University of Gdańsk

Subject card

Subject name and code	Differential geometry, PG_00208823						
Field of study	Mathematics						
Date of commencement of studies	October 2025		Academic year of realisation of subject	2026/2027			
Education level	Master's studies		Subject group	Optional subject group Specialty subject group			
Mode of study	full-time studies		Mode of delivery	at the university			
Year of study	2		Language of instruction	Polish			
Semester of study	4		ECTS credits	6.0			
Learning profile	academic		Assessment form	exam			
Conducting unit	Institute of Mathematics -> Faculty of Mathematics, Physics and Informatics -> Rector						
Name and surname of lecturer (lecturers)	Subject supervisor	dr hab. Andreas Zastrow					
	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		10.0	80.0	150	
Subject objectives	The aim of this subject is to familiarize the students with the terminology, theorems and methods of geometry while making use of differential and integral calculus od functions of several variables. The student should learn the precise definition of curvature, and obtain some mathematical intuition of the two-dimensional space that surrounds him.						

Learning outcomes

Course outcome	Subject outcome	Method of verification
[MATMU2_K04] is ready to understand and appreciate the importance of intellectual honesty in one's own and other people's actions; ethical conduct	The student is ready to understand and appreciate the importance of intellectual honesty in his own and other people's actions; ethical conduct	[SK8] observation of student's independent or team work
[MATMU2_U04] is able, at an advanced level and including modern mathematics, to apply and present, orally and in writing, methods of at least one selected branch of mathematics	In the area of differential geometry a student, can on the basis of the presented material learn to present mathematical arguments orally and in writing at an advanced level.	[SU2] presentation/project/paper/ report [SU3] text preparation/written work
[MATMU2_K05] is ready to independently search for information in literature, also in foreign languages	The student is ready to independently search for information in the literature in the field of differential geometry	[SK1] oral statement/conversation/ discussion
[MATMU2_U07] is able to define his/her interests and develop them; in particular, is able to establish contact with specialists in his/her field, e.g. understand their lectures intended for young mathematicians	The student is able to define his/ her interests and develop them; in particular, he is able to establish contact with specialists in the field of differential geometry, e.g. understand their lectures intended for young mathematicians.	[SU1] oral statement/conversation/ discussion [SU8] observation of student's independent or team work
[MATMU2_U03] can understand mathematical texts of various types from selected fields of mathematics	The student can apply the theorems including their methods of proof, that he/she learnt during the lecture, and can make use of the ideas and techniques that occured in the proofs of the theorems and the examples that were given during the classes, and can give applications of the these theorems. He/she can in an understanable way, orally and in writing, formulate definitions and theorems, and independenty present correct mathematical reasoning, for example investigate properties of a given object, construct an example of some object with prescribed properties, or give a corresponding counter-example.	[SU8] observation of student's independent or team work
[MATMU2_K06] is ready to formulate opinions on basic mathematical issues	The student is ready to formulate opinions on basic mathematical issues in the field of differential geometry	[SK1] oral statement/conversation/ discussion
[MATMU2_U05] can perform proofs in a selected field and, if necessary, also use tools from other areas of mathematics	The student is able to perform proofs in the those subfields of differential geometry that have been addressed in the lecture (in particuar the tangent space, the curvature of curves, the moving n-hedral, the curvature of surfaces, Gauss' Theorema Egregium, his first and second quadratic forms and the basics of Riemannian Geometry), using the standard methods of analysis, elementary geometry and of topology.	[SU2] presentation/project/paper/ report [SU8] observation of student's independent or team work
[MATMU2_U06] is able to apply methods and examples from a selected field of mathematics in related fields	The student is able to solve practical problems in the field of the lecture, (in particuar concerning the tangent space, the curvature of curves, the moving n-hedral, the curvature of surfaces, Gauss' Theorema Egregium, and his first and second quadratic forms).	[SU3] text preparation/written work [SU4] test/exam - oral or written

