



Univerza v Mariboru

Fakulteta za naravoslovje
in matematiko

UČNI NAČRT PREDMETA / COURSE SYLLABUS

Predmet:	Algebrska topologija
Course title:	Algebraic Topology

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Matematika, 2. stopnja		1. ali 2.	1. ali 3.
Mathematics, 2 nd cycle		1. or 2.	1. or 3.

Vrsta predmeta / Course type

Univerzitetna koda predmeta / University course code:

Predavanja Lectures	Seminar Seminar	Sem. vaje Tutorial	Lab. vaje Laboratory work	Teren. vaje Field work	Samost. delo Individ. work	ECTS
45		30			135	7

Nosilec predmeta / Lecturer:

Jeziki / Languages:	Predavanja / Lectures:	SLOVENSKO/SLOVENE
	Vaje / Tutorial:	SLOVENSKO/SLOVENE

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:

Poznavanje osnov splošne topologije.
Vsaka izmed naštetih obveznosti v načinih ocenjevanja mora biti opravljena s pozitivno oceno.
Pozitivni oceni pri ustni predstavitvi in sprotne naloge sta pogoj za pristop k ustnemu izpitu.

Vsebina:

Kategorije in funktorji.
1. Metrizabilnost:
- Metrizabilni prostori; omejene metrike, ki dajo isto topologijo; topološki produkti števno mnogo metrizabilnih prostorov,

Prerequisites:

Knowledge of introduction into general topology.
Each of the mentioned commitments must be assessed with a passing grade.
Passing grades of the oral presentation and the coursework are required for taking the oral exam.

Content (Syllabus outline):

Categories and functors.
1. Metrizability:

- Urysonohnova lema; Tietzejev razširitveni izrek. - Urysohnov izrek o metrizabilnosti. 2. Teorije kontinuumov: - Kontinuumi. Zgledi kontinuumov. Vgnezdjeni preseki. Verige. - Osnovne lastnosti. - Kompozanti. - Posebni primeri kontinuumov. Knasterjev kontinuum, psevdolok, pahljače, grafi. - Krivulje, ki zapolnijo prostor. - Izreki o napihovanju roba množice. - Lastnost fiksne točke. - Peanovi kontinuumi. 3. Hiperprostori: - Hausdorffova metrika in hiperprostori. - Limsup, liminf, lim. - Izreki o konvergenci množic. 4. Inverzna zaporedja. Inverzne limite. - Inverzne limite kontinuumov; - Nerazcepnost inverznih limit - Anderson-Choquetov vložitveni izrek - Kontinuumi, ki so podobni loku (drevesom) - Mahavierjevi sistemi.	- Metrizable spaces; bonded metrices that give the same topology; topological products of countably many metrizable spaces. - The Urysohn lemma; the Tietze extension theorem. - The Urysohn Metrization Theorem 2. Continuum theory: - Continua. Examples of continua. Nested intersections. Chains. - Basic properties - Composants. - Special examples. Knaster continuum, pseudoarc, fans, graphs. - Space filling curves. - Boundary bumping theorems. - Fixed-point property. - Peano continua. 3. Hyperspaces. - Hausdorff metric and hyperspaces - Limsup, liminf, lim. - Convergence of sets theorems. 4. Inverse sequences. Inverse limits. - Inverse limits of continua - Indecomposability of inverse limits. - Anderson-Choquet embedding theorem. - Arc-like (tree-like) continua. - Mahavier systems.
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Temeljni literatura in viri / Readings:

S .B. Nadler: Continuum theory: an introduction, Marcel Dekker, New York, 1992
A. Illanes, S. B. Nadler: Hyperspaces. Fundamentals and recent advances, Marcel Dekker, Inc., New York, 1999
J.R.Munkres: Topology: a first course, Englewood Cliffs, NJ, Prentice-Hall, 1975

Dodatna literatura/Additional Readings:

W.T. Ingram, W. S. Mahavier: Inverse limits: from continua to chaos, Springer, New York, 2012.

Cilji in kompetence:

Cilj in kompetence tega predmeta so, da študentje usvojijo pojme in metode poglavij iz topologije (temeljito spoznati in uporabljati klasične izreke metrizabilnih prostorov; kontinuumov in njihove lastnosti; hiperprostore in njihove lastnosti; inverzna zaporedja in inverzne limite kontinuumov) in jih spretno uporabljajo pri raziskovalnem delu in nadaljnjem študiju topologije.

Objectives and competences:

The objectives and competences of this course are for students to acquire knowledge of topics in topology (to know thoroughly classical theorems of metrizable spaces; continua and their properties; hyperspaces and their properties; inverse sequences and inverse limits of continua), and to thoroughly apply it in the further study of topology.

