UČNI NAČRT PREDMETA / COURSE SYLLABUS			
Predmet:	Diferencialna geometrija		
Course title:	Differential geometry		

Študijski program in stopnja **Study programme and level**	**Študijska smer** **Study field**	**Letnik** **Academic year**	**Semester** **Semester**
Magistrski študijski program Matematika	ni smeri	1 ali 2	prvi ali drugi
Master's study programme Mathematics	none	1 or 2	first or second

Vrsta predmeta / Course type	izbirni
Univerzitetna koda predmeta / University course code:	M2315

Predavanja **Lectures**	**Seminar** **Seminar**	**Vaje** **Tutorial**	**Klinične vaje** **work**	**Druge oblike študija**	**Samost. delo** **Individ. work**	**ECTS**
45		**30**			**105**	**6**

Nosilec predmeta / Lecturer:	prof. Janez Mrčun, prof. Pavle Saksida, prof. Sašo Strle

Jeziki / Languages:	**Predavanja / Lectures:**	slovenski/Slovene, angleški/English
	Vaje / Tutorial:	slovenski/Slovene, angleški/English

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	**Prerequisites:**
Vsebina:	**Content (Syllabus outline):**

Obvezni del: Uvod in osnovni pojmi: Vektorska polja in Liejev oklepaj. Temeljni pojmi teorije Liejevih grup in Liejevih algeber. Diferencialne forme. Vektorski svežnji in Riemannove strukture na njih. Glavni svežnji, pridruženi svežnji, sveženj ogrodij, pojem redukcije svežnja. Diferencialne forme z vrednostmi v Liejevih algebrah, povezave na glavnem svežnju. Horizontalni dvig poti. Ukrivljenost in holonomija. Različni opisi ukrivljenosti na glavnem svežnju. Povezave na vektorskih svežnjih, kovariantni odvod. Chernovi razredi. Temelji Riemannove geometrije: Riemannova metrika, Levi-Civitájeva povezava, Riemannov tenzor ukrivljenosti in njegove lastnosti, Riccijeva in Weylova ukrivljenost, avtoparalelnost, geodetske krivulje. Eksponentna preslikava. Izbirni del: Podgrupe grupe GL(n,C) in simetrični prostori. Gaussova ukrivljenost na ploskvah. Poissonove in simplektične mnogoterosti. Pontrjaginovi razredi in Bottov izrek. Konformnost in Weylov tenzor.	Core topics: Introduction: Vector fields and Lie bracket. Fundamental notions of the Lie theory. Differential forms. Vector bundles, Riemann structures on vector bundles. Principal bundles, associated bundles, frame bundles, reductions of bundles. Differential forms with values in Lie algebras, connections on principal bundles. Horizontal lift of a path. Curvature and holonomy. Various descriptions of the curvature on a principal bundle. Connections on vector bundles, covariant derivative. Chern classes. Fundamental notions of Riemann geometry: Riemannian metric, Levi-Civitá connection, Riemann curvature tensor and its properties, Ricci and Weyl curvatures, autoparallel curves, geodesic curves. Exponential map. Additional topics: Subgroups of the group GL(n, C) and symmetric spaces. Gaussian curvature on surfaces. Poisson and symplectic manifolds. Pontryagin classes and Bott's theorem. Conformality and Weyl tensor

Temeljni literatura in viri / Readings:

B. A. Dubrovin, A. T. Fomenko, S. P. Novikov: Modern Geometry - Methods and Applications II : The Geometry and Topology of Manifolds, Springer, New York, 1985.

