



Univerza v Mariboru

Fakulteta za naravoslovje
in matematiko

UČNI NAČRT PREDMETA / COURSE SYLLABUS						
Predmet:	Fraktali in dinamični sistemi					
Course title:	Fractals and dynamical systems					
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 degree				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		15	15		135	7
Nosilec predmeta / Lecturer: Mateja Grašič						
Jeziki / Languages:	Predavanja / Lectures:	SLOVENSKO/SLOVENE				
	Vaje / Tutorial:	SLOVENSKO/SLOVENE				
Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:				Prerequisites:		
Linearna algebra, Algebra, Analiza 2				Linear algebra, Algebra, Analysis 2		
Vsebina:				Content (Syllabus outline):		
<ul style="list-style-type: none">• Metričen prostor, različne vrste podprostorov, prostor fraktalov.• Afine transformacije, skrčitve, sistemi iterirajočih funkcij.• Osnove dinamičnih sistemov, dinamika fraktalnih množic.• Teoretično in eksperimentalno določanje dimenzije fraktala, Hausdorff-Bezikovičeva dimenzija.• Juliajeve množice, primeri njihove uporabe.				<ul style="list-style-type: none">• A metric space, different types of subspaces, the space of fractals.• Affine transformations, contraction mappings, systems of iterating functions.• Introduction to dynamical systems, dynamics on fractal sets.• The theoretical and experimental determination of the fractal dimension, Hausdorff-Besicovitch dimension.• Julia sets, examples of their application.		

Temeljni literatura in viri / Readings:

M. F. Barnsley: Superfractals. Cambridge University Press, Cambridge (2006).
 R. Devaney: An Introduction To Chaotic Dynamical Systems, 2nd ed., Westview Press (2003).
 G. Edgar: Classics on Fractals. Westview Press, Boulder (1992).
 K. J. Falconer: Fractal Geometry. J. Wiley, Chichester (1990).
 Y. Pesin, V. Climenhaga: Lectures on Fractal Geometry and Dynamical Systems, American Mathematical Society (2009).
 J. Vrabc: Metricni prostori. Ljubljana: DMFA (1993).

Cilji in kompetence:

Študenti se seznanijo s strukturo podprostora fraktalov v metričnem prostoru in z osnovnimi načini generiranja fraktalov (družine iterirajočih preslikav). Spoznajo tudi različne pristope k določanju dimenzije fraktala ter dinamiko fraktalnih množic.

Objectives and competences:

Students get familiar with the structure of the subset of fractals in a metric space and with the main ways of generating fractals (iterated functions systems). They also study different approaches to the fractal dimension and the dynamics of fractal sets.

Predvideni študijski rezultati:

Znanje in razumevanje:

- aktivno obvladanje strukture metričnega prostora in prepoznavanje fraktalnih podmnožic
- teoretično in eksperimentalno določanje dimenzije fraktalov
- analiza dinamičnih sistemov in njihova uporaba

Prenesljive/ključne spretnosti in drugi atributi:

- sposobnost generiranja fraktalov
- izračun dimenzije fraktalne množice
- modeliranje z dinamičnimi sistemi

Intended learning outcomes:

Knowledge and Understanding:

- active knowledge of metric space structure and the ability to recognize its fractal subsets
- theoretical and experimental ways for finding the dimension of a fractal
- the analysis of dynamical systems and their application

Transferable/Key Skills and other attributes:

- the ability to generate fractals
- the calculation of fractal dimension
- modeling with dynamical systems

Metode poučevanja in učenja:

- Predavanja
- Seminarske, laboratorijske vaje
- Individualno delo

Learning and teaching methods:

- Lectures
- Tutorial
- Individual work

Načini ocenjevanja:

Način (pisni izpit, ustno izpraševanje, naloge, projekt):	Delež (v %) / Weight (in %)	Type (examination, oral, coursework, project):
Seminarska naloga	20%	Seminar work
Pisni izpit – praktični del	40%	Written exam – practical part
Ustni izpit – teoretični del	40%	Oral exam – theoretical part

Assessment:**Reference nosilca / Lecturer's references:**

1. XIA, Yong-Hui, GRAŠIČ, Mateja, HUANG, Wentao, ROMANOVSKI, Valery. Limit cycles in a model of olfactory sensory neurons. *International journal of bifurcation and chaos in applied sciences and engineering*. 2019, vol. 29, no. 3, str. 1950038-1-1950038-9. ISSN 0218-1274.

DOI: [10.1142/S021812741950038X](https://doi.org/10.1142/S021812741950038X). [COBISS.SI-ID [22250006](#)]

2. BENKOVIČ, Dominik, GRAŠIČ, Mateja. Generalized skew derivations on triangular algebras determined by action on zero products. *Communications in algebra*. 2018, vol. 46, iss. 5, str. 1859-1867. ISSN 0092-7872. <https://doi.org/10.1080/00927872.2017.1360334>, DOI: [10.1080/00927872.2017.1360334](https://doi.org/10.1080/00927872.2017.1360334).

[COBISS.SI-ID [18505817](#)]

3. GRAŠIČ, Mateja. Zero product determined Jordan algebras, II. *Algebra colloquium*. 2015, vol. 22, iss. 1, str. 109-118. ISSN 1005-3867. DOI: [10.1142/S1005386715000103](https://doi.org/10.1142/S1005386715000103). [COBISS.SI-ID [21136136](#)]

4. BENKOVIČ, Dominik, GRAŠIČ, Mateja. Generalized derivations on unital algebras determined by action on zero products. *Linear Algebra and its Applications*. [Print ed.]. 2014, vol. 445, str. 347-368. ISSN 0024-3795. <http://dx.doi.org/10.1016/j.laa.2013.12.010>. [COBISS.SI-ID [20314120](#)]

5. BIERWIRTH, Hannes, BREŠAR, Matej, GRAŠIČ, Mateja. On maps determined by zero products. *Communications in algebra*. 2012, vol. 40, no. 6, str. 2081-2090. ISSN 0092-7872. <http://dx.doi.org/10.1080/00927872.2011.570833>. [COBISS.SI-ID [16315481](#)]