GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	fferential geometry, PG_00069470						
Field of study	Mathematics						
Date of commencement of studies	October 2025		Academic year of realisation of subject	2026/2027			
Education level	second-cycle studies		Subject group	Specialty 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	4.0			
Learning profile	general academic profile		Assessment form	assessment			
Conducting unit	Divison of Nonlinear Analysis -> Institute of Applied Mathematics -> Faculty of Applied Physics and Mathematics -> Faculties of Gdańsk University of Technology						
Name and surname of lecturer (lecturers)	Subject supervisor		prof. dr hab. Marek Izydorek				
	Teachers		prof. dr hab. Marek Izydorek				
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		5.0	35.0		100
Subject objectives	The purpose of the lecture is to introduce basic notions of differential geometry.						

Learning outcomes

Course outcome	Subject outcome	Method of verification
[K7_U03] uses differential and integral calculus, elements of complex analysis, algebraic methods, applies them in typical practical	Students are able to characterize the geometry of a Riemann manifold and give its basic topological properties. In practical matters, it utilizes the theory of differential equations, differential and integral calculus and linear algebra.	[SU3] Assessment of ability to use knowledge gained from the subject
[K7_W02] has enhanced knowledge of a selected branch of mathematics,theoretical or applied, knows classical definitions and theorems and their proofs and connections with other fields,understands problems being examined	Students know the basic concepts and theorems of differential geometry. They know what geodesic and Gaussian curvature are. Students are able to formulate the Egregium Theorem and outline its proof. They understand the Gauss-Bonnet theorem and its geometric interpretation.	[SW1] Assessment of factual knowledge
[K7_U05] recognize topological structures in mathematical objects occurring, for example, in geometry or mathematical analysis; uses the basic topological properties of sets, functions and transformations, uses the language and methods of functional analysis	Students have an in-depth knowledge of geometry and tpolology as well as differential and integral calculus. He/she recognizes and distinguishes geometric and topological structures in mathematical objects. Knows and is able to present and apply advanced methods of modern differential geometry. He/she knows the important theorems of this theory.	[SU3] Assessment of ability to use knowledge gained from the subject
[K7_K02] formulates questions to deepen own understanding of a given topic or find missing elements of reasoning, understands the need to clearly present selected achievements of higher mathematics to laymen.	The student is deepening their knowledge in topology, geometry, mathematical analysis, and linear algebra. He/she participates in discussions and is able to conduct some reasoning independently. He/she can formulate questions that allow for a better understanding of the topic.	[SK2] Assessment of progress of work

Subject contents

Course content – lecture
Plane curves. Curves in three-dimensional space. Parameterization of a curve. The arc length parameter. The Frenet frame. The curvature of a curve. Surfaces in three-dimensional space. Local coordinates. The normal to a surface and the tangent plane of a surface. Vector fields on a surface. The first and the second fundamental form of a surface. Curves on a surface. The normal curvature of a surface. The Gauss curvature. The Christoffel symbols. The Weingarten equations. The Gauss theorem. The covariant derivative. Geodesics. The Gauss-Bonnet theorem. Smooth manifolds. Submanifolds in the Euclidean space. The tangent space and the tangent bundle. The Riemann theorem.

Prerequisites and co-requisites

Mathematical analysis I-III. Topology. Linear algebra. Ordinary and partial differential equations.

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
Written exam	60.0%	100.0%

Recommended reading

Basic literature	1. J. Oprea, Differential geometry and its applications, Classroom Resource Materials Series, Mathematical Association of America, Washington, 2007. 2. A . Goetz, Geometria różniczkowa (Differential geometry), PWN, Warszawa, 1965 (in Polish).
Supplementary literature	No recommendations
eResources addresses	

Example issues/ example questions/ tasks being completed

1. Find the curvature and torsion of a hyperbolic helix. 2. Find the shape operator for the saddle surface z=xy. 3. Show that a geodesic has constant speed.

Practical activites within the subject

Not applicable

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