

UČNI NAČRT PREDMETA / COURSE SYLLABUS (leto / year 2017/18)						
Predmet:		Algebraična topologija 1				
Course title:		Algebraic topology 1				
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 temeljni / core elective		
Univerzitetna koda predmeta / University course code:				M2309		
Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje work	Druge oblike študija	Samost. delo Individ. work	ECTS
30	15	30			105	6
Nosilec predmeta / Lecturer:		prof. dr. Janez Mrčun, prof. dr. Petar Pavešić, prof. dr. Dušan Repovš, prof. dr. 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:		
Vpis v letnik študija.				Enrolment in the programme.		
Vsebina:				Content (Syllabus outline):		

<p>Homotopija, homotopska ekvivalenca, homotopska kategorija, razširitve in dvigi homotopij. Celični kompleksi, celularne preslikave.</p> <p>Fundamentalna grupa, Seifert - van Kampenov izrek. Krovni prostori, klasifikacija, krovne transformacije. Grupa vozla, proste grupe, prostori $K(G,1)$.</p> <p>Homološke grupe, homotopska invariantnost, eksaktna zaporedja, izrez. Stopnja preslikave, celularna homologija, Mayer-Vietorisovo zaporedje. Ovojna in spletna števila, indeks vektorskega polja, Lefschetzev izrek, vztrajna homologija, bordizem, homologija Hovanova.</p>	<p>Homotopy, homotopy equivalence, homotopy category, homotopy extensions and liftings. Cell complexes, cellular maps.</p> <p>Fundamental group, Seifert - van Kampen theorem. Covering spaces, classification, deck transformations. Group of a knot, free groups, $K(G,1)$ spaces.</p> <p>Homology groups, homotopy invariance, exact sequences, excision. Degree of a map, cellular homology, Mayer-Vietoris sequence. Winding and linking numbers, index of a vector field, Lefschetz fixed point theorem, persistent homology, bordism, Khovanov homology.</p>
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Temeljni literatura in viri / Readings:

<p>A. Hatcher: Algebraic Topology, Ch. 0-2.</p> <p>W.Massey: A Basic Course in Algebraic Topology, Ch. I-X.</p> <p>E. Spanier: Algebraic Topology, Ch. 1-4.</p> <p>Dodatna:</p> <p>A. Dold: Lectures on Algebraic Topology, Ch. 1-6.</p> <p>P. May, A Concise Course in Algebraic Topology</p> <p>J. Munkres: Elements of Algebraic Topology, Ch. 1-4.</p> <p>R. Switzer: Algebraic Topology – Homotopy and Homology</p>
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Cilji in kompetence:

<p>Študent spozna osnovne pojme algebraične topologije kot so homotopija, celični prostori, fundamentalna grupa in homološke grupe.</p>

Objectives and competences:

<p>Student learns basic concepts of algebraic topology: homotopy, cellular spaces, fundamental group, homology groups.</p>
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Predvideni študijski rezultati:

Intended learning outcomes:

Znanje in razumevanje:

Poznavanje osnovnih pojmov in tehnik za delo s fundamentalno grupo in homološkimi grupami. Razumevanje homotopske invariance in prijemov za obravnavanje geometrijskih vprašanj s pomočjo algebre.

Uporaba:

V področjih matematike, ki delajo z geometričnimi objekti (kompleksna in globalna analiza, dinamični sistemi, geometrijska in diferencialna topologija, teorija grafov), v računalništvu (grafika, prepoznavanje vzorcev, topološka analiza podatkov, robotika), v teoretični fiziki.

Refleksija:

Razumevanje teorije na podlagi primerov in uporabe.

Prenosljive spretnosti – niso vezane le na en predmet:

Formulacija problemov v primernem jeziku, reševanje in analiza doseženega na primerih, prepoznavanje algebrainih struktur v geometriji.

Knowledge and understanding:

Basic concepts and techniques for the computation of the fundamental group and homology groups. Understanding of the concepts of homotopy invariance and of approaches to geometric problems by algebraic methods.

Application:

Parts of mathematics with strong geometric content (complex and global analysis, geometric and differential topology, graph theory), computer science (computer graphics, pattern recognition, topological data analysis, robotics), theoretical physics.

