

M105	Introduction to Differential Geometry	P	S	V	ECTS
		2	0	2	6

The aim of the course. The objective of this course is to familiarize students with fundamental concepts of differential geometry, surfaces in the first place, and with their properties. During the lectures we will introduce and analyze the basic concepts and prove their properties and their mutual links, accompanied by numerous examples, with special emphasis on the examples seen in the previously taken courses. During the exercises students should adopt techniques of examining the properties of surfaces and curves, and problem solving.

Prerequisites. Linear algebra I and II, Multidimensional Calculus.

Course content.

1. Definitions of the surface and of the curve, examples and basic properties. Tangent spaces. Vector fields on surfaces.
2. Orientation of surface. The Gauss map.
3. Vector fields along curves and geodesics. Covariant derivative and parallel transport.
4. The Weingarten map. Curvature of surfaces and of plane curves. The first and the second fundamental form.
5. Arc length and line integrals.
6. Parametrization of a surface. Examples of parametrized surfaces. Local equivalence of surfaces. Surface area (volume).

Learning outcomes

No.	Learning outcomes
1.	Analyze surfaces and distinguish the basic properties of surfaces and curves.
2.	Apply the properties of surfaces and curves when solving the tasks.
3.	Analyze properties of the Gauss and of the Weingarten map.
4.	Determine the orientation and curvature of a surface.
5.	Determine the arc length and determine geodesics on given surface.
6.	Describe the procedure of determination of parametrized surface area (volume).

Relating the learning outcomes, organization of the educational process and estimation of the learning outcomes.

Organization of the educational process	ECTS	Learning outcomes **	Student activities*	The method of estimate	Points	
					Min	max
Lecture attendance	1	1-6	Lecture attendance, discussion, team work and independent work on given tasks.	Attendance sheets, tracking activities	0	4
Written exam. (colloquium)	2	1-6	Preparing for written exam.	Evaluation.	25	48
Final exam.	3	1-6	Repetition of the subject matter.	Oral exam.	25	48
Total	6				50	100

Teaching and evaluation of knowledge. Attendance at lectures and exercises is required. The exam consists of written and oral part, and can be taken after completion of lectures and exercises. During the semester students can take colloquiums that replace the written examination.

Basic literature:

1. J.A. Thorpe, Elementary Topics in Differential Geometry, Springer-Verlag, New York, 1979.

Additional literature:

1. M.P. do Carmo, Differential Geometry of Curves and Surfaces, Prentice-Hall, New Jersey, 1976.
2. J. Oprea, Differential Geometry and Its Applications, Mathematical Association of America, 2007.
3. A.N. Pressley, Elementary Differential Geometry, Spinger-Verlag, London, 2005.
4. M. Spivak, A Comprehensive Introduction to Differential Geometry, Publish or Perish, Boston, 1970.