



Univerza v Mariboru

Fakulteta za naravoslovje  
in matematiko

### UČNI NAČRT PREDMETA / COURSE SYLLABUS

<b>Predmet:</b>	Izbrana poglavja iz diferencialnih enačb
<b>Course title:</b>	Selected Chapters from 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 3. ali 4.
Mathematics, 3 <sup>rd</sup> cycle		1 <sup>st</sup> or 2 <sup>nd</sup>	1 <sup>st</sup> or 3 <sup>rd</sup> or 4 <sup>th</sup>

**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					150	6

**Nosilec predmeta / Lecturer:**

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

**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:**

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.

**Content (Syllabus outline):**

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.
- X. Zhang, Integrability of Dynamical Systems: Algebra and Analysis. Springer, 2017.
- 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:**

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

**Learning and teaching methods:**

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

Delež (v %) /

**Načini ocenjevanja:**

Weight (in %)

**Assessment:**

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

**Reference nosilca / Lecturer's references:**

- ARCET, Barbara, ROMANOVSKI, Valery. Integrability and linearizability of symmetric three-dimensional quadratic systems. *Discrete and continuous dynamical systems. Series S*. April 2022, 18 str. ISSN 1937-1632. DOI: [10.3934/dcds.2022104](https://doi.org/10.3934/dcds.2022104). [COBISS.SI-ID [130109955](https://www.cobiss.si/record/130109955)], [JCR, SNIP, WoS, Scopus]  
kategorija: 1A2
- LI, Yongjun, ROMANOVSKI, Valery. Hopf bifurcations in a predator - prey model with an omnivore. *Qualitative theory of dynamical systems*. Dec. 2019, vol. 18, iss. 3, str. 1201-1224. ISSN 1575-5460. <https://link.springer.com/article/10.1007/s12346-019-00333-9>, DOI: [10.1007/s12346-019-00333-9](https://doi.org/10.1007/s12346-019-00333-9). [COBISS.SI-ID [47367683](https://www.cobiss.si/record/47367683)], [JCR, SNIP, WoS]  
kategorija: 1A1
- ZHENGXIN, Zhou, ROMANOVSKI, Valery. The center problem and the composition condition for a family of quartic differential systems. *Electronic journal of qualitative theory of differential equations*. 2018, vol. 2018, no. 15, str. 1-17. ISSN 1417-3875. DOI: [10.14232/ejqtde.2018.1.15](https://doi.org/10.14232/ejqtde.2018.1.15). [COBISS.SI-ID [21365270](https://www.cobiss.si/record/21365270)], [JCR, SNIP, WoS]  
kategorija: 1A1
- GINÉ, Jaume, ROMANOVSKI, Valery, TORREGROSA, Joan. Time-reversibility and integrability of  $p : -q$  resonant vector fields. *AIMS mathematics*. 2024, vol. 9, iss. 1, str. 73-88. ISSN 2473-6988. DOI: [10.3934/math.2024005](https://doi.org/10.3934/math.2024005). [COBISS.SI-ID [184528899](https://www.cobiss.si/record/184528899)], [JCR]  
kategorija: 1A1
- ARCET, Barbara, GINÉ, Jaume, ROMANOVSKI, Valery. Linearizability of planar polynomial Hamiltonian systems. *Nonlinear analysis: real world applications*. Feb. 2022, vol. 63, 19 str. ISSN 1468-1218. DOI: [10.1016/j.nonrwa.2021.103422](https://doi.org/10.1016/j.nonrwa.2021.103422). [COBISS.SI-ID [110154755](https://www.cobiss.si/record/110154755)], [JCR]  
kategorija: 1A1