UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	Teorija iger
Course title:	Game Theory

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Fizika 2. st.		1,2	**2,3**
Physics 2nd degree		1,2	**2,3**

Vrsta predmeta / Course type	izbirni/ optional
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
30	0	0	30	0	90	**5**

Nosilec predmeta / Lecturer:	Stefan Schuster, Marko MarhlL

Jeziki / Languages:	**Predavanja / Lectures:**	slovenski/Slovenian in/and angleški/English
	Vaje / Tutorial:	slovenski/Slovenian in/and angleški/English

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

Vsebina:	**Content (Syllabus outline):**
1. Igre z in brez strategije kooperacije. **2.** »Payoff« matrike pri dveh igralcih. **3.** Primeri iger: npr. boj med spoloma, dilema zapornika, igra sokola in goloba. **4.** Posplošitev na igre z več igralci, igre v prostoru. **5.** Tragedija in propad družbe. **6.** Aplikacije teorije iger v biologiji, npr. igra sokola in goloba v populacijskih sistemih, dilema zapornika v metaboličnih sistemih. **7.** Aplikacije teorije iger v ekonomiji. **8.** Evolucija kooperacije.	**1.** Cooperative and non-cooperative games. **2.** Payoff matrix for two players. **3.** Examples of games, e.g., prisoner's dilemma, hawk-dove game. **4.G**eneralization to n players and to spatial problems. **5.** Tragedy of the commons. **6.** Applications of the game theory in biology, e.g., hawk-dove game in population systems, prisoner's dilemma in metabolic systems. **7.** Applications of the game theory in the economy. **8.** Evolution of the cooperativity.

Temeljni literatura in viri / Readings:

1. Hofbauer, J. and Sigmund, K. (1998). Evolutionary Games and Population Dynamics. Cambridge University Press, Cambridge.
2. Axelrod, R. (1984) The Evolution of Cooperation. Basic Books, New York.
3. Pfeiffer, T. and Schuster, S. (2005) Game-theoretical approaches to studying the evolution of biochemical systems. Trends Biochem. Sci. 30, 20-25.
4. Hauert, C. and Szabo, G. (2005) Game theory and physics. Am. J. Phys. 73, 405-414.
5. Drugi strokovni in znanstveni članki v revijah / Articles published in professional and scientific journals.

Cilji in kompetence: **Objectives and competences:**

• Razvijati sposobnosti za kvalitativno in kvantitativno analizo kompleksnih sistemov. • Predstaviti zvezo med strukturo, dinamiko in evolucijo kompleksnih sistemov. • Poudariti pomen evolucijskih mehanizmov za razvoj dinamike in strukture sistemov. • Uporaba računalniških programov za simulacijo iger.	• Developing skills for qualitative and quantitative analysis of complex systems. • Presenting interconnections between the structure, dynamics and the evolution of complex systems. • Pointing out the importance of evolutionary mechanisms for developing the system's dynamics and its structure. • Using computer programs for game simulations.

Predvideni študijski rezultati:	**Intended learning outcomes:**
Znanje in razumevanje: • Poznati metode za kvalitativno in kvantitativno analizo kompleksnih sistemov. • Predstaviti zvezo med strukturo, dinamiko in evolucijo kompleksnih sistemov. • Poudariti pomen evolucijskih mehanizmov za razvoj dinamike in strukture sistemov. • Uporaba računalniških programov za implementacijo iger. Prenesljive/ključne spretnosti in drugi atributi: • Metode kvantitativne analize kompleksnih sistemov so univerzalne in jih je mogoče uporabiti na najrazličnejših področjih. • Poudarek je na prenosu znanja s primerov iz fizike na področja biologije, ekonomije, …	Knowledge and Understanding: • Be able to use methods for qualitative and quantitative analysis of complex systems. • Be able to realize interconnections between the structure, dynamics and the evolution of complex systems. • Know the importance of evolutionary mechanisms for developing the system's dynamics and its structure. • Using computer programs for the implementation of games. Transferable/Key Skills and other attributes: • Methods for quantitative analysis of complex system are universal and can be implemented in different fields of research. • In particular, a knowledge transfer from examples in physics to examples in biology, economics, etc. is emphasised.

