



Univerza v Mariboru

Fakulteta za naravoslovje
in matematiko

UČNI NAČRT PREDMETA / COURSE SYLLABUS

Predmet:	Izbrana poglavja iz diferencialnih enačb
Course title:	Advanced topics in differential equations

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Matematika, 3. stopnja		1. ali 2.	1. ali 4.
Mathematics, 3 rd Degree		1 st or 2 nd	1 st or 4 th

Vrsta predmeta / Course type

Univerzitetna koda predmeta / University course code:

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje work	Druge oblike študija	Samost. delo Individ. work	ECTS
30					120	5

Nosilec predmeta / Lecturer:

Jeziki / Languages:	Predavanja / Lectures:	<input type="text" value="Slovenski / Slovene"/>
	Vaje / Tutorial:	<input type="text" value="Slovenski / Slovene"/>

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

Znanje osnovnih pojmov in rezultatov iz teorije NDE

Prerequisites:

Basic knowledge of fundamental notions and results of the theory of ODE's

Vsebina:

Content (Syllabus outline):

Izbrana so posebna poglavja iz teorije dinamičnih sistemov, funkcij Ljapunova, normalnih form, Poincarejevega problema centra, invariant diferencialnih enačb, izohronosti nihanj, bifurkacij limitnih ciklov ali katerega drugega modernega področja teoriji dinamičnih sistemov. Izbira poglavij je odvisna od interesa in raziskovalne usmerjenosti študentov. Spodaj navedena literatura praviloma služi le kot osnova in je nadgrajena z bolj specializiranimi teksti.

Special topics in dynamical systems, Lyapunov functions, normal forms, Poincare center problem, invariants of differential equations, isochronicity of oscillations, limit cycles bifurcations or some other area of contemporary theory of dynamical systems are chosen. The choice depends on students' interests and their research orientation. The literature below in principle serves only as a basis, and is combined with more specialized texts.

Temeljni literatura in viri / Readings:

- D.K. Arowsmith, C.M. Place, Dynamical systems. Differential equations, maps and chaotic behaviour, Chapman and Hall Mathematics Series, Chapman & Hall, London 1992.
- S. N. Chow, J. K. Hale, Methods of bifurcation theory, Grundlehren der Mathematischen Wissenschaften, 251. Springer-Verlag, New York – Berlin 1982.
- J. Guckenheimer, P. Holmes, Nonlinear oscillations, dynamical systems and bifurcations of vector fields, Applied Mathematical sciences, 42, Springer-Verlag, New York 1983.
- J. A. Murdock, Normal forms and unfoldings for local dynamical systems, Springer, New York, 2003
- V. G. Romanovski, D.S. Shafer, The Center and Cyclicity Problems A Computational Algebra Approach. Birkhäuser, Boston, 2009

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
- Zmožnost razvijanja kritične refleksije na področju diferencialnih enačb

Objectives and competences:

- Understanding main approaches to the qualitative and bifurcational analysis of differential equations
- Gaining knowledge 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
- Ability to develop critical reflection in differential equations

Predvideni študijski rezultati:

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:

- podlaga za raziskovalno delo na področju dinamičnih sistemov

Intended learning outcomes:

Knowledge and understanding:

- Understanding of methods of qualitative and bifurcational analysis of dynamical systems
- Gaining some systematic approaches to studying of solutions of dynamical systems and their properties

Transferable/Key Skills and other attributes:

- a basis for research in the theory of dynamical systems

Metode poučevanja in učenja:

Learning and teaching methods:

- predavanja;
- priprava seminarja;
- konzultacije;
- samostojni študij.

- lectures;
- seminar work;
- consultations;
- self-study.

Delež (v %) /

Načini ocenjevanja:

Weight (in %) **Assessment:**

Način (pisni izpit, ustno izpraševanje, naloge, projekt):	Weight (in %)	Type (examination, oral, coursework, project):
<ul style="list-style-type: none"> • seminarsko predavanje; • pisni izpit; • ustno izpraševanje. 	<p>20%</p> <p>30%</p> <p>50%</p>	<ul style="list-style-type: none"> • seminar talk; • written work; • oral examination.

Reference nosilca / Lecturer's references:

1. ROMANOVSKI, Valery, SHAFER, Douglas. *The center and cyclicity problems : a computational algebra approach*. Basel: Birkhäuser, 2009. XV; 330 str. ISBN 978-0-8176-4726-1. [COBISS.SI-ID [62709761](#)]
2. ROMANOVSKI, Valery, XIA, Yong-Hui, ZHANG, Xiang. Varieties of local integrability of analytic differential systems and their applications. *Journal of differential equations*, ISSN 0022-0396, 2014, vol. 257, iss. 9, str. 3079-3101, doi: [10.1016/j.jde.2014.06.007](#). [COBISS.SI-ID [20828680](#)]
3. MAHDI, Adam, ROMANOVSKI, Valery, SHAFER, Douglas. Stability and periodic oscillations in the Moon-Rand systems. *Nonlinear analysis: real world applications*, ISSN 1468-1218, 2013, vol. 14, iss. 1, str. 294-313. <http://dx.doi.org/10.1016/j.nonrwa.2012.06.005>. [COBISS.SI-ID [19482120](#)]
4. GINÉ, Jaume, KADYRSIZOVA, Zhibek, LIU, Yirong, ROMANOVSKI, Valery. Linearizability conditions for Lotka-Volterra planar complex quartic systems having homogeneous nonlinearities. *Computers & Mathematics with Applications*, ISSN 0898-1221. [Print ed.], 2011, vol. 61, no. 4, str. 1190-1201 [COBISS.SI-ID [18187272](#)]
5. LEVANDOVSKYY, Viktor, ROMANOVSKI, Valery, SHAFER, Douglas. The cyclicity of a cubic system with nonradical Bautin ideal. *Journal of differential equations*, ISSN 0022-0396, 2009, vol. 246, iss. 3, str. 1274-1287. [COBISS.SI-ID [62112257](#)]