GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Basics of Mechanics, PG_00047526		
Field of study	Automatic Control, Cybernetics and Robotics		
Date of commencement of studies	October 2024	Academic year of realisation of subject	2025/2026
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	2	Language of instruction	Polish
Semester of study	4	ECTS credits	3.0
Learning profile	general academic profile	Assessment form	assessment
Conducting unit	Department of Mechanics and Mechatronics -> Faculty of Mechanical Engineering and Ship Technology		
Name and surname of lecturer (lecturers)	Subject supervisor	dr hab. inż. Krzysztof Lipiński	
	Teachers	dr hab. inż. Krzysztof Lipiński	

Lesson types and methods of instruction	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	3.0	27.0	75

Subject objectives	To familiarize students with the necessary knowledge of the modeling in mechanics, the main concepts and theorems of statics. The introduction of methods for modeling sliding friction and rolling resistance. Get to know the stress-strain relationship, and the concepts of allowable stress in tensile elements, compression, bending and torsion. Presentation of methods of determining the stresses and line deflection of beams, for statically determinable and indeterminable systems. Introduction of the basic concepts and theorems kinematics and dynamics of mechanical systems.

Learning outcomes	Course outcome	Subject outcome	Method of verification
	[K6_U02] can perform tasks related to the field of study in an innovative way as well as solve complex and nontypical problems, applying knowledge of physics, in changing and not fully predictable conditions	Students solve elementary, non-typical and innovative problems of statics and kinematics Students solve elementary, non-typical and innovative problems of strength of materials: he determines stress and strain of simple deformable elements Students solve elementary, non-typical and innovative problems of dynamics of mechanical systems	[SU4] Assessment of ability to use methods and tools [SU1] Assessment of task fulfilment

Course outcome	Subject outcome	Method of verification
[K6_W02] knows and understands, to an advanced extent, selected laws of physics and physical phenomena as well as methods and theories explaining the complex relationships between them, constituting the basic general knowledge in the field of technical sciences related to the field of study	Student prepares physical models of real objects. Student presents basic concepts, principia and laws of statics and kinematics. Student replaces constraints by reaction forces and torques. Student writes equilibrium conditions for concurrent planar systems of forces, he/she calculates reactions at the supporting points. Student writes equilibrium conditions for general planar systems of forces. Student determines friction forces for sliding friction, belt friction and rolling resistance. Student writes equilibrium conditions for concurrent spatial systems of forces. Student writes equilibrium conditions for general spatial systems of forces. Student determines gravity forces and coordinates of gravity centers. Student determines limit stresses for tension, compression, bending, torsion. Student determines diagrams of bending and torsion moments for beams. Student determines second moments of area of the beam cross-section. Student determines deflection line for beams, he/she solves statically indeterminate beams. Student determines yield stresses in uniaxial tension for complex stress states. Student describes kinematics of a particle with use of different systems of coordinates. Student determines relations between position, velocity and acceleration of the particle. Student determines relations between velocities of different point of a body. Student determines position of temporal center of rotation, he/she use it to determinate velocities of different point of a rigid body. Student presents basic concepts, principia and laws of dynamics. Student solves practical problems referring to dynamics of particles. Student evaluates work, power, kinematical energy and potential energy of particles. Student determines inertia parameters of rigid bodies(statical moment, moments of inertia, inertia products). Student determines linear momentum and angular momentum of bodies. Student solves practical problems referring to dynamics of planar motion of bodies. Student determines dynamical reactions at supporting point of rotating body. Student evaluates kinetic energy and potential energy of bodies, he/she used these terms to solve practical problems referring to dynamics of particles and bodies.	[SW1] Assessment of factual knowledge

