University of Gdańsk

Subject card

Subject name and code	, PG_00158580						
Field of study	Physics						
Date of commencement of studies	October 2024		Academic year of realisation of subject	2024/2025			
Education level	undergraduate studies		Subject group	Obligatory subject group 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 The language used will be Polish or English, depending on the needs of the participants or the language spoken by the lecturer.			
Semester of study	2		ECTS credits	5.0			
Learning profile	academic		Assessment form				
Conducting unit	Faculty of Mathematics, Physics and Informatics -> Rektor						
Name and surname of lecturer (lecturers)	Subject supervisor		dr hab. Marcin Marciniak				
	Teachers						
Lesson types	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	30.0	30.0	0.0	0.0	0.0	60
	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	60		0.0	60.0		120
Subject objectives	The aim of the course is to familiarize students with the concepts, theorems, and methods of differential and integral calculus for functions of one and several variables.						

Learning outcomes	Course outcome	Subject outcome	Method of verification
	[FIZL3_K02] can precisely formulate problems to deepen understanding of a given topic	A student is able to present solutions to selected problems using precise terminology of mathematical analysis.	[SK1] oral statement/conversation/ discussion
	[FIZL3_W04] knows the basic techniques of higher mathematics, including differential and integral calculus of functions of one and many variables, and the basics of algebra to the extent necessary to describe physical phenomena and solve physical problems	A student knows: The properties of basic elementary functions: power, exponential, logarithmic, trigonometric, and cyclometric functions. Basic definitions related to the concepts of sequences and series, limits, and continuity of functions. Basic theorems of the theory of numerical sequences and series. Basic theorems related to the concepts of limits and continuity of functions - The definition and geometric and physical interpretation of the derivative of a function of one variable. Basic theorems of differential calculus for functions of one variable - Basic definitions related to the concepts of indefinite and definite integrals of a function of one variable, as well as functional sequences and series. Basic theorems of integral calculus for functions of one variable - The concept of limits and continuity of functions of several variables and their basic properties - Basic concepts of differential calculus for functions of several variables: partial derivatives, directional derivatives, and differentiability. The definition of higher-order partial derivatives. The definition of local extremum and the necessary and sufficient conditions for the existence of a local extremum at a point, the concept of conditional extremum, and the necessary condition for the existence of a conditional extremum (Lagrange multipliers method). Basic concepts of vector analysis: gradient, divergence, curl The definition of the Riemann integral of a function defined on any bounded subset of R^2 the definition of improper integrals on unbounded sets or from unbounded functions. The concept of iterated integrals and the relationship between iterated integrals and the Riemann integral, the theorem on the change of variables in the Riemann integral. Definitions of line and surface integrals of the first and second kind, Green's, Stokes', and Gauss' theorems	[SW4] test/exam - oral or written
	[FIZL3_K01] knows the limitations of his own knowledge and understands the need for further education	A student is able to draw conclusions from mistakes made while solving problems.	[SK1] oral statement/conversation/ discussion
	[FIZL3_U16] can independently plan and implement his own learning	A student is able to learn selected elements of the curriculum independently from a textbook.	[SU8] observation of student's independent or team work

<table>
<tr><td>Subject contents</td><td>
Elements of topology of metric spaces:

• Open and closed sets and their properties
• Sequences in metric spaces, convergence, Cauchy's condition, completeness
• Accumulation points of sequences, accumulation points of sets, compactness
• Closure, interior, boundary

Euclidean space as a metric space

• Case of the set of real numbers
  • Order properties, supremum, infimum, continuity principle
  • Numerical sequences, convergence, lower and upper limits
  • Completeness
  • Numerical series, convergence criteria, absolute and conditional convergence
• General case
  • Sequences of points in RnRn as systems of numerical sequences and resulting conclusions
  • Characterization of compact sets

Limit of a function at a point and continuity of functions

• Equivalence of Heine's and Cauchy's definitions
• One-dimensional case: one-sided limits and continuity

Differentiability

• General case: derivative as a linear transformation
• Real functions of several variables: gradient, directional derivatives, partial derivatives, higher-order derivatives, examination of local extrema
• Real functions of one variable: derivation of differentiation rules, examination of variability, Lagrange's and Taylor's theorems

Elements of vector analysis

• Vector product in R3R3
• Vector fields and their characteristics: curl, divergence
• Potential fields and their characterization

Integral calculus

• Construction of the Riemann integral for functions of one variable
• Integration of rational functions, rational functions of trigonometric functions (universal substitution), rational functions of exex and lnxlnx (Euler's substitutions)
• Integration of functions of several variables over regions in RnRn, Fubini's theorem, iterated integrals
• Line and surface integrals
• Green's, Ostrogradsky-Gauss's, and Stokes's theorems
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<tr><td>Prerequisites and co-requisites</td><td>Completion of the basic mathematics course in the first semester.</td></tr>
<tr><td>Assessment methods and criteria</td><td>
<table>
<tr><th>Subject passing criteria</th><th>Passing threshold</th><th>Percentage of the final grade</th></tr>
<tr><td>Exam</td><td>51.0%</td><td>100.0%</td></tr>
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<tr><td>Recommended reading</td><td>
<table>
<tr><td>Basic literature</td><td>W. Rudin, Principles of Mathematical Analysis

GM Fikhtengol'ts, Course of Differential and Integra Calculusl</td></tr>
<tr><td>Supplementary literature</td><td>not applicable</td></tr>
<tr><td>eResources addresses</td><td>Adresy na platformie eNauczanie:</td></tr>
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<tr><td>Example issues/ example questions/ tasks being completed</td><td>not applicable</td></tr>
<tr><td>Work placement</td><td>Not applicable</td></tr>
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