

UČNI NAČRT PREDMETA / COURSE SYLLABUS

Predmet:	Metode raziskovanja v nelinearni dinamiki
Course title:	Research methods in nonlinear dynamics

Študijski program Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Inženiring in avtomobilska industrija		prvi	drugi
		first	second

Vrsta predmeta / Course type

Modul-izbirni

Univerzitetna koda predmeta / University course code:

DR_31005

Predavanja Lectures	Seminar Seminar	Sem. vaje Tutorial	Lab. vaje Laboratory work	Teren. vaje Field work	Samost. delo Individ. work	ECTS
60	-		30	-	180	10

Nosilec predmeta / Lecturer:

Doc. dr. Anatolij Nikonov

**Jeziki /
Languages:**

**Predavanja /
Lectures:**

Slovenski /
Slovenian

Vaje / Tutorial:

Slovenski / slovenian

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

- vpis v prvi letnik tretje stopnje študija,
- študent(ka) mora obvladati znanja iz predmeta Izbrana poglavja iz matematike in Izbrana poglavja iz mehanike na drugi stopnji študija

Prerequisites:

- inscription in the first year of the 3rd level of study,
- mastering of knowledges obtained within the courses Selected topics in mathematics and Selected topics in mechanics at the 2nd level of study.

Vsebina:

Content (Syllabus outline):

- Hitra inverzna Laplaceova transformacija v sistemih z iracionalnimi in transcendentnimi prenosnimi funkcijami. Metoda harmonskega ravnovesja. Metoda koračnega harmonskega ravnovesja. Lindstedt-Poincarejeva metoda. Metoda Krilova, Bogoljubova in Mitropolskega.

- Fast inverse Laplace transform in systems with irrational and transcendental transfer functions. Method of harmonic balance. Method of incremental harmonic balance. Lindstedt-Poincare method. Krylov-Bogolubov-Mitropolsky method. Homotopic methods. The theory of stability. The theory

<p>Homotopske metode. Teorija stabilnosti. Teorija razvejitev. Teorija upravljanja dinamičnih sistemov. Upravljanje nihanj s pomočjo nevronske mreže in genetskih algoritmov. Metode identifikacije parametrov dinamičnih sistemov. Numerične metode v pojavih velikih razponov skal. Petrov-Galerkinova metoda brez mrežnih končnih elementov. Stohastični končni elementi.</p>	<p>of branching. Theory for management of dynamical systems. Management fluctuations by using neural networks and genetic algorithms. Methods of identification of parameters of dynamic systems. Numerical methods in the emergence of large scale ranges. Petrov-Galerkin meshless finite element method. Stochastic finite elements.</p>
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Temeljni literatura in viri / Readings:

<ul style="list-style-type: none"> - Nayfeh, A. H., Mook, D. T. Nonlinear Oscillations, Wiley, New York, 1979. - Wiggins, S. Introduction to Applied Nonlinear Dynamical Systems and Chaos. Springer Verlag, New York, 1990. - Liu, G. R., Gu, Y.T. An Introduction to Meshfree Methods and Their Programming. Springer, 2005.

Priporočljiva literatura / Recommended Textbooks

<ul style="list-style-type: none"> - S.H. Strogatz. Nonlinear Dynamics and Chaos with Applications to Physics, Biology, Chemistry and Engineering, Perseus Books Publishing, 2000. - D. Kaplan and L. Glass. Understanding nonlinear dynamics, Springer-Verlag, New York, 1995.

Cilji in kompetence:

<p>Cilji</p> <p>Predmet je namenjen pridobitvi poglobljenih znanj in specializaciji študentov za posamezna raziskovalna področja doktorskega študija, ki zajemajo razvoj in uporabo metod pri reševanju problemov nelinearne dinamike zveznih in diskretiziranih mehanskih sistemov.</p> <p>Kompetence</p> <p><i>Učna enota prispeva k razvoju naslednjih splošnih in specifičnih kompetenc:</i></p> <ul style="list-style-type: none"> - sposobnost raziskovanja problemov mehanskih nihanj in njihove analize, - sposobnost ugotavljanja stabilnosti mehanskih sistemov in dinamične analize stabilnosti, - sposobnost izvedbe upravljanja dinamičnih sistemov s posebnim ozirom na upravljanje nihanj, - sposobnost identifikacije parametrov dinamičnih sistemov v analizi in sintezi dinamičnih sistemov,
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Objectives and competences:

<p>Objectives</p> <p>The course is designed to gain in-depth knowledge and specialization of students in specific research areas of the doctoral study, covering the development and application of methods in solving problems of nonlinear dynamics continuous and discrete mechanical systems</p> <p>Competences</p> <p><i>Learning unit contributes to the development of generic and specific competences:</i></p> <ul style="list-style-type: none"> - the ability to research problems of the problems of mechanical vibrations and their analysis, - ability to assess the stability of mechanical systems and dynamic stability analysis, - ability to implement the management of dynamic systems with particular reference to the management of fluctuations, - ability to identify the parameters of dynamic systems for the analysis and synthesis of dynamical systems,

