



Univerza v Mariboru

Fakulteta za naravoslovje  
in matematiko

### UČNI NAČRT PREDMETA / COURSE SYLLABUS

<b>Predmet:</b>	<b>Fizika živih bitij</b>
<b>Course title:</b>	<b>Physics of living beings</b>

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
FIZIKA		1. ali 2.	1., 2. ali 3.
PHYSICS		1. or 2.	1., 2. or 3.

**Vrsta predmeta / Course type**

Izbirni za modul Biofizika 3, Fizika 1, 2, 3 in Izobraževalna fizika 1, 2

**Univerzitetna koda predmeta / University course code:**

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Lab. vaje Laboratory work	Terenske vaje Field work	Samost. delo Individ. work	ECTS
5					145	5

**Nosilec predmeta / Lecturer:**

**Samo Kralj**

**Jeziki /**

**Languages:**

**Predavanja /** slovenski/Slovenian

**Lectures:**

**Vaje / Tutorial:**

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

Predznanje iz klasične in moderne fizike

**Prerequisites:**

Pre-knowledge of classical physics and modern physics

**Vsebina:**

**Content (Syllabus outline):**

### Osnove

- Osnove statistične fizike
- Naključni sprehajalec in univerzalni modeli
- Mali svet, sinhronizacija
- Samo-organizirana kritičnost

### Posamezna bitja

- Celice in zlom simetrije
- Genski zapis in vpliv okolice, naravna selekcija
- Velikost in skalno obnašanje, vzorci
- Detektorji
- Možgani
- Kako narediti genija

### Skupina bitij

- Kolektivno obnašanje, modeliranje

### Basics

- Basics of statistical physics
- Random walker and universal models
- Small world, synchronization
- Self organized criticality

### Individual being

- Cells and symmetry breaking
- Genetics, influence of environment, selection pressures
- Size of creatures, scaling
- Detectors
- Brains, neuron cells
- How to make an expert

### Group

- Collective behavior, modelling

### **Temeljni literatura in viri / Readings:**

- 1) P. Bak, How Nature Works, The Science of Self-Organized Criticality, Springer Verlag, 1996.
- 2) Murray Gell-Mann, Quark and Jaguar, W.H. Freeman and company, New York, 1994
- 3) J.F.F. Mendes and N.S. Dorogovtsev, Evolution of Networks: From Biological Nets to the Internet and WWW, Oxford University Press, Oxford, 2003
- 4) J. M. Smith, Evolution and the Theory of Games, Cambridge Univ. Press, Cambridge, 1982.
- 5) S. H. Strogatz, Nonlinear Dynamics and Chaos , Perseus, New York, 1994.

### **Cilji in kompetence:**

Študentje poglobijo znanje iz živih bitij.

### **Objectives and competences:**

Students acquire advanced knowledge on living beings.

### **Predvideni študijski rezultati:**

Znanje in razumevanje:

Razumevanje procesov v živi naravi.

Prenesljive/ključne spretnosti in drugi atributi:

Rešitev problemov z matematičnimi orodji,

### **Intended learning outcomes:**

Knowledge and understanding:

Understanding of processes in living world.

Transferable/Key Skills and other attributes:

Solving of problems with mathematical tools,

numeričnimi metodami, univerzalnosti v fiziki in celosten pristop k reševanju problemov.

numerical methods, universalities in physics and gained global approach on solving a problem.

**Metode poučevanja in učenja:**

Predavanja in reševanje zastavljenih problemov.

**Learning and teaching methods:**

Lectures and solving of defined problems.

**Načini ocenjevanja:**

Delež (v %) /  
Weight (in %)

**Assessment:**

Način (pisni izpit, ustno izpraševanje, naloge, projekt)	Delež (v %) / Weight (in %)	Type (examination, oral, coursework, project):
Dva seminarja	<b>50%</b>	Two seminars
Ustni izpit	<b>50%</b>	Oral exam

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

- 1) RANJKESH SIAHKAL, Amid, AMBROŽIČ, Milan, KRALJ, Samo, SLUCKIN, T. J. Computational studies of history dependence in nematic liquid crystals in random environments. *Physical review. E, Statistical, nonlinear, and soft matter physics*, ISSN 1539-3755, 2014, vol. 89, iss. 2, str. 022504-1-022504-14, doi: [10.1103/PhysRevE.89.022504](https://doi.org/10.1103/PhysRevE.89.022504). [COBISS.SI-ID [20347912](#)]
- 2) TRČEK, Maja, CORDOYIANNIS, George, TZITZIOS, Vassilios, KRALJ, Samo, NOUNESIS, George, LELIDIS, Ioannis, KUTNJAK, Zdravko. Nanoparticle-induced twist grain boundary phases. *Physical review. E, Statistical, nonlinear, and soft matter physics*, ISSN 1539-3755, 2014, vol. 90, issue 3, str. 1-8, doi: [10.1103/PhysRevE.90.032501](https://doi.org/10.1103/PhysRevE.90.032501). [COBISS.SI-ID [27908903](#)]
- 3) KRALJ, Samo, MAJUMDAR, Apala. Order reconstruction patterns in nematic liquid crystal wells. *Proceedings. Series A, Mathematical, Physical and Engineering Sciences*, ISSN 1364-5021. [Print ed.], 2014, vol. 470, no. 2169, str. 1-18. <http://rspa.royalsocietypublishing.org/content/470/2169/20140276.abstract>, doi: [10.1098/rspa.2014.0276](https://doi.org/10.1098/rspa.2014.0276). [COBISS.SI-ID [20812040](#)]
- 4) RANJKESH SIAHKAL, Amid, AMBROŽIČ, Milan, CORDOYIANNIS, George, KUTNJAK, Zdravko, KRALJ, Samo. History-dependent patterns in randomly perturbed nematic liquid crystals. *Advances in condensed matter physics*, ISSN 1687-8108, 2013, vol. 2013, str. 505219-1-505219-10, doi: [10.1155/2013/505219](https://doi.org/10.1155/2013/505219). [COBISS.SI-ID [26806567](#)]
- 5) S. Kralj, G. Cordoyiannis, D. Jesenek, A. Zidansek, G. Lahajnar, N. Novak, H. Amenitsch, Z. Kutnjak, Dimensional crossover and scaling behavior of a smectic liquid crystal confined to controlled-pore glass matrices, *Soft matter* 8, 2460 (2012).