University of Gdańsk

Subject card

Subject name and code	Differential Geometry for Physicists, PG_00182567		
Field of study	Physics		
Date of commencement of studies	October 2025	Academic year of realisation of subject	2026/2027
Education level	Bachelor's studies	Subject group	Obligatory subject group in the field of study Optional subject group 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	5.0
Learning profile	academic	Assessment form	credit
Conducting unit			
Name and surname of lecturer (lecturers)	Subject supervisor	dr Denis Dobkowski-Ryłko	
	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	65.0	125

Subject objectives

The aim of the course is to introduce students to the fundamental concepts and theorems of differential geometry, with particular emphasis on topics relevant to theoretical physics. The course is intended to provide the mathematical preparation necessary for the study of field theory, special and general relativity, as well as to establish a solid foundation for further exploration of modern geometric and physical theories.

Learning outcomes

Course outcome	Subject outcome	Method of verification
[FIZL3_U01] can use advanced mathematical formalism to define, describe, and solve problems in physics	Is able to use the apparatus of tensor calculus and differential forms in solving physical and mathematical problems. Is able to independently analyze literature that makes use of the language of differential geometry.	[SU3] text preparation/written work [SU4] test/exam - oral or written
[FIZL3_W04] knows the methods 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	Knows and understands the fundamental concepts of differential geometry, such as differentiable manifold, tangent space, vector and tensor fields, bundles, differential forms, connections, and curvature. Understands the role of differential geometry in describing physical phenomena. Possesses knowledge of the applications of geometric tools in modern theoretical physics and mathematics	[SW4] test/exam - oral or written [SW3] text preparation/written work

<table>
<tr><td>Subject contents</td><td>• Elements of linear algebra and topology
• Differentiable manifolds
• Tangent space and tangent bundle
• Vector fields and forms
• Submanifolds
• Vector bundles
• Tensor analysis
• Lie derivative
• Covariant derivative
• Theory of connections</td></tr>
<tr><td>Prerequisites and co-requisites</td><td>Passed exam in Mathematical Analysis for Physicists and Algebra</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>50.0%</td></tr>
<tr><td>Midterm</td><td>51.0%</td><td>50.0%</td></tr>
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<tr><td>Recommended reading</td><td>
<table>
<tr><td>Basic literature</td><td>Foundations of Differential Geometry, Vol. 1, Shoshcichi Kobayashi, Katsumi Nomizu</td></tr>
<tr><td>Supplementary literature</td><td>J.M. Lee, Manifolds and Differential Geometry, Graduate Studies in Mathematics, vol 107

Visual Differential Geometry and Forms: A Mathematical Drama in Five Acts, T. Needham</td></tr>
<tr><td>eResources addresses</td><td></td></tr>
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<tr><td>Example issues/ example questions/ tasks being completed</td><td></td></tr>
<tr><td>Work placement</td><td>Not applicable</td></tr>
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