Subject contents	Information on the organization of the course. Bibliography. Historical overview. Mechanics and its main topics. Modeling in mechanics. Concepts of real object, physical model, mathematical model, algorithm. Concepts of rigid body, material particle, concentrated force. Newton's laws. Primitive notions and axioms. Equivalent systems of forces. Net force for a concurrent et of forces. Torque about a point and about an axis. Net force for a set of two parallel forces. A couple of forces and its torque. Net torque for a concurrent and general set of forces. Main net force and main net torque. Degrees of freedom, constraints, reactions. Statically determinable system of forces, statically undeterminable system of forces, mechanisms. Statics. Basic concepts. Equilibrium conditions for planar systems. Particular cases of systems and their equilibrium conditions: concurrent system so forces parallel system of forces. Equilibrium conditions for spatial systems. Particular cases of systems and their equilibrium conditions: concurrent system so forces parallel system of forces. Alternative equilibrium conditions. Principle of independent actions of forces (principle of superposition). Origins of the forces: internal and external forces. Gravity forces and coordinates of the gravity centers. Static momentum of inertia. Sliding friction, belt friction, rolling resistance. Strain/stress characteristics. Limit stresses for tension, compression, bending, torsion, Hook law, Young modulus, termall stresses, factor of saferty. Diagrams of bending and torsion moments for beams. Secend moments of area of the beam cross-section. Deflection line for beams, statically indeterminate beams. Yield stresses in uniaxial tension for complex stress statees. Kinematics of a point: basic concepts and principles: position velocity acceleration, motion equations, trajectory. Description of the motion equations with Cartesian coordinates, polar coordinates, cylindrical coordinates, spherical coordinates, natural coordinates. Tangent and normal acceleration. Particular cases of motion of the point: rectilinear uniform motion. Rectilinear motion with constant acceleration, harmonic motion, slider-crank motion, rotational motion. Kinematics of a rigid body. Basic concepts and principles. Position of a body. Its rotational velocity and acceleration. Velocities and acceleration for a point of a body. Particular cases of motion: translational motion, rotational motion, planar motion. General motion of a body as a combination of translational and rotational motions. Temporal centre of rotation. Kinematics of gears, gear transmission ratio. Relative motion and Coriolis acceleration. Basic concepts, principia and laws of dynamics. Practical problems referring to dynamics of particles. Work, power, kinematical energy and potential energy of particles. Inertia parameters of rigid bodies(statical moment, moments of inertia, inertia products). Linear momentum and angular momentum of bodies. Practical problems referring to dynamics of planar motion of bodies. Dynamical reactions at supporting point of rotating body. Kinetic energy and potential energy of bodies
Prerequisites and co-requisites	Completed course of Mathematics Completed course of Physics Main attention set on basic knowledge about geometry, trigonometry, vector calculus (analysis), matrix calculus, abilities in integrations and derivation of basic mathematical formulas

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
Midterm colloquium	56.0%	66.0%
qualifying test of the theory	56.0%	34.0%

Recommended reading

Basic literature	1. Wittbrodt E., Sawiak S.: Mechanika ogólna. Teoria i zadania. Wyd. PG, Gdańsk 2005 2. Sawiak S., Wittbrodt E.: Mechanika. Wybrane zagadnienia. Skrypt PG, Gdańsk 2003 3. Leyko J.: Mechanika ogólna, t. I i 2, PWN, Warszawa 1980 4. Niezgodziński M.E., Niezgodziński T.: Zbiór zadań z mechaniki ogólnej, PWN, Warszawa 1997 5. Dyląg Z.,Jakubowicz A., Orłoś Z.: Wytrzymałość materiałów, Warszawa WNT, t.I 1996, t.II 1997
Supplementary literature	1. Osiński Z.: Mechanika ogólna, t. I i 2, PWN, Warszawa 1987 2. Leyko J., Szmelter J.: Zbiór zadań z mechaniki ogólnej, t. I i 2, PWN, Warszawa 1976 3. Mieszczerski I. W.: Zbiór Zadań z mechaniki, PWN, Warszawa 4. Niezgodziński T.: Mechanika ogólna. WNT, Warszawa 1999 5. Nizioł J.:Metodyka rozwiązywania zadań z mechaniki. WNT, Warszawa 2002
eResources addresses	Adresy na platformie eNauczanie:

Example issues/ example questions/ tasks being completed	Determination of reaction forces for the system of known geometrical structure and known structure of load Determining of deflections of the cantilever beam loaded by some lateral force distributed continuously within specified distance on the beam. Determination of speed of some selected points at a given mechanism Balance between the kinetic and potential energy of the mechanical system
Work placement	Not applicable