factual knowledge		
	[K6_U01] demonstrates the ability for lifelong independent learning, including acquiring information from literature, databases and other appropriate sources.	Is able to learn alone and acquire information from the literature, the internet and other resources			[SU2] Assessment of ability to analyse information		
	[K6_W01] demonstrates an understanding of the civilisational significance of physics and its applications.	understands the physical basis of mechanical phenomena and thermodynamics in the modern world			[SW1] Assessment of factual knowledge		
	[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.	Can correctly describe, analyze and solve problems in the field of mechanics and heat using appropriate analytical methods.			[SU2] Assessment of ability to analyse information		

Subject contents	<p>Course content – lecture</p> <p><b>MECHANICS (35h). Introduction.</b> Physical quantities and their units. SI units. Algebra of vectors. Kinematics of a particle: rectilinear motion, curvilinear motion. <b>Dynamics.</b> Newton's laws of linear (translational) motion. Friction. Dynamics of rigid body: the rotation around a fixed axis, moment of inertia, principal axes, Steiner law, torque and angular momentum, equation of rotational motion, precession and gyroscopes. Combined translational and rotational motion of a rigid body. Galilean transformations. Inertial and non-inertial reference systems. Inertial forces. <b>Conservation laws in mechanics:</b> the principle of conservation of energy, the principle of conservation of momentum, the principle of conservation of angular momentum. <b>Fluid mechanics:</b> pressure, Pascal's law, Archimedes' principle, the equation of stream continuity, Bernoulli equation.</p> <p><b>HEAT (25h). The kinetic theory of gases.</b> A molecular model of an ideal gas, the Maxwell velocity distribution, kinetic interpretation of temperature and pressure gas. The equation of state of an ideal gas. The principle of equipartition of energy and specific heat of an ideal gas. Selected processes of changing the state of an ideal gas. <b>The principles of thermodynamics.</b> The temperature and zero law of thermodynamics. The internal energy and the first law of thermodynamics. Circular processes and the Carnot cycle. Heat machines: the steam engine, the internal combustion engine, heat pump and refrigerator. Reversible and irreversible processes. Entropy and the second law of thermodynamics. Real gases. Phase transitions. <b>Thermodynamic potentials. Applications of thermodynamic equations.</b></p> <p>Course content – exercises  Topics: 1. Vector Calculus 2. Kinematics of Translational and Rotational Motion 3. Dynamics of a Material Point and a Rigid Body: Dynamics of Translational Motion: Dynamics of Rotational Motion 4. Non-inertial Frames of Reference: Inertial Forces 5. Conservation Laws: Work and Energy: Conservation of Mechanical Energy: Conservation of Momentum: Collisions of Bodies: Conservation of Angular Momentum 6. Fluid Dynamics: The Continuity Equation and Bernoulli's Principle 7. Ideal Gas: Gas Processes 8. Laws of Thermodynamics: Internal Energy and Heat: First Law of Thermodynamics: Heat Engines: Entropy: Second Law of Thermodynamics</p>														
Prerequisites and co-requisites	Not applicable														
Assessment methods and criteria	<table border="1"> <thead> <tr> <th data-bbox="448 954 794 987">Subject passing criteria</th> <th data-bbox="794 954 1141 987">Passing threshold</th> <th data-bbox="1141 954 1487 987">Percentage of the final grade</th> </tr> </thead> <tbody> <tr> <td data-bbox="448 987 794 1021">tutorial</td> <td data-bbox="794 987 1141 1021">50.0%</td> <td data-bbox="1141 987 1487 1021">40.0%</td> </tr> <tr> <td data-bbox="448 1021 794 1055">written exam</td> <td data-bbox="794 1021 1141 1055">50.0%</td> <td data-bbox="1141 1021 1487 1055">30.0%</td> </tr> <tr> <td data-bbox="448 1055 794 1093">oral exam</td> <td data-bbox="794 1055 1141 1093">50.0%</td> <td data-bbox="1141 1055 1487 1093">30.0%</td> </tr> </tbody> </table>			Subject passing criteria	Passing threshold	Percentage of the final grade	tutorial	50.0%	40.0%	written exam	50.0%	30.0%	oral exam	50.0%	30.0%
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<p>Example issues/ example questions/ tasks being completed</p>	<p>1. Newton 's laws of translational and rotational motion. Examples of applications:</p> <p>Cyclist (or car) on the flat (or sloping) surface.</p> <p>Airplane executing a loop in the vertical plane.</p> <p>Man on the carousel.</p> <p>Two bodies (of masses <math>m_1</math> and <math>m_2</math>) suspended on a pulley (with radii <math>R_1</math> and <math>R_2</math>). A solid cylinder rolls on a sloping surface without slipping downwards (upwards). 2. Moment of inertia. Derive the formula for the moment of inertia of a solid cylinder relative to the axis of symmetry coinciding with the height.</p> <p>3. The principle of conservation of momentum. Jet propulsion.</p> <p>4. The angular momentum relative to the fixed axis of rotation. The principle of conservation of angular momentum. Examples of applications. A man with a bicycle wheel on a revolving stool.</p> <p>5. The principle of conservation of energy. The car is travelling on a flat or sloping surface. A solid cylinder rolls down (up) an inclined plane.</p> <p>6. Forced (Larmor) precession of a spinning top. The frequency of precession of spinning top in a uniform gravitational field. How will the precession frequency change, when you put a spinning top in an elevator moving with acceleration?</p> <p>7. Bernoulli's equation. Examples of applications. Venturi tube. Torricelli formula.</p> <p>8. Maxwell distribution of gas molecules velocity. Estimate the average speed of nitrogen molecules at room temperature.</p> <p>9. The kinetic interpretation of gas pressure and temperature.</p> <p>10. The first law of thermodynamics for the various transformations of gas.</p> <p>11. The second law of thermodynamics and heat engines (formulation of Kelvin and Clausius).</p> <p>12. The second law of thermodynamics formulated by using entropy. 13. Heat engines: PV diagrams for the Carnot and Otto cycles.</p> <p>14. The principle of operation of heat pumps and refrigerators.</p>
<p>Practical activities within the subject</p>	<p>Not applicable</p>

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