Univerza v Mariboru

Fakulteta za naravoslovje in matematiko

UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	**Nelinearna dinamika**
Course title:	**Nonlinear dynamics**

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 modula Biofizika 3 in Fizika 1, 2, 3

Univerzitetna koda predmeta / University course code:

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Lab. vaje Laboratory work	Mentorstvo Mentorship	Samost. delo Individ. work	ECTS
7	**3**				**290**	**10**

Nosilec predmeta / Lecturer: **Marko Robnik**

Jeziki / Languages:	**Predavanja / Lectures:**	slovenski/Slovenian
	Vaje / Tutorial:	

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

Ni posebnih zahtev.

Prerequisits:

No special prerequisites.

Vsebina:

Content (Syllabus outline):

Uvod v dinamiko:
- Avtonomni dinamični sistemi prvega reda
- Linearne transformacije ravnine
- Avtonomni dinamični sistemi drugega reda
- Konservativni hamiltonski sistemi z eno prostostno stopnjo
- Lagrangiani
- Teorije transformacij
- Kotne in akcijske spremenljivke
- Teorije motenj
- Adiabatični in hitri oscilirajoči pogoji
- Linearni sistemi
- Kaotično gibanje in nelinearne preslikave

Uvod v nelinearno dinamiko:
- Uvod in pregled
- Enodimenzionalne preslikave
- Čudni atraktorji (strange attractors) in fraktalna dimenzija
- Dinamične lastnosti kaotičnih sistemov
- Kaotične množice, ki niso atraktorji
- Kvaziperiodičnost
- Kaos v hamiltonskih sistemih
- Kaotični prehodi
- Multifraktali
- Kvantni kaos

Introduction to dynamics:
- Autonomous dynamical systems of first order
- Linear transformations in the plane
- Autonomous dynamical systems of second order
- Conservative Hamiltonian systems with one degree of freedom
- Langragians
- Theory of transformations
- Angle and action variables
- Perturbation theory
- Adiabatic and fast oscillations conditions
- Linear systems
- Chaotic motion and nonlinear mapping

Introduction to nonlinear dynamics:
- Introduction and overview
- Onedimensional mappings
- Strange attractors and fractla dimension
- Dynamical properties of chaotic systems
- Chaotic sets, which are not strange atractors
- Quasiperidodicity
- Chaos in Hamiltonian systems
- Chaotic transitions
- Multifractals
- Quantum chaos

Temeljni literatura in viri / Readings:

1) I. Percival and D. Richards, Introduction to Dynamics, Cambridge University Press, 1982.
2) E. Ott, Chaos in Dynamical Systems, Cambridge University Press, 1993.
3) A.J. Lichenberg and M.A. Lieberman, Regular and Stohastic Motion, Springer, 1983.

Cilji in kompetence:

- Razumeti osnove nelinearne dinamike
- Pridobiti osnovne izkušnje pri uporabi metod nelinearne dinamike
- Rešiti nekaj osnovnih problemov s področja nelinearne dinamike v okviru seminarske naloge

Objectives and competences:

- Understanding the fundamentals of nonlinear dynamics
- Gaining the basic experience in applying the methods of nonlinear dyanamics
- Solving some fundamental problems in the field of nonlinear dynamics as a seminar report

Predvideni študijski rezultati:

Intended learning outcomes:

Znanje in razumevanje:	Knowledge and understanding:
• Znanje osnov nelinearne dinamike • Poglobljeno razumevanje principov nelinearne dinamike	• Knowledge of the fundamentals of nolinear dynamics • Understanding the principles of nonlienar dynamics
Prenesljive/ključne spretnosti in drugi atributi:	Transferable/Key Skills and other attributes:
• Sposobnost uporabe metod nelinearne dinamike • Uporaba metod na drugih aplikativnih področjih • Samostojno razvijanje fizikalnega znanja	• Capability of applying the methods of nonlinear dynamics • Application of methods in other applied fields • Development of knew knowledge

Metode poučevanja in učenja:	**Learning and teaching methods:**
Predavanja, seminar	Lectures, seminar

Načini ocenjevanja:	Delež (v %) / Weight (in %)	**Assessment:**
Način (pisni izpit, ustno izpraševanje, naloge, projekt)		Type (examination, oral, coursework, project):
• Ustni izpit • Pisni izpit	**50%** **50%**	• Oral exam • Written exam

Reference nosilca / Lecturer's references:

1. ANDRESAS, Dimitris, ROBNIK, Marko. Statistical properties of the energy in time-dependent homogeneous power law potentials. *Journal of physics. A, Mathematical and theoretical*, ISSN 1751-8113, 2014, vol. 47, issue 35, str. 355102-1 - 355102-10, doi: 10.1088/1751-8113/47/35/355102. [COBISS.SI-ID 79388417]

2. GRUBELNIK, Vladimir, LOGAR, Marjan, ROBNIK, Marko. Quantum Fermi acceleration in the resonant gaps of a periodically driven one-dimensional potential box. *Journal of physics. A, Mathematical and theoretical*, ISSN 1751-8113, 2014, vol. 47, no. 35, str. 355103-1 - 355103-17, doi: 10.1088/1751-8113/47/35/355103. [COBISS.SI-ID 18017814]

3. MANOS, Thanos, ROBNIK, Marko. Survey on the role of accelerator modes for anomalous diffusion : the case of the standard map. *Physical review. E, Statistical, nonlinear and soft matter physics*, ISSN 1550-2376. [Online ed.], 2014, vol. 89, iss. 2, str. 022905-1 - 022905-12, graf. prikazi, doi: 10.1103/PhysRevE.89.022905. [COBISS.SI-ID 77280257]

4. BATISTIĆ, Benjamin, MANOS, Thanos, ROBNIK, Marko. The intermediate level statistics in dynamically localized chaotic eigenstates. *Europhysics letters*, ISSN 0295-5075, 2013, vol. 102, no. 5, str. 50008-1-50008-6. http://iopscience.iop.org/0295-5075/102/5/50008/pdf/0295-5075_102_5_50008.pdf, doi: 10.1209/0295-5075/102/50008. [COBISS.SI-ID 74806017]

5. MANOS, Thanos, ROBNIK, Marko. Dynamical localization in chaotic systems: spectral statistics and localization measure in the kicked rotator as a paradigm for time-dependent and time-independent systems.

Physical review. E, Statistical, nonlinear and soft matter physics, ISSN 1550-2376. [Online ed.], 2013, vol. 87, iss. 6, str. 062905-1 - 062905-17, graf. prikazi. http://pre.aps.org/pdf/PRE/v87/i6/e062905, doi: 10.1103/PhysRevE.87.062905. [COBISS.SI-ID 74771713]