Predvideni študijski rezultati:

Znanje in razumevanje:

Po zaključku tega predmeta bo študent sposoben

- razumeti pojme poglavij iz topologije.
- razložiti in uporabljati izreke poglavij iz topologije.
- za reševanje problemov uporabiti izkušnje iz izbranih poglavij topologije.
- razumeti in uporabljati klasične izreke metrizabilnih prostorov.
- razumeti in uporabljati lastnosti kontinuumov.
- razumeti in uporabljati konstrukcijske metode za konstrukcijo novih primerov kontinuumov.
- razumeti in uporabljati lastnosti hiperprostorov in z njihovo pomočjo konstruirati nove prostore.
- razumeti in uporabljati inverzne limite inverznih zaporedij in z njimi graditi nove prostore.

Intended learning outcomes:

Knowledge and understanding:

On completion of this course the student will be able to

- understand concepts of topics in topology.
- explain and use theorems from selected topics of topology,
- apply experience from selected topics in topology for problem solving.
- understand concepts of classical theorems of metrizable spaces and know their applications.
- be able to understand different properties of continua.
- be able to understand and implement construction methods for constructions of new examples of continua.
- be able to understand and implement construction of hyperspaces.
- be able to understand and implement construction of spaces using inverse systems.

Prenosljive/ključne spretnosti in drugi atributi: • Spretnosti komuniciranja: ustni zagovor izpita, pisno izražanje pri pisnem izpitu. • Uporaba informacijske tehnologije: uporaba računalna ali računalniških aplikacij pri reševanju problemov. • Reševanje problemov: reševanje problemov s pomočjo metod iz izbranih poglavij iz topologije. • Uporaba znanja pri samostojnem raziskovalnem delu. • Prenos znanja obravnavanih metod na druga področja, predvsem na področja analize, kompleksne analize, teorije grafov, geometrije in topologije.	Transferable/Key skills and other attributes: • Communication skills: oral exam, manner of expression at written examination. • Use of information technology: use of a calculator or computer applications for problem solving. • Problem solving: problem solving using methods from selected topics in topology. • To apply the knowledge and skills to individual research work. • Knowledge transfer of treated methods into other fields, to analysis, complex analysis, graph theory, geometry and topology.						
Metode poučevanja in učenja: • Predavanja • Seminarske vaje	Learning and teaching methods: • Lectures • Tutorial						
Načini ocenjevanja:	Assessment:						
Ustni izpit Ustna predstavitev Sprotne naloge	<table> <tr> <td>50%</td> <td>Oral exam</td> </tr> <tr> <td>25%</td> <td>Oral presentation</td> </tr> <tr> <td>25%</td> <td>Coursework</td> </tr> </table>	50%	Oral exam	25%	Oral presentation	25%	Coursework
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25%	Coursework						

Reference nosilca / Lecturer's references:

1. BANIČ, Iztok, ČREPNIJAK, Matevž, MERHAR, Matej, MILUTINOVIĆ, Uroš, SOVIČ, Tina. The closed subset theorem for inverse limits with upper semicontinuous bonding functions. *Bulletin of the Malaysian Mathematical Society*, ISSN 0126-6705, 2019, vol. 42, iss. 3, str. 835-846, doi: [10.1007/s40840-017-0517-5](https://doi.org/10.1007/s40840-017-0517-5). [COBISS.SI-ID [23281928](https://cobiss.si/23281928)].
2. BANIČ, Iztok, ČREPNIJAK, Matevž, MERHAR, Matej, MILUTINOVIĆ, Uroš. The (weak) full projection property for inverse limits with upper semicontinuous bonding functions. *Mediterranean journal of mathematics*, ISSN 1660-5446, Aug. 2018, vol. 15, iss. 4, str. 1-21, doi: [10.1007/s00009-018-1209-6](https://doi.org/10.1007/s00009-018-1209-6). [COBISS.SI-ID [23960328](https://cobiss.si/23960328)].
3. BANIČ, Iztok, ČREPNIJAK, Matevž, MERHAR, Matej, MILUTINOVIĆ, Uroš, SOVIČ, Tina. An Anderson-Choquet-type theorem and a characterization of weakly chainable continua. *Mediterranean journal of mathematics*, ISSN 1660-5446, 2017, vol. 14, iss. 2, str. 1-14, doi: [10.1007/s00009-017-0868-z](https://doi.org/10.1007/s00009-017-0868-z). [COBISS.SI-ID [22997512](https://cobiss.si/22997512)]

4. BANIČ, Iztok, ČREPNIJAK, Matevž, ERCEG, Goran, MERHAR, Matej, MILUTINOVIĆ, Uroš. Inducing functions between inverse limits with upper semicontinuous bonding functions. *Houston journal of mathematics*, ISSN 0362-1588, 2015, vol. 41, no. 3, str. 1021-1037. [COBISS.SI-ID [21550856](#)]

5. BANIČ, Iztok, ČREPNIJAK, Matevž, MERHAR, Matej, MILUTINOVIĆ, Uroš. Inverse limits, inverse limit hulls and crossovers. *Topology and its Applications*, ISSN 0166-8641. [Print ed.], 2015, vol. 196, str. 155-172, doi: [10.1016/j.topol.2015.09.040](#). [COBISS.SI-ID [21615112](#)]