UČNI NAČRT PREDMETA / COURSE SYLLABUS (leto / year 2016/17)			
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):**

Homotopija, homotopska ekvivalenca, razširitve in dvigi homotopij, homotopska kategorija. CW kompleksi, konstrukcija, topološke lastnosti, celularne preslikave. Fundamentalna grupa, Seifert-van Kampenov izrek, uporaba (osnovni izrek algebre, Brouwerjev in Borsuk-Ulamov izrek, grupa vozla). Krovni prostori, povezava s fundamentalno grupo, klasifikacija. Homološke grupe, definicija in osnovne lastnosti, računanje, uporaba (stopnja preslikave, ovojna in spletna števila, indeks vektorskega polja, negibne točke). Očrt konstrukcije homoloških grup, osnove homološke algebre.	Homotopy, homotopy equivalence, extensions and liftings of homotopies, homotopy category. CW complexes, construction, topological properties, cellular maps. Fundamental group, Seifert-van Kampen theorem, applications (fundamental tehorem of algebra, Brouwer and Borsuk-Ulam theorem, knot group). Covering spaces, relation to the fundamental group, classification. Homology groups, definition and properties, computation, applications (degree of a map, winding and linking numbers, index of a vector field, fixed points). Outline of the construction of homology groups, basic facts of homological algebra.

Temeljni literatura in viri / Readings:

A. Hatcher: Algebraic Topology, Cambridge Univ. Press, Cambridge, 2002.

Cilji in kompetence:	**Objectives and competences:**
Študent spozna osnovne pojme algebraične topologije kot so homotopija, celični prostori, fundamentalna grupa in homološke grupe.	Student learns basic concepts of algebraic topology: homotopy, cellular spaces, fundamental group, homology groups.

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 algebraičnih 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:	**Learning and teaching methods:**
predavanja, vaje, domače naloge, konzultacije	Lectures, exercises, homeworks, consultations

Načini ocenjevanja:	Delež (v %) / Weight (in %)	**Assessment:**

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

Reference nosilca / Lecturer's references:

Petar Pavešić:

PAVEŠIĆ, 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]

PAVEŠIĆ, 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]

PAVEŠIĆ, 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]

Dušan Repovš:

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]