Reflection:

Understanding of theoretical concepts through examples and applications.

Transferable skills:

Recognition of algebraic structures in geometry, appropriate formulation of problems.

Metode poučevanja in učenja:

predavanja, vaje, domače naloge, konzultacije

Learning and teaching methods:

Lectures, exercises, homeworks, consultations

Načini ocenjevanja:

Delež (v %) /

Weight (in %) **Assessment:**

Način (pisni izpit, ustno izpraševanje, naloge, projekt):		Type (examination, oral, coursework, project):
izpit iz vaj		written exam
ustni izpit		oral exam
Ocene: 1-5 (negativno), 6-10 (pozitivno) (po Statutu UL)	50%	Grading: 1-5 (fail), 6-10 (pass) (according to the Statute of UL)
	50%	

Reference nosilca / Lecturer's references:

Petar Pavešič:

PAVEŠIČ, Petar. The Hopf invariant one problem, (Podiplomski seminar iz matematike, 23). Ljubljana: Društvo matematikov, fizikov in astronomov Slovenije, 1995. 65 str. ISBN 961-212-050-1. [COBISS.SI-ID 53969664]

PAVEŠIČ, Petar. Reducibility of self-homotopy equivalences. Proceedings. Section A, Mathematics, ISSN 0308-2105, 2007, vol. 137, iss 2, str. 389-413. [COBISS.SI-ID 14371929]

PAVEŠIČ, Petar, PICCININI, Renzo A. Fibrations and their classification, (Research and exposition in mathematics, vol. 33). Lemgo: Heldermann, cop. 2013. XIII, 158 str., ilustr. ISBN 978-3-88538-233-1. [COBISS.SI-ID 16616793]

Janez Mrčun:

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]

MOERDIJK, Ieke, MRČUN, Janez. Lie groupoids, sheaves and cohomology. V: EuroSchool PQR2003 on Poisson geometry, deformation quantisation and group representations, Université Libre de Bruxelles, June 13-17, 2003. GUTT, Simone (ur.), RAWNSLEY, John Howard (ur.), STERNHEIMER, Daniel (ur.). Poisson geometry, deformation quantisation and group representations, (London Mathematical Society lecture note series, ISSN 0076-0552, 323). Cambridge [etc.]: Cambridge University Press, cop. 2005, str. 147-272. [COBISS.SI-ID 13657689]

MRČUN, Janez. Topologija, (Izbrana poglavja iz matematike in računalništva, 44). Ljubljana: DMFA - založništvo, 2008. VI, 147 str., ilustr. ISBN 978-961-212-207-2. [COBISS.SI-ID 243021824]

Sašo Strle:

OWENS, Brendan, STRLE, Sašo. A characterisation of the $n < 1 > [oplus] < 3 >$ form and applications to

rational homology spheres. *Mathematical research letters*, ISSN 1073-2780, 2006, vol. 13, iss. 2, str. 259-271. [COBISS.SI-ID 13873241]

OWENS, Brendan, STRLE, Sašo. Rational homology spheres and the four-ball genus of knots. *Advances in mathematics*, ISSN 0001-8708, 2006, vol. 200, iss. 1, str. 196-216. [COBISS.SI-ID 13875033]

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]

Dušan Repovš:

KARIMOV, Umed H., REPOVŠ, Dušan. On the homology of the Harmonic Archipelago. *Central European Journal of Mathematics*, ISSN 1895-1074, 2012, vol. 10, no. 3, str. 863-872. [COBISS.SI-ID 16242009]

KARIMOV, Umed H., REPOVŠ, Dušan. On noncontractible compacta with trivial homology and homotopy groups. *Proceedings of the American Mathematical Society*, ISSN 0002-9939, 2010, vol. 138, no. 4, str. 1525-1531. [COBISS.SI-ID 15382873]

HEGENBARTH, Friedrich, REPOVŠ, Dušan. Applications of controlled surgery in dimension 4: examples. *Journal of the Mathematical Society of Japan*, ISSN 0025-5645, 2006, vol. 58, no. 4, str. 1151-1162. [COBISS.SI-ID 14120537]