UČNI NAČRT PREDMETA / COURSE SYLLABUS

Predmet:	**Izbrana poglavja iz diferencialnih enačb**
Course title:	**Differential equations – selected topics**

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
FIZIKA, 3. stopnja		1. ali 2.	**1., 2. ali 4.**
PHYSICS, 3rd cycle		1. or 2.	**1., 2. or 4.**

Vrsta predmeta / Course type Izbirni za vse module

Univerzitetna koda predmeta / University course code:

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Lab. vaje Laboratory work	Mentorstvo Mentorship	Samost. delo Individ. work	ECTS
15					165	6

Nosilec predmeta / Lecturer: **Valerij Romanovskij**

Jeziki / **Languages:**	**Predavanja /** **Lectures:**	slovenski/Slovenian in/and angleški s slovenskim prevodom/English with translation in Slovenian
	Vaje / Tutorial:	/

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

Ni posebnih zahtev.

Prerequisits:

No special prerequisites.

Vsebina:

Navadne diferencialne enačbe:

• diferencialne enačbe 1. reda

• diferencialne enačbe 2. reda

• približne rešitve linearnih diferencialnih enačb

• približne rešitve nelinearnih diferencialnih enačb

Content (Syllabus outline):

Ordinary differential equations:

- first order ODE

- second order ODE

- approximate solutions of linear differential equations

- approximate solutions of nonlinear differential equations

• reguarna in singularna perturbacijska teorija	- regular and singular perturbation theory
• perturbacijske metode za probleme lastnih vrednosti	- perturbations methods for the eigenvalues problem
• aproksimacije WKB	- WKB approximations
• problem dveh zavojnih točk	- the two turn points problem
Metode bifurkacijske teorije:	Some methods of the theory of Bifurcations:
• tokovi in invariantni subprostori	• flows and invariant subspaces
• linearne in nelinearne preslikave	• linear and nonlinear maps
• normalne forme diferencialnih enačb in	• normal forms of differential equations and maps
• preslikav	
• bifurkacije ravnovesne lege	• bifurcations of singular points
• bifurkacije periodičnih orbit	• bifurcations of periodic orbits
• • uvod v kaos	• an introduction to chaos

Temeljni literatura in viri / Readings:

1) D.K. Arowsmith, C.M. Place, Dynamical systems. Diferential equations, maps an chaotic behaviour, Chapman and Hall Mathematics Series, Chapman & Hall, London 1992.

2) C. M. Bender, S. A. Orszag, Advanced mathematical methods for scientists and engineers, International series in pure and applied mathematics, McGraw-Hill Book Co., New York 1978.

3) S. N. Chow, J. K. Hale, Methods of bifurcation theory, Grundlehren der Mathematischen wissenschaften, 251. Springer-Verlag, New York – Berlin 1982.

4) J. Guckenheimer, P. Holmes, Nonlinear oscillations, dynamical systems and bifurcations of vector fields, Applied Mathematical sciences, 42, Springer-Verlag, New York 1983.

5) Yu. A. Kuznetsov, Elements of Applied Bifurcation Theory, Springer, 2004.

6) L. Barreira, C. Valls, Dynamical Systems, Universitext, Springer, 2014.

Cilji in kompetence:

- Razumevanje osnovnih načinov kvalitativne in bifurkacijske analize diferencialnih enačb
- Poznavanje metod študija lastnosti rešitev diferencialnih enačb in gladkih preslikav
- Pridobiti si sposobnost detajlne analize določenih matematičnih modelov opisanih z navadnimi diferencialnimi enačbami ali gladkimi preslikavami

Objectives and competences:

- Understanding of main approaches to the qualitative and bifurcational analysis of differential equations
- Gaining knowlege of methods of studying the properties of solutions of differential equations and smooth maps
- Gaining skills of detail analysis of certain mathematical model described by ordinary differential equations or smooth maps

Predvideni študijski rezultati:	Intended learning outcomes:
Znanje in razumevanje: • Razumevanje metod kvalitativne in bifurkacijske analize dinamičnih sistemov • Pridobivanje sposobnosti sistematskega študija rešitev dinamičnih sistemov in njihovih lastnosti Prenesljive/ključne spretnosti in drugi atributi: • Uporaba znanja za študij matematičnih modelov različnih procesov in pojavov v fizikalni, tehnični in drugih uporabnih znanostih • Sposobnost razumevanja in analiziranja dinamičnih procesov opisanih z diferencialnimi enačbami in gladkimi preslikavami	Knowledge and understanding: • Understanding of methods of qualitative and bifurcational analysis of dynamical systems • Gaining some systematical approaches to studying of solutions of dynamical systems and their properties Transferable/Key Skills and other attributes: • The use of knowledge for studying of mathematical models of various processes and phenomena arising in physical, technical and other applied sciences • The ability to understand and analyse the dynamics of processes described by differential equations and smooth maps

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) • Ustni izpit • Pisni izpit	 50% 50%	Type (examination, oral, coursework, project): • Oral exam • Written exam

Reference nosilca / Lecturer's references:

1. ROMANOVSKI, Valery, FERNANDES, Wilker, OLIVEIRA, Regilene. Bi-center problem for some classes of [Z] [sub] 2-equivariant systems. *Journal of Computational and Applied Mathematics*, ISSN 0377-0427. [Print ed.], 2017, vol. 320, str. 61-75, doi: 10.1016/j.cam.2017.02.003. [COBISS.SI-ID 23085576]

2. FERNANDES, Wilker, ROMANOVSKI, Valery, SULTANOVA, Marzhan, TANG, Yilei. Isochronicity and linearizability of a planar cubic system. *Journal of mathematical analysis and applications*, ISSN 0022-247X. [Print ed.], 2017, vol. 450, iss. 1, str. 795-813, doi: 10.1016/j.jmaa.2017.01.058. [COBISS.SI-ID 22987784]

3. ROMANOVSKI, Valery, SHAFER, Douglas. Complete integrability and time-reversibility of some 3-dim systems. *Applied Mathematics Letters*, ISSN 0893-9659. [Print ed.], January 2016, vol. 51, str. 27-33, doi: 10.1016/j.aml.2015.07.006. [COBISS.SI-ID 21562120]

4. SHENG, Lijuan, HAN, Maoan, ROMANOVSKI, Valery. On the number of limit cycles by perturbing a piecewise smooth Liénard model. *International journal of bifurcation and chaos in applied sciences and engineering*, ISSN 0218-1274, 2016, vol. 26, no. 10, str. 1650168-1-1650168-16, doi: 10.1142/S0218127416501686. [COBISS.SI-ID 23084040]

5. DU, Zengji, ROMANOVSKI, Valery, ZHANG, Xiang. Varieties and analytic normalizations of partially integrable systems. *Journal of differential equations*, ISSN 0022-0396, 2016, vol. 260, iss. 9, str. 6855-6871, doi: 10.1016/j.jde.2016.01.009. [COBISS.SI-ID 22043144]

6. FERČEC, Brigita, GINÉ, Jaume, ROMANOVSKI, Valery, EDNERAL, Victor F. Integrability of complex planar systems withhomogeneous nonlinearities. *Journal of mathematical analysis and applications*, ISSN 1096-0813. [Online ed.], feb. 2016, vol. 434, issue 1, str. 894-914, doi: 10.1016/j.jmaa.2015.09.037. [COBISS.SI-ID 84566529]