<ul style="list-style-type: none"> - sposobnost razvoja in uporabe diskretnih numeričnih metod v analizi dinamičnih problemov. 	<ul style="list-style-type: none"> - ability to develop and use discrete numerical methods in the analysis of dynamic problems.
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Predvideni študijski rezultati:

Intended learning outcomes:

<p>Znanje in razumevanje: <i>Študent/študentka:</i></p> <ul style="list-style-type: none"> - obvlada področja nelinearne dinamike ter zveznih in diskretiziranih struktur v mehaniki - osvoji poglobljena znanja na področjih analize in sinteze dinamičnih sistemov v mehaniki, - zna uporabljati računalniška orodja za analizo in sintezo zveznih in diskretiziranih struktur v mehaniki 	<p>Knowledge and understanding: <i>Student:</i></p> <ul style="list-style-type: none"> - mastered the field of nonlinear dynamics and continuous and discrete structures in mechanics, - acquire in-depth knowledge in the areas of analysis and synthesis of dynamic systems in mechanics, - be able to use computer tools for analysis and synthesis of continuous and discrete structures in mechanics.
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Metode poučevanja in učenja:

Learning and teaching methods:

<ul style="list-style-type: none"> - <i>predavanja</i> z aktivno udeležbo študentov, ki vsebujejo razprave, diskusije in odgovore na vprašanja, - individualno delo v obliki <i>konzultacij</i>. 	<ul style="list-style-type: none"> - lectures with active participation of students, which contain debates, discussions and answering questions, - individual work in the form of consultations.
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Načini ocenjevanja:

**Delež (v %) / Assessment:
Weight (in%)**

<ul style="list-style-type: none"> - seminarska naloga (60%) - ustni izpit (40%) - končna ocena izpita je povprečje obeh ocen (seminarske naloge in ustnega dela izpita). 	<ul style="list-style-type: none"> - seminar (60%) - oral exam (40%) - the final grade of the exam is the average of both grades (of the seminar and oral exam, respectively).
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Reference nosilca / Lecturer's references:

<ul style="list-style-type: none"> - - NIKONOV, Anatolij, BURNIK, Stojan, ROTOVNIK, Bojan, EMRI, Igor. Jolt - new criterium of safety in climbing. V: GOLOBIČ, Iztok (ur.), CIMERMAN, Franc (ur.). Engineering - development and innovations for new employments 2014 : proceedings of the 4th AMES International Conference, Ljubljana, Slovenia, October 23th, 2014. 1st ed. Ljubljana: Association of Mechanical Engineers of Slovenia - AMES, 2015, str. 199-204, ilustr. [COBISS.SI-ID 14122267] - NIKONOV, Anatolij Viktorovič, SAPRUNOV, Ivan, ZUPANČIČ, Barbara, EMRI, Igor. Influence of moisture on functional properties of climbing ropes. International Journal of Impact Engineering, ISSN 0734-743X. [Print ed.], Nov. 2010, vol. 38, iss. 11, str. 900-909,
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doi:10.1016/j.ijimpeng.2011.06.003. [COBISS.SI-ID 11964699]

- NIKONOV, Anatolij Viktorovič, BURNIK, Stojan, EMRI, Igor. Examination of the time-dependent behaviour of climbing ropes under impact loading = Preiskava časovno odvisnega vedenja plezalnih vrvi pri impulznih obremenitvah. Kinesiologia Slovenica, ISSN 1318-2269. [Print ed.], 2010, vol. 16, no. 3, str. 7-13, ilustr., tabeli. [COBISS.SI-ID 4044977]
- ZUPANČIČ, Barbara, NIKONOV, Anatolij Viktorovič, FLORJANČIČ, Urška, EMRI, Igor. Časovno odvisno vedenje pogonskih jermenov pod vplivom periodične mehanske obremenitve : analiza lokacije enojne spektralne črte = Time-dependent behaviour of drive belts under periodic mechanical loading : analysis of the location of a single line spectrum. Strojniški vestnik, ISSN 0039-2480, 2007, letn. 53, št. 10, str. 696-705. [COBISS.SI-ID 10330395]
- EMRI, Igor, KRAMAR, Janez, HRIBAR, Anton, NIKONOV, Anatolij Viktorovič, FLORJANČIČ, Urška. Time-dependent constitutive modeling of drive belts - I. : the effect of geometry and number of loading cycles. Mechanics of time-dependent materials, ISSN 1385-2000, 2006, letn. 10, št. 3, str. 245-262. <http://dx.doi.org/10.1007/s11043-006-9021-2>. [COBISS.SI-ID 9871387]
- NIKONOV, Anatolij Viktorovič, DAVIES, A.R., EMRI, Igor. The determination of creep and relaxation functions from a single experiment. Journal of rheology, ISSN 0148-6055, 2005, letn. 49, št. 6, str. 1193-1211. [COBISS.SI-ID 8872219]
- ZAKHAROV, D.D., NIKONOV, Anatolij Viktorovič. Approximate description of the dynamics of thin isotropic elastic coatings and interlayers by using asymptotics of high order of accuracy. Mechanics of composite materials, ISSN 0191-5665, 2005, letn. 41, št. 6, str. 527-534. <http://dx.doi.org/10.1007/s11029-006-0006-7>. [COBISS.SI-ID 9506843]