Univerza v Mariboru

Fakulteta za naravoslovje in matematiko

UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	**Kompleksni sistemi**
Course title:	**Complex Systems**

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Enovit magistrski študijski program druge stopnje Predmetni učitelj	**/**	**3**	**5**
Five-year master's degree program Subject Teacher	**/**	**3**	**5**

Vrsta predmeta / Course type	Obvezni/Obligatory
Univerzitetna koda predmeta / University course code:	

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje work	Druge oblike študija	Samost. delo Individ. work	ECTS
30		**15**			**75**	**4**

Nosilec predmeta / Lecturer:	Samo Kralj

Jeziki / Languages:	**Predavanja / Lectures:**	slovenski/Slovene
	Vaje / Tutorial:	slovenski/Slovene

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	**Prerequisits:**
Priporočljivo je predznanje klasične in moderne fizike. Vsaka izmed naštetih obveznosti v načinih ocenjevanja mora biti opravljena s pozitivno oceno.	Recommended is preknowledge of classical and modern physics is recommended. Each of the listed obligations in the assessment methods must be completed with a positive grade.

Vsebina:	**Content (Syllabus outline):**

Definicija kompleksnosti kot vmesno stanje med redom in neredom. Enostavnost na subatomskem nivoju in kompleksnost na makroskopski skali.Naključje na mikroskopski skali in determinizem na makroskopski skali. Vzroki skalnega obnašanja.DNK in ompleksnost živih bitij, nastanek vzorcev.Granularni sistemi kot modelni sistemi tekočih, trdnih in celo kristalnih stanj. Kinetika bioloških sistemov: – sistemi metabolizma in transporta (shrambni modeli, modeli biokemijskih reakcij, farmakokinetski modeli) – modelni pristop h kompleksnim biološkim procesom (modeli razmnoževanja in interakcij, modeli rasti in delitve, evolucijski modeli, modeli neuronskih procesov) – difuzijski sistemi in oblikovanje vzorcev	Definition of complexity as a state between order and disorder.Simplicity on the subatomic scale and complexity on the macroscopic scale. Reasons behind scaling behaviour.DNA and complexity, onset of patterns in leaving creatures.Granular systems as model systems of fluids, solids and even crystal states. The kinetics of biological systems: - systems of metabolism and transport (compartmental analysis, models of biochemical reactions, pharmacokinetic models) - model approaches to some complex biological processes (models of propagation and ecological interactions, models of growth and differentiation, models of evolution, models of neuronal processes) - diffusion system and pattern growth

Temeljni literatura in viri / Readings:

1. M. Mitchell Waldrop, Complexity-The-Emerging Science at Edge of Order and Chaos, Touchstone, New York, 1992. (Free Download, Borrow, and Streaming : Internet Archive)
2. Geoffrey B. West, Scale: The Universal Laws of Growth, Innovation, Sustainability, and the Pace of Life in Organisms, Cities, Economies, and Companies, Penguin Press, 2017.
3. Steven Strogatz, Sync: The Emerging Science of Spontaneous Order by Hyperion/Allen Lane, 2003.
4. M. Slavinec, M. Ambrožič, R. Repnik, Matematična fizika 1, Fakulteta za naravoslovje in matematiko, 2016
ISBN - 978-961-6657-57-0
COBISS.SI-ID - 88229121

4. Članki v Science, Nature, Scientific American.

Cilji in kompetence:	**Objectives and competences:**
Študenti usvojijo osnovno znanje s področja kompleksnih pojavov.	Students acquire elemental knowledge on complexity.

Predvideni študijski rezultati:	**Intended learning outcomes:**

Znanje in razumevanje:	**Knowledge and understanding:**
Razumevanje osnovnih procesov v naravi, ki vodijo do kompleksnih obnašanj.	Understanding of basic processes in the nature giving rise to complexity.
Prenesljive/ključne spretnosti in drugi atributi:	**Transferable/Key Skills and other attributes:**
Razumevanje osnovnih procesov v naravi, ki vodijo do kompleksnih obnašanj in celosten pristop k reševanju problemov	Understanding of basic processes in the nature giving rise to complexity and gained global approach to solving problems.

Metode poučevanja in učenja:	**Learning and teaching methods:**
Metodika obsega: teoretičen uvod v problematiko in numerično reševanje posameznih problemov, demonstracijski poskusi pri predavanjih	They are based on: theoretical introduction and numerical solving of specific problems, demonstration experiments during lectures

Načini ocenjevanja:	Delež (v %) / Weight (in %)	**Assessment:**
Pisni izpit.	**50 %**	Written exam
Ustni izpit.	**50 %**	Oral exam

Reference nosilca / Lecturer's references:

1) ČREŠNAR, Dejvid, ROŽIČ, Brigita, KUTNJAK, Zdravko, KRALJ, Samo. Theoretical and experimental study of elastocaloric responses in liquid crystalline elastomers. *Journal of molecular liquids*. [Online ed.]. Nov. 2024, vol. 413, [article no.] 126058, str. 1-14, ilustr. ISSN 1873-3166. DOI: 10.1016/j.molliq.2024.126058. [COBISS.SI-ID 208151299],
2) SINGH, Varun, PAL, Kaushik, SINGH WATTS, Sarangat, ASTHANA, Nidhi, ALI KHAN, Azmat, FATIMA, Sabiha, JELEN, Andreja, KRALJ, Samo. Graphene oxide dispersed rose-petals based green chemistry synthesis of hybrid composite for novel spectroscopic applications. *Journal of molecular liquids*. [Print ed.]. 2024, vol. 414, art. 126166, 16 str. ISSN 0167-7322. DOI: 10.1016/j.molliq.2024.126166. [COBISS.SI-ID 211786243]
3) SVETEC, Milan, HARKAI, Saša, PAL, Kaushik, KRALJ, Samo. Twist disclinations mediated transformations in confined nematic liquid crystals. *Journal of molecular liquids*. [Online ed.]. 15 Nov. 2024, part b, [article no.] 126138, 10 str., ilustr. ISSN 1873-3166. DOI: 10.1016/j.molliq.2024.126138. [COBISS.SI-ID 214061315]
4) JELEN, Andreja, ZID, Maha, PAL, Kaushik, RENUKA, Remya Rajan, ČREŠNAR, Dejvid, KRALJ, Samo. Nano and micro-structural complexity of nematic liquid crystal configurations. *Journal of molecular liquids*. [Print ed.]. 2024, vol. 415, part a, [article no.] 126275, 9 str., ilustr. ISSN 0167-7322. DOI: 10.1016/j.molliq.2024.126275, DOI: 20.500.12556/DKUM-91264. [COBISS.SI-ID 217792259]
5) HÖLBL, Arbresha, PAL, Kaushik, AHMAD, Irfan, ASIRI, Hatem Mohammed A, KRALJ, Samo. Colloid and nanoparticle-driven phase behavior in weakly perturbed nematic liquid

crystals. *Journal of molecular structure*. [Print ed.]. Jul. 2024, vol. 1307, [article no.] 138002, 8 str. ISSN 0022-2860. DOI: 10.1016/j.molstruc.2024.138002. [COBISS.SI-ID 194451715]