GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Mechanics and heat, PG_00060214		
Field of study	Technical Physics		
Date of commencement of studies	October 2024	Academic year of realisation of subject	2024/2025
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_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
[K6_W01] understands the importance of physics and its applications in connection to civilization	undersands the physical basis of mechanical phenomena and thermidynamics in the modern world	[SW1] Assessment of factual knowledge
[K6_U01] learns independently, obtains information from literature, databases and other properly selected sources	is able to learn alone and acqiure information from the literature, the internet and other resources	[SU2] Assessment of ability to analyse information

Subject contents	**MECHANICS (35h**). **Introduction**. Physical quantities and their units. SI units. Algebra of vectors. Kinematics of a particle: rectilinear motion, curvilinear motion. **Dynamics.** 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 . **Conservation laws in mechanics:** the principle of conservation of energy, the principle of conservation of momentum, the principle of conservation of angular momentum. **Fluid mechanics:** pressure, Pascal's law, Archimedes' principle, the equation of stream continuity, Bernoulli equation. **HEAT (25h)**. **The kinetic theory of gases.** 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. **The principles of thermodynamics.** 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. **Thermodynamic potentials. Applications of thermodynamic equations.**
Prerequisites and co-requisites	Not applicable
Assessment methods and criteria	

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%

Recommended reading	
Basic literature	1. D. Halliday, R. Resnick, J. Walker. Podstawy fizyki. T.1 oraz T. 2; PWN, Warszawa 2003. 2. J. Massalski. Fizyka dla inżynierów. T.1; WNT, Warszawa 2007 , lub wydania wcześniejsze. 3. Cz. Bobrowski. Fizyka. Krótki kurs. WNT, Warszawa (dowolne wydanie).
Supplementary literature	1. A. Januszajtis, Fizyka dla Politechnik T.1 Cząstki. 2. I.W. Sawieliew, Kurs fizyki T.1. Mechanika i fizyka cząsteczkowa 3. Ch. Kittel, W.D. Knight, M.A. Ruderman, Mechanika 4. A. Piekara, Mechanika
eResources addresses	Adresy na platformie eNauczanie:

Example issues/ example questions/ tasks being completed	**1.** Newton 's laws of translational and rotational motion. Examples of applications: Cyclist (or car) on the flat (or sloping) surface. Airplane executing a loop in the vertical plane. Man on the carousel. Two bodies (of masses m1 and m2) suspended on a pulley (with radii R1 and R2). 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. **3.** The principle of conservation of momentum. Jet propulsion. **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. **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. **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? **7.** Bernoulli's equation. Examples of applications. Venturi tube. Torricelli formula. **8.** Maxwell distribution of gas molecules velocity. Estimate the average speed of nitrogen molecules at room temperature. **9.** The kinetic interpretation of gas pressure and temperature. **10.** The first law of thermodynamics for the various transformations of gas. **11.** The second law of thermodynamics and heat engines (formulation of Kelvin and Clausius). **12.** The second law of thermodynamics formulated by using entropy. **13.** Heat engines: PV diagrams for the Carnot and Otto cycles. **14.** The principle of operation of heat pumps and refrigerators.
Work placement	Not applicable

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