UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	Modelska fizika
Course title:	Modelling Physics

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Fizika 2. st.		1	**1**
Physics 2nd 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	**10**

Nosilec predmeta / Lecturer:	Aleksander Zidanšek

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:**
Ni zahtev. Priporočeno znanje iz osnov klasične fizike, programiranja in matematične fizike.	None. Recommended basic knowledge of classical physics, programming and mathematical physics.

Vsebina:	**Content (Syllabus outline):**
- **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 - **Evolucijsko programiranje:** genetski algoritmi - **Nevronske mreže:** učna pravila, globoko	- **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 - **Evolution programming:** genetic algorithms - **Neural networks:** learning rules, deep learning, convolutional neural networks

učenje, konvolucijske nevronske mreže - **Kvantni računalniki:** Shorov algoritem, Groverjev algoritem, BB84, Hadamardova vrata	- **Quantum computers:** Shor algorithm, Grover's algorithm, BB84, Hadamard gate

Temeljni literatura in viri / Readings:

1. F. J. Vesely, Computational Physics: An Introduction, Springer, 2012.
2. P. Bak, How Nature Works: The Science of Self-Organized Criticality, Springer, 1996.
3. M. Mitchell, An Introduction to Genetic Algorithms, The MIT Press, 1998.
4. Ian Goodfellow, Yoshua Bengio and Aaron Courville, Deep Learning, The MIT Press, 2016.
5. C. P. Williams, Explorations in Quantum Computing, Springer, 2010.
6. C. Bernhardt, Quantum Computing for Everyone, The MIT Press, 2019.
7. 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:	**Objectives and competences:**
• Študentje pridobijo 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 razlage modela	• Students get 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 justification of the model.

Predvideni študijski rezultati:	**Intended learning outcomes:**
Znanje in razumevanje: • Razume in uporabi različne fizikalne modele. • Ustvari kompleksne fizikalne modele. • Analizira fizikalne modele, jih reši in ovrednoti dobljene rezultate. Prenesljive/ključne spretnosti in drugi atributi: • Delo z modeli je prenosljivo na druga, ne-fizikalna področja, npr. ekonomijo.	Knowledge and Understanding: • The student understands and applies various physical models. • The student creates complex physical models. • The student analyses physical models, solves them and evaluates the obtained results. Transferable/Key Skills and other attributes: • Work with the models is transferable to non-physical fields, for example to economy.

Metode poučevanja in učenja:	**Learning and teaching methods:**
Razlaga, razgovor, študij primerov, problemsko učenje, laboratorijsko delo z računalniki.	Lecture, discussion, case studies, problem based learning, laboratory work with computers.

Načini ocenjevanja:	Delež (v %) / Weight (in %)	**Assessment:**
opravljene laboratorijske vaje z dnevnikom laboratorijskih vaj	**35**	completed lab work with a logbook of laboratory work
seminarska naloga	**35**	seminar work
ustni izpit	**30**	oral exam

Reference nosilca / Lecturer's references:

- ABINA, Andreja, PUC, Uroš, JEGLIČ, Anton, ZIDANŠEK, Aleksander. Structural characterization of thermal building insulation materials using terahertz spectroscopy and terahertz pulsed imaging. NDT & E International, ISSN 0963-8695. [Print ed.], 2016, vol. 77, str. 11-18, doi: 10.1016/j.ndteint.2015.09.004. [COBISS.SI-ID 28983847]
- PUC, Uroš, ABINA, Andreja, SLUBAN, Melita, ZIDANŠEK, Aleksander, JEGLIČ, Anton, VALUŠIS, Gintaras. Terahertz spectroscopic identification of explosive and drug simulants concealed by various hiding techniques. Applied optics, ISSN 1559-128X. Tiskana izd., 2015, vol. 54, no. 14, str. 4495-4502, doi: 10.1364/AO.54.004495. [COBISS.SI-ID 28541735]
- PUC, Uroš, ABINA, Andreja, JEGLIČ, Anton, ZIDANŠEK, Aleksander, KAŠALYNAS, Irmantas, VENCKEVIČIUS, Rimvydas, VALUŠIS, Gintaras. Spectroscopic analysis of melatonin in the terahertz frequency range. *Sensors*, ISSN 1424-8220, 2018, vol. 18, no. 12, str. 4098-1-4098-12, doi: 10.3390/s18124098. [COBISS.SI-ID 31962407]
- VASUDEVAN, Aswathy, SHVALYA, Vasyl, ZIDANŠEK, Aleksander, CVELBAR, Uroš. Tailoring electrical conductivity of two dimensional nanomaterials using plasma for edge electronics : a mini review. *Frontiers of Chemical Science and Engineering*. 13 (3): 427-443, 2019, 17 str. ISSN 2095-0179. DOI: 10.1007/s11705-019-1805-4. [COBISS.SI-ID 32306471]
- JAZBINŠEK, Mojca, PUC, Uroš, ABINA, Andreja, ZIDANŠEK, Aleksander. Organic crystals for THz photonics. *Applied sciences*, ISSN 2076-3417, 2019, vol. 9, no. 5, str. 882-1-882-45, doi: 10.3390/app9050882. [COBISS.SI-ID 32214055]