GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	General Mechanics, PG_00060452		
Field of study	Mechanical and Naval Engineering		
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	Part-time studies	Mode of delivery	at the university
Year of study	1	Language of instruction	Polish online lectures exercises and laboratory in university rooms
Semester of study	2	ECTS credits	7.0
Learning profile	general academic profile	Assessment form	exam
Conducting unit	Institute of Mechanics and Machine Design -> Faculty of Mechanical Engineering and Ship Technology		
Name and surname of lecturer (lecturers)	Subject supervisor	dr hab. inż. Jarosław Szwedowicz	
	Teachers	mgr inż. Grzegorz Banaszek dr hab. inż. Jarosław Szwedowicz dr inż. Sławomir Sommer	

Lesson types and methods of instruction	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	27.0	27.0	9.0	0.0	0.0	63
	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	63	11.0	101.0	175

Subject objectives
(1) Understanding the real structure or design concept of mechanical devices in terms of load transfer, kinematics, and dynamics. (2) Simplifying the real, mechanical system into a physical model reflecting the actual behaviour of the system under acting loads and accelerations. (3) Creating a mathematical model which determines the behaviour of the mechanical system under acting loads and learning methods for solving mathematical equations. (4) Ability to measure the mechanical system and interpret the obtained experimental results.

Learning outcomes

Course outcome	Subject outcome	Method of verification
[K6_W02] possesses an organized knowledge on physics, including classic mechanics, electricity and magnetism, shows knowledge of the elements of thermodynamics	Ability to measure the mechanical system and interpret the experimental results	[SW1] Assessment of factual knowledge
[K6_U01] is able to acquire information from specialized literary sources, databases and other resources, essential for solving engineering tasks; is able to compile the obtained information pieces and to interpret them, additionally is able to form conclusions and present justified opinion	Defining the material and physical properties needed for the mechanical analysis of the designed device	[SU5] Assessment of ability to present the results of task [SU2] Assessment of ability to analyse information
[K6_U06] is able to use mathematical and physical models for analysing the processes and phenomena occurring in mechanical devices within the range of material strength, thermodynamics and fluid mechanics	Simplification of the real system to a physical model reflecting the actual behaviour of the system under acting loads. Creation of a mathematical model and learning the solution techniques for analytical modelling of the behaviour of the mechanical system under loadings.	[SU4] Assessment of ability to use methods and tools [SU3] Assessment of ability to use knowledge gained from the subject [SU1] Assessment of task fulfilment
[K6_W04] possesses knowledge on mechanics, including the processes of modelling mechanical systems, statics, kinematics and dynamics of rigid objects and basic knowledge on vibrations	Understanding of the real structure or design concept of mechanical devices in terms of load transfer, kinematics and dynamics.	[SW1] Assessment of factual knowledge

Subject contents	Historical overview. **Mechanics, its role and division**. 1.1) Modelling in mechanics: real system, physical model, mathematical model, perfectly rigid body, material point, concentrated force. 1.2) Scalar and vector quantities. 1.3) Newton's laws. 1.4) Primary concepts and axioms. 1.5) Resultant of a convergent system of forces. Moment of force about a point and about an axis. Projection of force on the axis. 1.6) Resultant of two parallel forces. A pair of forces and their moment. The resultant moment of a convergent and parallel system of forces. Equivalent force systems. 1.7) Degrees of freedom, constraints, and their reactions. Statically determinate, indeterminate, and unstable systems. 1.8) Forces and their sources. Forces: active and passive, external and internal. **Statics**. 2.1) Basic concepts. 2.2) Main force and main moment. 2.3) Basic conditions of equilibrium of any spatial system of forces. 2.4) Equilibrium conditions for special cases of force systems: plane, convergent and parallel, acting along one straight line. 2.5) Rule of two and rule of three. 2.6) Substitute equilibrium conditions. 2.7) Force of gravity, centre of gravity. 2.8) Resistance forces: sliding friction, cable friction, rolling resistance. **Kinematics**. 3.1) Basic concepts of point kinematics: position, velocity and acceleration, equations of motion. 3.2) Description of motion in rectangular and vector coordinates.

3.3) Description of point motion in natural coordinates. Tangential and normal acceleration.

3.4) Special cases of point motion. Straight-line motion, including: uniform and uniformly accelerated, harmonic.

