GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Mathematical methods of physics and technics I, PG_00037285		
Field of study	Technical Physics		
Date of commencement of studies	October 2026	Academic year of realisation of subject	2027/2028
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	3	ECTS credits	4.0
Learning profile	general academic profile	Assessment form	assessment
Conducting unit	Department of Theoretical Physics and Quantum Computing -> Faculty of Applied Physics and Mathematics -> Faculties of Gdańsk University of Technology		
Name and surname of lecturer (lecturers)	Subject supervisor	prof. dr hab. Anna Perelomova	
	Teachers		

Lesson types

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	5.0	50.0	100

Subject objectives

The lectures are introduction into the Mathematical Physics relating to the basic problems of classic mechanics, fluid mechanics, elastic theory, theory of diffusion and the wave theory. Epecial attention is paid to problems connected with dynamics of continuum medium, dynamics of material point, propagation of waves over continuous media and diffusion of mass and heat. The basis is description of dynamics of continuous media and material point by means of differential and integral equations. The aim is to form the consistent view at different areas of physics and technics.

Learning outcomes

Course outcome	Subject outcome	Method of verification
[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.	The student is able to solve problems using the knowledge acquired during lectures and exercises. The basic examples are discussed during lectures. The hometasks are announced at lectures and exercises.	[SU3] Assessment of ability to use knowledge gained from the subject
[K6_W03] possesses structured knowledge of higher mathematics, including algebra, analysis, probability and numerical methods, sufficient to describe, understand and model complex physical phenomena and selected technical processes.	A student must understand the discrete form of conervation laws. The knowledge in the field of diffrentials and simple differential equations of the I and II orders is necessary. A student can study individually, find the proper literature and ask proper questions A student makes the knowlegde deeper in the course of lectures. The previous courses are repeated.	[SW1] Assessment of factual knowledge

Subject contents	Course content – lecture -Introduction to the course. The physical field. Fluid model for gases and liquids. Material point and fluid's element (2) -Description of continuum mechanics in variables of Euler and Lagrange (2) - Kinematics of continuum medium. Trajectories and streamlines. (4) -Continuity equation (conservation of charge and other integral quantities) in integral and differential forms. Mass flux. (2) -Kinematics of material point. (2) -Conservation equation for energy in the field of potential force. Potencial. (2) -Trajektories in the phase plane. (2) -Mathematical and physical oscillators and the dynamics of a material point in the field of non-potetential force. (2) -Mass diffusion. Probabilistic description. (2) -Diffusion of heat. Moments of the diffusion equation. Heat flux, (2) -General and particular integrals of the diffusion equation in 1D at the axis and half-axis . Metoda Fouriera. (2) -Transverse and longitudinal elastic waves . Wave equation at the infinite axis. The solution of D'Alambert. (2) - Some solutions of the wave equation at the axis, half-axis and sector. (2) -Acoustic waves. Nonlinearity. Shock waves in fluids. (2) Course content – exercises Exercises designed to review and discuss theoretical knowledge from the lectures. Exercises topics: - Field operations: divergence, gradient, rotation. Applications: determining a plane tangent to a surface, a line perpendicular to the surface; -Eulerian and Lagrangian descriptions of physical fields; - Kinematics of a material point. Translational, deformational, and rotational motion. Examples of flows. Determination of paths and streamlines; -Solution of simple second-order differential equations modeling motion in a given force field; -Vector flux through a surface. Volume and mass flow rates. Mass flow through a surface -Ostrogradsky-Gauss theorem; -Oriented line integral. Work of a force. Stokes' theorem. -Potential fields. Determination of potential. Prześlij opinię

Prerequisites and co-requisites	A student must know the foundations of Mechanics, Mathematical Analysis and Differential Equations.

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
A student is active during exersises	10.0%	10.0%
A student derives the basic equations	60.0%	60.0%
A student solves the basic problems	60.0%	30.0%

Recommended reading

Basic literature

1. L. Schwartz: Mathematical Methods in Physics, McGraw-Hill 1984
2. A. Tikhonov, A. Samarsky: The equations of mathematical physics, McGraw-Hill 19633.
3. R. Puzyrewski, J. Sawicki: Foundations of fluid mechanics and hydraulics, PWN, Warsaw 2000
4. B. Budak, A. Samarsky A. Tikhonov: Tasks and problems of mathematical physics, PWN, Warsaw 1965
5. A. Zagorski: Methods of Mathematical Physics, Warsaw University of Technology Publishing House, Warsaw 2001
6. V. Vladimirov:, Equations of mathematical physics, Mir Publishers Moscow 1984
7. Ladau L., Lifszitz E. Mechanics of Continuum Media,, PWN, Warsaw 1958
8. Burka E., Nałęcz T. Fluid Mechanics in Examples, PWN, Warsaw 1999.

Supplementary literature

1. Grybos R. Fundamentals of fluid mechanics, PWN, Warsaw, 1998.
2. Golebiewski C., Luczywek E., Walicki E. Collected problems of Fluid Mechanics, PWN, Warsaw 1975.
3. Grybos R. Collected problems of Fluid Mechanics, Gliwice 1979.
4. Iljuszyn A.A., Lomakin W.A., Szmakow A.P., Fluid Mechanics of Continuum Media in Exercises, PWN, Warsaw 1987.

eResources addresses

Example issues/ example questions/ tasks being completed

To derive the continuity equation.

To calculate the rate of mass flow over the given surface.

To determine the period of mathematical oscillator, using the integral of the II Newton law.

To determine the particular solution of the wave equation at the interval [0, l].

Practical activites within the subject

Not applicable

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