Metode poučevanja in učenja:	**Learning and teaching methods:**
• Predavanja • Teoretične vaje • Vaje na računalniku • Eksperimentalne vaje	• Lectures • Theoretical exercises • Computer exercises • Experiments

Načini ocenjevanja:	Delež (v %) / Weight (in %)	**Assessment:**
• ustno • pisno • praktično - seminar	40 40 20	• oral • written • practical - seminar

Reference nosilca / Lecturer's references:

Marko Marhl:

BODENSTEIN, Christian, KNOKE, Beate, MARHL, Marko, PERC, Matjaž, SCHUSTER, Stefan. Using Jensen's inequality to explain the role of regular calcium oscillations in protein activation. *Physical biology*, 2010, vol. 7, no. 3, str. 036009-1-036009-12, doi: 10.1088/1478-3975/7/3/036009. [COBISS.SI-ID 14376470]

GOSAK, Marko, KOROŠAK, Dean, MARHL, Marko. Optimal network configuration for maximal coherence resonance in excitable systems. *Phys. rev., E Stat. nonlinear soft matter phys. (Print)*, 2010, vol. 81, iss. 5, str. 056104-1-056104-7, ilustr., doi: 10.1103/PhysRevE.81.056104. [COBISS.SI-ID 17626120]

KNOKE, Beate, BODENSTEIN, Christian, MARHL, Marko, PERC, Matjaž, SCHUSTER, Stefan. Jensen's inequality as a tool for explaining the effect of oscillations on the average cytosolic calcium

concentration.*Theory biosci.*, Jun. 2010, vol. 129, no. 1, str. 25-38, doi: 10.1007/s12064-010-0080-1. [COBISS.SI-ID 14376726]

GOSAK, Marko, KOROŠAK, Dean, MARHL, Marko. Topologically determined optimal stochastic resonance responses of spatially embedded networks. *New journal of physics*. [Online ed.], Jan. 2011, vol. 13, issue 1, str. 013012-1-013012-15, ilustr. http://dx.doi.org/10.1088/1367-2630/13/1/013012. [COBISS.SI-ID 18087432]

GOSAK, Marko, MARKOVIČ, Rene, MARHL, Marko. The role of neural architecture and the speed of signal propagation in the process of synchronization of bursting neurons. *Physica, A*. [Print ed.], 2012, vol. 391, no. 8, str. 2764-2770, ilustr., doi: 10.1016/j.physa.2011.12.027. [COBISS.SI-ID 18948872]

Stefan Schuster:

D. Deutscher, I. Meilijson, S. Schuster, E. Ruppin: Can single knockouts accurately single out gene functions? BMC Systems Biology 2008, 2, 50, http://www.biomedcentral.com/1752-0509/2/50

S. Schuster, T. Pfeiffer and D.A. Fell: Is maximization of molar yield in metabolic networks *a* universal principle? J. theor. Biol. 2008, **252 (3)**, 497–504

S. Schuster , A. von Kamp, M. Pachkov: Understanding the roadmap of metabolism by pathway analysis. In*: Metabolomics, Methods and Protocols (W. Weckwerth, ed.) Humana Press, Totowa (NJ), 2007,* 199-226.

A. von Kamp, S. Schuster: Metatool 5.0: fast and flexible elementary modes analysis. Bioinformatics 2005, **22 (15)**,1930-1931.

J. Stelling, S. Klamt , K. Bettenbrock, S. Schuster, E.D. Gilles: Metabolic network structure determines key aspects of functionality and regulation. Nature 2002, **420 (6912)**, 190-193.