



## Subject card

Subject name and code	Mechanics and heat, PG_00060214						
Field of study	Technical Physics						
Date of commencement of studies	October 2023	Academic year of realisation of subject			2023/2024		
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						
Name and surname of lecturer (lecturers)	Subject supervisor	dr hab. inż. Waldemar Stampor					
	Teachers	dr inż. Daniel Pelczarski dr hab. inż. Waldemar Stampor					
Lesson types and methods of instruction	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	10.0		120.0	250	
Subject objectives	The main objective of the course is: - gain some knowledge in the field of classical mechanics and thermodynamics, - acquire the ability to think in terms of cause-and-effect relationships and limitations imposed by the basic laws of physics, - acquire skills encountered in the professional work of an engineer.						
Learning outcomes	Course outcome	Subject outcome			Method of verification		
	[K6_W01] Understands the importance of physics and its applications in connection to civilization.	understands the physical basis of mechanical phenomena and thermodynamics in the modern world			[SW1] Assessment of factual knowledge		
	[K6_U01] Can learn independently, obtain information from literature, databases and other properly selected 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_W02] Has systematized knowledge of the basics of physics, including mechanics, thermodynamics, electricity and magnetism, optics, atomic and particle physics, solid-state physics, nuclear and elementary particle physics.	has knowledge of basic physics, including classical mechanics and phenomenological thermodynamics			[SW1] Assessment of factual knowledge		

Subject contents	<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>														
Prerequisites and co-requisites	Not applicable														
Assessment methods and criteria	<table border="1" data-bbox="448 736 1487 875"> <thead> <tr> <th data-bbox="448 736 794 770">Subject passing criteria</th> <th data-bbox="794 736 1141 770">Passing threshold</th> <th data-bbox="1141 736 1487 770">Percentage of the final grade</th> </tr> </thead> <tbody> <tr> <td data-bbox="448 770 794 804">oral exam</td> <td data-bbox="794 770 1141 804">50.0%</td> <td data-bbox="1141 770 1487 804">30.0%</td> </tr> <tr> <td data-bbox="448 804 794 837">written exam</td> <td data-bbox="794 804 1141 837">50.0%</td> <td data-bbox="1141 804 1487 837">30.0%</td> </tr> <tr> <td data-bbox="448 837 794 875">tutorial</td> <td data-bbox="794 837 1141 875">50.0%</td> <td data-bbox="1141 837 1487 875">40.0%</td> </tr> </tbody> </table>			Subject passing criteria	Passing threshold	Percentage of the final grade	oral exam	50.0%	30.0%	written exam	50.0%	30.0%	tutorial	50.0%	40.0%
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Recommended reading	Basic literature	<ol style="list-style-type: none"> <li>1. D. Halliday, R. Resnick, J. Walker. Podstawy fizyki. T.1 oraz T. 2; PWN, Warszawa 2003.</li> <li>2. J. Massalski. Fizyka dla inżynierów. T.1; WNT, Warszawa 2007, lub wydania wcześniejsze.</li> <li>3. Cz. Bobrowski. Fizyka. Krótki kurs. WNT, Warszawa (dowolne wydanie).</li> </ol>													
	Supplementary literature	<ol style="list-style-type: none"> <li>1. A. Januszajtis, Fizyka dla Politechnik T.1 Cząstki.</li> <li>2. I.W. Sawieliew, Kurs fizyki T.1. Mechanika i fizyka cząsteczkowa</li> <li>3. Ch. Kittel, W.D. Knight, M.A. Ruderman, Mechanika</li> <li>4. A. Piekara, Mechanika</li> </ol>													
	eResources addresses	<p>Podstawowe  <a href="https://enauczanie.pg.edu.pl/moodle/course/view.php?id=29522">https://enauczanie.pg.edu.pl/moodle/course/view.php?id=29522</a> - Adresy na platformie eNauczanie:            Mechanika i Ciepło 2023/24 - Moodle ID: 29522  <a href="https://enauczanie.pg.edu.pl/moodle/course/view.php?id=29522">https://enauczanie.pg.edu.pl/moodle/course/view.php?id=29522</a></p>													

<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>Work placement</p>	<p>Not applicable</p>