Course outcome	Subject outcome	Method of verification
[MATMU2_W02] knows and understands well the role and importance of the construction of mathematical reasoning	The student knows and understands the basics of differential geometry, in particular the theorems that are the subject of this lecture, concerning amongst others the theory of curves, curvature of surfaces and the basis of Riemannian geometry, including the corresponding definitions, examples, and most important proofs or proof-sketches.	[SW4] test/exam - oral or written
[MATMU2_K02] is ready to precisely formulate questions to deepen his/her understanding of a given topic or find missing elements of reasoning	In the field of differential geometry, the student is ready to precisely formulate questions to deepen his or her understanding of a given topic or find missing elements of reasoning.	[SK1] oral statement/conversation/ discussion
[MATMU2_W01] knows and understands in-depth the theory of selected areas of mathematics	In the area of those parts of Differential Geometry, that can be presented in the course of one semester (in part curvature of surfaces and the basis of Riemannian geometry, including the corresponding definitions, examples, and most important proofs or proof-sketches) the student knows and understands in-depth the relevant theory. Especially in this field he/ she can communicate about basic definitions and formulae, knows examples and counterexamples of defined objects, and correctly formulates and proves basic theorems.	[SW4] test/exam - oral or written
[MATMU2_W03] knows and understands in-depth a selected field of theoretical or applied mathematics and is able to understand the formulations of issues in this field that are still at the research stage and knows the connections of issues in this field with other areas of mathematics	The student knows and understands the basics of differential geometry, in particular the theorems that are the subject of this lecture, concerning amongst others the theory of curves, curvature of surfaces and the basis of Riemannian geometry, including the corresponding definitions, examples, and most important proofs or proof-sketches. He/she knows and understands the connection between the issues being the subject of the lecture, and the mathematical objects that were thought earlier, e.g. in the framework of the lectures on mathematical analysis and linear algebra.	[SW4] test/exam - oral or written
[MATMU2_K01] is willing to acknowledge the limitations of his or her own knowledge and is willing to pursue further education	The student is ready to acknowledge the limitations of one's own knowledge and pursue further education.	[SK8] observation of student's independent or team work

Course outcome	Subject outcome	Method of verification
[MATMU2_U01] can construct mathematical reasoning: prove theorems and refute hypotheses through construction and selection of counterexamples	The student can apply the theorems including their methods of proof, that he/she learnt during the lecture, and can make use of the ideas and techniques that occured in the proofs of the theorems and the examples that were given during the classes, and can give applications of the these theorems. He/she can in an understanable way, orally and in writing, formulate definitions and theorems, and independenty present correct mathematical reasoning, for example investigate properties of a given object, construct an example of some object with prescribed properties, or give a corresponding counter-example (in particuar concerning the tangent space, the curvature of curves, the moving n-hedral, the curvature of surfaces, Gauss' Theorema Egregium, and his first and second quadratic forms).	[SU2] presentation/project/paper/ report [SU3] text preparation/written work [SU4] test/exam - oral or written

Subject contents

Making the student aquainted with
1. the elements of the theory of curves,
the Frenet-Seret-frame, and the curvature of curves,
2. The terminology of surfaces, the tangent space, Riemannian metrics,
isometries and geodesics.
3. geodesic equations, the Gauss map and Gauss' curvature
4. Gauss' Theorema Egregium, first and second quadratic forms.
5. the angle-sum in triangles and the description of geodesics
in the euclidean plane, the hyperbolic plane and on the sphere.
6. Some facts from Riemannian geometry: covariant derivative, parallel transport, connection

Prerequisites and co-requisites

the standard lectures on Analysis, Linear Algebra and metric Topology
from the prior years of mathematical studies

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
observation of the attitude of the student	51.0%	0.0%
activity and test-results in the example classes	51.0%	50.0%
exam	51.0%	50.0%

Recommended reading

Basic literature	1. W. Klingenberg - A course of differential geometry, Springer 19782.) 2. J. Oprea, Geometry and its applications, Prentice-Hall Inc., Upper Saddle River (New Jersey, USA), 1997 3.. L. W. Tu, Differential Geometry, Graduate Texts in Mathematics 275, Springer International Publishing, Cham (Switzerland)
Supplementary literature	none
eResources addresses	

Example issues/ example questions/ tasks being completed	not included
Work placement	Not applicable

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