3.5) Examples - Movement of the piston, crank and crosshead mechanism.

3.6) Movement on a plane, including: oblique projection, movement of a point around a circle and an ellipse.

3.7) Spatial movement

Solid kinematics.

4.1) Concepts: position, velocity, and angular acceleration of a solid and velocity and acceleration of a point of a solid.

4.2) Relationships between the velocities of points belonging to a rigid body.

4.3) Special cases of solid motion: translational motion and rotational motion.

4.4) Plane motion of a solid. Plane motion as a combination of translational and rotational motion and as rotation around a point, instantaneous centre of velocity.

4.5) Velocity of a point of a solid in plane motion. Theorems regarding the velocity field of a solid.

4.6) Acceleration of a point of a solid in plane motion. A momentary means of acceleration. Theorems regarding the acceleration field of a solid.

4.7) Kinematics of gears: toothed, friction, belt and planetary.

Dynamics.

5.1) Basic concepts of the dynamics of a material point. Differential equations of point dynamics in vector, rectangular and natural coordinates. Types of tasks in dynamics.

5.2) Special cases of equations: straight-line motion, oblique projection, free fall with resistance taken into account, harmonic motion, mathematical pendulum.

5.3) Principles of dynamics of a material point. dAlemberts principle.

5.4) The principle of momentum and drive. Principle of conservation of momentum.

5.5) The principle of twist and turn. The principle of conservation of twist.

5.6) Principle of energy and work. Differential form of the energy principle.

5.7) Principle of conservation of mechanical energy. Work of a constant force on a straight-line displacement and of a variable force on a curvilinear displacement.

5.8) The power of strength. Potential.

Basic concepts of solid dynamics.

6.1) Geometry of masses: mass, centre of mass, mass moments of inertia: polar, axial, plane and deviation.

6.2) Moments of inertia when transforming axle systems: translation (shift) and rotation (rotation).

6.3) Steiner's theorem. The main inertia system and the main moments of inertia.

6.4) Equations of solid dynamics in translational, rotational and plane motion.

6.5) Principles of solid dynamics. Drive and momentum as well as the twist and turn of a solid in translational, rotational and plane motion.

6.6) Kinetic energy and work of forces acting on a solid in translational, rotational and plane motion.

6.7) Calculation of the reaction of rotor bearings, balancing of rotors"

Special issues of dynamics.

7.1) Gyroscope, gyroscopic effect.

7.2) Straight and diagonal mid-collisions. Center of impact.

7.3) Dynamics of a system with variable mass

Prerequisites and co-requisites

Knowledge of physics and mathematics at secondary school level, including in particular: geometry and trigonometry, vector and matrix calculus, and differential calculus (solving non-uniform differential equations of ordinary equations of the first and second order)

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
	56.0%	100.0%

Recommended reading

Basic literature	Wittbrodt E., Sawiak S.: General Mechanics. Theory and tasks (in polish: Mechanika ogólna. Teoria i zadania). Wydawnictwo Politechniki Gdańskiej, Gdańsk, 2020 (wyd. VII)
Supplementary literature	Nizioł J.: Methodology for solving problems in mechanics (in polish: Metodyka rozwiązywania zadań z mechaniki). WNT, Warszawa, 2002
eResources addresses	Adresy na platformie eNauczanie: Mechanika ogólna PG_00060452 - Moodle ID: 37315 https://enauczanie.pg.edu.pl/moodle/course/view.php?id=37315 Mechanika ogólna PG_00060452 - Moodle ID: 37315 https://enauczanie.pg.edu.pl/moodle/course/view.php?id=37315 Mechanika ogólna PG_00060452 - Moodle ID: 37315 https://enauczanie.pg.edu.pl/moodle/course/view.php?id=37315

Example issues/ example questions/ tasks being completed

Excercise 1Calculate the natural frequency and period of oscillation of a mathematical pendulum with mass "m" and length "L".Exercise 2Calculate the polar geometric moment of inertia of an isosceles triangle with side length "H" relative to one of its vertices, if a hole with a diameter "H/4" is made in the geometric center of the triangle.Task 3A 65 kg skater stands on the ice and holds a 1 kg ball. Suddenly he throws the ball in front of him with a speed of 25 m/s. Calculate the opposite speed of the skater after throwing the ball.

Work placement

Not applicable