



Univerza v Mariboru

Fakulteta za naravoslovje  
in matematiko

### UČNI NAČRT PREDMETA / COURSE SYLLABUS

<b>Predmet:</b>	<b>Fizika družbe</b>
<b>Course title:</b>	<b>Social physics</b>

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
FIZIKA, 1. stopnja		3.	6.
PHYSICS, 1st cycle		3.	6.

**Vrsta predmeta / Course type**

Izbirni / elective

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

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Lab. vaje Laboratory work	Teren. vaje Field work	Samost. delo Individ. work	ECTS
30					150	6

**Nosilec predmeta / Lecturer:**

Matjaž Perc

**Jeziki /**

**Languages:**

**Predavanja /**

**Lectures:**

Slovenski / Slovenian

**Vaje / Tutorial:**

Slovenski / Slovenian

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

Ni pogojev.

**Prerequisites:**

None.

**Vsebina:**

Teorija iger, fizikalna interpretacija Darwinovega zakona evolucije, uspešnost različnih vedenjskih vzorcev v luči fizike, vpliv vedenjskih vzorcev na uspešnost družbe kot celote, nastanek kompleksnih mrež in pojav malega sveta.

**Content (Syllabus outline):**

Game theory, physical interpretation of the Darwinian law of evolution, successfulness of different behavioural patterns in terms of physics, impacts of different behavioural patterns on the prosperity of society as a whole, emergence of complex networks and the small-world phenomenon.

## Temeljni literatura in viri / Readings:

- 1) K. Sigmund, *Games of life* (Oxford University Press, Oxford, 1993).
- 2) R. Axelrod, *The evolution of cooperation* (Basic Books, New York, 1984).
- 3) J. Hofbauer and K. Sigmund, *Evolutionary games and population dynamics* (Cambridge University Press, Cambridge, 1998).
- 4) A. Szolnoki, et al., Cyclic dominance in evolutionary games: A review, *J. R. Soc. Interface* 11, 20140735 (2014)
- 5) M. Perc and P. Grigolini, Collective behavior and evolutionary games - An introduction, *Chaos, Solitons & Fractals* 56, 1-5 (2013)
- 6) M. Perc and A. Szolnoki, Coevolutionary games - A mini review, *BioSystems* 99, 109-125 (2010)

### Cilji in kompetence:

Študenti usvojijo temeljna teoretična znanja s področja o vedenjskih strategijah v družbi in razumeti njihov uspeh (ali neuspeh) na podlagi fizike, in jih znajo uporabiti pri reševanju ustreznih problemov z rabo matematičnih orodij.

### Objectives and competences:

Students acquire basic theoretical knowledge about behavioural patterns in society and understand their success (or failure), in view of the underlying mechanisms of physics and are able to use the knowledge to solve problems with the use of mathematical tools.

### Predvideni študijski rezultati:

#### Znanje in razumevanje:

Po uspešno zaključeni učni enoti bodo študenti zmožni:

- Opisati učinke in potenciale različnih vedenjskih vzorcev v družbi.
- Uporabiti programiranje za analizo in študij modelov, ki opisujejo socialno dinamiko.
- Razlikovati med skupinsko in kolektivno dinamiko v socialnih modelih.

#### Prenesljive/ključne spretnosti in drugi atributi:

Po uspešno zaključeni učni enoti bodo študenti zmožni:

- Prepoznati različne vedenjske vzorce in strategije ter predvideti njihov vpliv na družbo (ali skupino ljudi), ki jim je podvržena.
- Pripravljati socialne modele za različne realne sisteme v družbi.

### Intended learning outcomes:

#### Knowledge and understanding:

On completion of this course students will be able to:

- Describe different behavioural patterns and strategies, and foretell their impact on the affected society.
- Use programming to analyse and study models that describe social dynamics.
- Differentiate between group and collective dynamics in social models.

#### Transferable/Key Skills and other attributes:

On completion of this course students will be able to:

- Recognize different behavioural patterns and strategies, and foretell their impact on the affected society (or group of people).
- Prepare social models for different real systems in our societies.

**Metode poučevanja in učenja:**

Predavanja in projektno delo.

**Learning and teaching methods:**

Lectures and project work.

<b>Načini ocenjevanja:</b>	Delež (v %) / Weight (in %)	<b>Assessment:</b>
Način (pisni izpit, ustno izpraševanje, naloge, projekt):		Type (examination, oral, coursework, project):
Ustni izpit	<b>50%</b>	Oral exam
Opravljeno projektno delo	<b>50%</b>	Done project work
Za uspešno zaključeno učno enoto mora biti vsak del posebej pozitiven. Opravljeno projektno delo je pogoj za pristop k izpitu.		For a successfully finished course, both parts have to be positive. Done project work is a prerequisite to access the oral exam.

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

1. LI, Wen-Jing, CHEN, Zhi, WANG, Jun, JIANG, Luo-Luo, PERC, Matjaž (avtor, korespondenčni avtor). Social mobility and network reciprocity shape cooperation in collaborative networks. *Chaos, solitons and fractals*. [Print ed.]. May 2023, vol. 170, [article no.] 113378, str. 1-7, ilustr., graf. prikazi. DOI: [10.1016/j.chaos.2023.113378](https://doi.org/10.1016/j.chaos.2023.113378). [COBISS.SI-ID [147095043](#)]
2. DONG, Ziwei, MAO, Shuai, PERC, Matjaž, DU, Wei, TANG, Yang. A distributed dynamic event-triggered algorithm with linear convergence rate for the economic dispatch problem. *IEEE transactions on network science and engineering*. 2023, vol. 10, no. 1, str. 500-513. ISSN 2327-4697. DOI: [10.1109/TNSE.2022.3216572](https://doi.org/10.1109/TNSE.2022.3216572). [COBISS.SI-ID [137300227](#)]
3. IZGI, Burhaneddin, ÖZKAYA, Murat, ÜRE, Nazım Kemal, PERC, Matjaž. Machine learning driven extended matrix norm method for the solution of large-scale zero-sum matrix games. *Journal of computational science*. Apr. 2023, vol. 68, [article no.] 101997, str. 1-7, tabele, graf. prikazi. ISSN 1877-7503. DOI: [10.1016/j.jocs.2023.101997](https://doi.org/10.1016/j.jocs.2023.101997). [COBISS.SI-ID [147417347](#)]
4. CHOWDHURY, Sayantan Nag, BANERJEE, Jeet, PERC, Matjaž, GHOSH, Dibakar. Eco-evolutionary cyclic dominance among predators, prey, and parasites. *Journal of theoretical biology*. 2023, vol. 564, [article no.] 111446, 9 str. ISSN 0022-5193. DOI: [10.1016/j.jtbi.2023.111446](https://doi.org/10.1016/j.jtbi.2023.111446). [COBISS.SI-ID [144694787](#)]
5. HU, Kaipeng, WANG, Pengyue, HE, Junzhou, PERC, Matjaž, SHI, Lei. Complex evolutionary interactions in multiple populations. *Physical review. E*. Apr. 2023, vol. 107, iss. 4, [article no.] 044301, 9 str. ISSN 2470-0045. DOI: [10.1103/PhysRevE.107.044301](https://doi.org/10.1103/PhysRevE.107.044301). [COBISS.SI-ID [149424387](#)]