



## Subject card

Subject name and code	Differential geometry, PG_00021513						
Field of study	Mathematics						
Date of commencement of studies	October 2022	Academic year of realisation of subject			2023/2024		
Education level	second-cycle studies	Subject group			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	general academic profile	Assessment form			exam		
Conducting unit	Department of Nonlinear Analysis and Statistics -> Faculty of Applied Physics and Mathematics						
Name and surname of lecturer (lecturers)	Subject supervisor	prof. dr hab. Marek Izydorek					
	Teachers	prof. dr hab. Marek Izydorek					
Lesson types and methods of instruction	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		60.0	125
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_W01	Student gets additional knowledge in topology, geometry, mathematical analysis and linear algebra.			[SW1] Assessment of factual knowledge		
	K7_U06	Student is able to characterise geometry of a Riemann manifold and list its basic topological properties.			[SU3] Assessment of ability to use knowledge gained from the subject		
	K7_U09	Student has an advanced knowledge concerning geometry and topology as well as differential and integral analysis.			[SU4] Assessment of ability to use methods and tools [SU2] Assessment of ability to analyse information		
	K7_W03	Student is knows and is able to present and apply advanced methods of contemporary differential geometry. Student knows basic theorems in that theory..			[SW1] Assessment of factual knowledge		
K7_W06	Student knows basic notions and theorems in differential geometry. In particular, student understands geodesic, the Gauss curvature, Student is able to formulate the Egregium Thm and present an outline of proof.			[SW1] Assessment of factual knowledge			
Subject contents	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.		
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	Adresy na platformie eNauczanie:	
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.		
Work placement	Not applicable		