

## UČNI NAČRT PREDMETA / COURSE SYLLABUS

<b>Predmet:</b>	Modelska fizika
<b>Course title:</b>	Physics Modelling

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Fizika 2. st.		1	1
Physics 2 <sup>nd</sup> degree		1	1

**Vrsta predmeta / Course type** obvezni/compulsory

**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	30	30	0	210	<b>10</b>

**Nosilec predmeta / Lecturer:** Aleksander Zidanšek

**Jeziki / Languages:**

<b>Predavanja / Lectures:</b>	slovenski/Slovenian in/and angleški/English
<b>Vaje / Tutorial:</b>	slovenski/Slovenian in/and angleški/English

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

Osnovno znanje klasične fizike, programiranja in matematične fizike

**Prerequisites:**

Basic knowledge of classical physics, programming and mathematical physics

**Vsebina:**

- **Univerzalni numerični modelni sistemi**
- **Grafični prikaz podatkov:** obdelava s programskimi orodji
- **Naključni sprehajalec:** pokrajinsko in koračno pravilo, evolucijski modeli, aplikacije v živi in neživi naravi
- **Celični avtomati:** modeliranje samo-organizirano kritičnih pojavov
- **Nelinearni sistemi:** kaos, fraktali, karakterizacija
- **Univerzalni fenomenološki modeli:** opis modela, ravnovesni pogoji in enačbe, izračun merljivih odzivnih funkcij, kritično obnašanje
- **Metode Monte Carlo:** simulacija pojava, analiza podatkov
- **Metode molekularne dinamike:** simulacija pojava, analiza podatkov
- **Fazni prehodi:** analiza kritičnega obnašanja za izbran primer s programskim orodjem
- **Genetski algoritmi:** evolucijsko programiranje
- **Nevronske mreže:** učna pravila

**Content (Syllabus outline):**

- **Universal numerical model systems**
- **Graphical presentation of data:** software tools
- **Random walk:** landscape and step rule, evolution models, applications in nature
- **Cellular automata:** modeling of self-organized critical behavior
- **Non-linear systems:** chaos, fractals, characterization
- **Universal phenomenological models:** description of the model, equilibrium conditions and equations, evaluation of measurable response functions, critical behavior
- **Monte Carlo methods:** simulations and data analysis
- **Molecular dynamics:** simulations and data analysis
- **Phase transitions:** analysis of critical behavior for a given case using a software tool
- **Genetic algorithms:** evolution programming
- **Neural networks:** learning rules

## Temeljni literatura in viri / Readings:

1. F. J. Vesely, Computational Physics: An Introduction, Springer, 2001.
2. P. Bak, How Nature Works: The Science of Self-Organized Criticality, Springer, 1996.
3. T. Vicsek, Fractal Growth Phenomena, World Scientific, Singapore, 1992.
4. D. E. Goldman, Genetic Algorithms in Search, Optimization, and Machine Learning, Addison-Wesley, 1989.
5. T. Khanna, Foundations of Neural Networks, Addison-Wesley, 1990.
6. Novejši članki v Physical Review Letters, Nature, Science in drugih sorodnih revijah./ Recent articles in Physical Review Letters, Nature, Science and similar journals.

### Cilji in kompetence:

- Študentje pridobijo osnovna teoretična in praktična znanja s področja modelov v fiziki.
- Pri laboratorijskih vajah samostojno pripravijo projekt in izračun enega modela.
- Seminarsko delo je namenjeno pripravi teoretične osnove enega modela

### Objectives and competences:

- Students get basic theoretical and practical knowledge from the models in Physics
- Student prepares one model in the scope of the laboratory work
- Seminar work is designed for preparing theoretical summary of one model.

### Predvideni študijski rezultati:

Znanje in razumevanje:

- Opisati in razumeti različne pojave v naravi

Prenesljive/ključne spretnosti in drugi atributi:

- Delo z modeli je prenosljivo na druga, ne-fizikalna področja, recimo ekonomijo.

### Intended learning outcomes:

Knowledge and Understanding:

- interpretation and understanding various phenomena in the nature

Transferable/Key Skills and other attributes:

- Work with the models is transferable to non-physical fields, for example to economy

### Metode poučevanja in učenja:

Predavanja  
Seminarske vaje  
Laboratorijske vaje

### Learning and teaching methods:

Lectures  
Seminar work  
Laboratory work

Načini ocenjevanja:	Delež (v %) / Weight (in %)	Assessment:
pisni in ustni izpit	70	written and oral exam
opravljene lab. vaje in dnevnik lab. vaj	30	done lab work and logbook of laboratory work

### Reference nosilca / Lecturer's references:

KRALJ, Samo, CORDOYIANNIS, George, JESENEK, Dalija, ZIDANŠEK, Aleksander, LAHAJNAR, Gojmir, NOVAK, Nikola, AMENITSCH, Heinz, KUTNJAK, Zdravko. Dimensional crossover and scaling behavior of a smectic liquid crystal confined to controlled-pore glass matrices. Soft matter, 2012, vol. 8, issue 8, str. 2460-2470, doi: 10.1039/C1SM06884A. [COBISS.SI-ID 25534759]

ZIDANŠEK, Aleksander, AMBROŽIČ, Milan, MILFELNER, Maja, BLINC, Robert, LIOR, Noam. Solar orbital power : sustainability analysis. Energy (Oxford). [Print ed.], 2011, vol. 36, no. 4, str. 1986-1995. [COBISS.SI-ID 24602919]

CORDOYIANNIS, George, ZIDANŠEK, Aleksander, LAHAJNAR, Gojmir, KUTNJAK, Zdravko, AMENITSCH, Heinz, NOUNESIS, George, KRALJ, Samo. Influence of confinement in controlled-pore glass on the layer spacing of smectic-A liquid crystals. Phys. rev., E Stat. nonlinear soft matter phys. (Print), 2009, vol. 79, no. 5, str. 051703-1-051703-7. [COBISS.SI-ID 22602791]

KRALJ, Samo, CORDOYIANNIS, George, ZIDANŠEK, Aleksander, LAHAJNAR, Gojmir, AMENITSCH, Heinz, ŽUMER, Slobodan, KUTNJAK, Zdravko. Presmectic wetting and supercritical-like phase behavior of octylcyanobiphenyl liquid crystal confined to controlled-pore glass matrices. J. chem. phys., 2007, vol. 127,

no. 15, str. 154905-1-154905-9. [COBISS.SI-ID 21141287]

BLINC, Robert, SELIGER, Janez, ZIDANŠEK, Aleksander, ŽAGAR, Veselko, MILIA, Fani, ROBERT, Hector. [<sup>14</sup>N nuclear quadrupole resonance of some sulfa drugs. Solid state nucl. magn. reson.. [Print ed.], 2006, vol. 30, str. 61-68. [COBISS.SI-ID 20015655]