

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 of 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_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_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_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 [SU4] test/exam - oral or written
	[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 particular 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_K05] is ready to independently search for information in literature, also in foreign languages	Student jest gotów do samodzielnego wyszukiwania informacji w literaturze w dziedzinie geometrii różniczkowej, także w językach obcych	[SK1] oral statement/conversation/discussion
	[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_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
	[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_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

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[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 particular 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
[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_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 occurred 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 understandable way, orally and in writing, formulate definitions and theorems, and independently 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_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 occurred 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 understandable way, orally and in writing, formulate definitions and theorems, and independently 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 particular 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

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Subject contents	<p>Making the student acquainted with</p> <ol style="list-style-type: none"> 1. the elements of the theory of curves, the Frenet-Serret-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	<table border="1"> <thead> <tr> <th>Subject passing criteria</th> <th>Passing threshold</th> <th>Percentage of the final grade</th> </tr> </thead> <tbody> <tr> <td>exam</td> <td>51.0%</td> <td>50.0%</td> </tr> <tr> <td>activity and test-results in the example classes</td> <td>51.0%</td> <td>50.0%</td> </tr> <tr> <td>observation of the attitude of the student</td> <td>51.0%</td> <td>0.0%</td> </tr> </tbody> </table>	Subject passing criteria	Passing threshold	Percentage of the final grade	exam	51.0%	50.0%	activity and test-results in the example classes	51.0%	50.0%	observation of the attitude of the student	51.0%	0.0%
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Supplementary literature	n/a												
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Example issues/ example questions/ tasks being completed	none												
Work placement	Not applicable												

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