S. Helgason: Differential Geometry, Lie Groups, and Symmetric Spaces, AMS, Providence, 2001.

S. Kobayashi, K. Nomizu: Foundations of Differential Geometry I, II, John Wiley &; Sons, New York, 1996.

P. Petersen: Riemannian Geometry, Springer, New York, 1997.

J. Cheeger, D. Ebin, Comparison Theorems in Riemannian Geometry, AMS Chelsea Publishing, Providence, 2008

Cilji in kompetence:	**Objectives and competences:**
Študent se spozna s temelji sodobne diferencialne geometrije. Osnovna pojma tega predmeta sta povezava na glavnem ali na vektorskem svežnju in ukrivljenost povezave. Ukrivljenost je predstavljena skozi optiko Frobeniusovega izreka. Vpeljan je pojem holonomije, opisana je zveza med ukrivljenostjo in holonomijo. Te pojme uporabimo pri obravnavi temeljev Riemannove geometrije. Prek Chernovih razredov poudarimo povezavo s topologijo.	Fundamental concepts of modern differential geometry are introduced. The central objects of the course are connections on principal or vector bundles and their curvatures. The curvature is described from the point of view of the Frobenius theorem. The notion of holonomy is introduced and the relationship between holonomy and curvature is described. These notions are then used in the presentation of the fundamentals of the Riemannian geometry. The relationship between differential geometry and topology is illustrated by means of Chern classes.
Predvideni študijski rezultati:	**Intended learning outcomes:**
Znanje in razumevanje: Poznavanje in razumevanje osnovnih pojmov in definicij iz diferencialne geometrije. Uporaba: Uporaba teorije pri reševanju problemov. Refleksija: Razumevanje teorije na podlagi uporabe. Prenosljive spretnosti – niso vezane le na en predmet: Spretnosti uporabe domače in tuje literature in drugih virov, identifikacija in reševanje problemov, kritična analiza.	Knowledge and understanding: Understanding the fundamental definitions and concepts of differential geometry. Application: Solving problems by applying the relevant theory. Reflection: Understanding the theory through its applications. Transferable skills: Skills in the use of the relevant literature and other sources, formulating problems and solving them, critical analysis.
Metode poučevanja in učenja:	**Learning and teaching methods:**

predavanja, vaje, domače naloge, konzultacije	Lectures, exercises, homework, consultations

Načini ocenjevanja:	Delež (v %) / Weight (in %)	**Assessment:**
pisni izpit ustni izpit Ocene: 1-5 (negativno), 6-10 (pozitivno) (po Statutu UL)	50% 50%	written exam oral exam Grading: 1-5 (fail), 6-10 (pass) (according to the Statute of UL)

Reference nosilca / Lecturer's references:

Janez Mrčun:

– MRČUN, Janez. An extension of the Reeb stability theorem. Topology and its Applications, ISSN 0166-8641. [Print ed.], 1996, let. 70, št. 1, str. 25-55 [COBISS.SI-ID 7630169]

– MOERDIJK, Ieke, MRČUN, Janez. On integrability of infinitesimal actions. American journal of mathematics, ISSN 0002-9327, 2002, vol. 124, no. 3, str. 567-593 [COBISS.SI-ID 11700057]

– MOERDIJK, Ieke, MRČUN, Janez. Introduction to foliations and Lie groupoids, (Cambridge studies in advanced mathematics, 91). Cambridge, UK: Cambridge University Press, 2003. IX, 173 str., ilustr. ISBN 0-521-83197-0 [COBISS.SI-ID 12683097]

Pavle Saksida:

– SAKSIDA, Pavle. Nahm's equations and generalizations Neumann system. Proceedings of the London Mathematical Society, ISSN 0024-6115, 1999, let. 78, št. 3, str. 701-720 [COBISS.SI-ID 8853849]

– SAKSIDA, Pavle. Integrable anharmonic oscillators on spheres and hyperbolic spaces. Nonlinearity, ISSN 0951-7715, 2001, vol. 14, no. 5, str. 977-994 [COBISS.SI-ID 10942809]

– SAKSIDA, Pavle. Lattices of Neumann oscillators and Maxwell-Bloch equations. Nonlinearity, ISSN 0951-7715, 2006, vol. 19, no. 3, str. 747-768 [COBISS.SI-ID 13932377]

Sašo Strle:

– STEFANOVSKA, Aneta, STRLE, Sašo, KROŠELJ, Peter. On the overestimation of the correlation dimension. Physics letters. Section A, ISSN 0375-9601. [Print ed.], 1997, vol. 235, str. 24-30 [COBISS.SI-ID 607828]

– RUBERMAN, Daniel, STRLE, Sašo. Mod 2 Seiberg-Witten invariants of homology tori. Mathematical research letters, ISSN 1073-2780, 2000, vol. 7, no. 5-6, str. 789-799 [COBISS.SI-ID 10557785]

– STRLE, Sašo. Bounds on genus and geometric intersections from cylindrical end moduli spaces. Journal of differential geometry, ISSN 0022-040X, 2003, vol. 65, no. 3, str. 469-511 [COBISS.SI-ID 13135193]