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| **UČNI NAČRT PREDMETA / COURSE SYLLABUS** | | | | | | | | | | | | | | | | | |
| **Predmet:** | | | Izbrana poglavja vodenja kompleksnih sistemov | | | | | | | | | | | | | | |
| **Course title:** | | | Selected Topics of Complex Systems Control Design | | | | | | | | | | | | | | |
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| **Študijski program in stopnja**  **Study programme and level** | | | | | **Študijska smer**  **Study field** | | | | | | | | **Letnik**  **Academic year** | | **Semester**  **Semester** | | |
| doktorski študijski program tretje stopnje Elektrotehnika | | | | | Ni smeri | | | | | | | | 1 | |  | | |
| 3rd cycle: doctoral study programme Electrical Engineering | | | | |  | | | | | | | | **1** | |  | | |
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| **Vrsta predmeta / Course type** | | | | | | | | | | | | Izbirni /Elective | | | | | |
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| **Univerzitetna koda predmeta / University course code:** | | | | | | | | | | | | 64833 | | | | | |
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| **Predavanja**  **Lectures** | **Seminar**  **Seminar** | | | **Vaje**  **Tutorial** | | | **Klinične vaje**  **work** | | | | **Druge oblike študija** | | | **Samost. delo**  **Individ. work** | |  | **ECTS** |
| **30** | **60** | | | **/** | | | **/** | | | | **/** | | | **35** | |  | **5** |
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| **Nosilec predmeta / Lecturer:** | | | | | Maja Atanasijević-Kunc | | | | | | | | | | | | |
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| **Jeziki /**  **Languages:** | | **Predavanja / Lectures:** | | | | **slovenski, angleški / Slovene, English** | | | | | | | | | | | |
| **Vaje / Tutorial:** | | | | **/** | | | | | | | | | | | |
| **Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:** | | | | | | | | |  | **Prerequisits:** | | | | | | | |
| Vpis na doktorski študij. | | | | | | | | |  | Enrolment in the PHD study. | | | | | | | |
| **Vsebina:** | | | | | | | |  | | **Content (Syllabus outline):** | | | | | | | |
| Vsebina predmeta obsega predvesem obravnavo naslednje snovi:   * **uvod v kompleksne sisteme** (opis in matematične predstavitve kompleksnih sistemov:   nezanesljivosti modelov, multivariabilni in veliki sistemi, sistemi z zakasnitvami, fazno -neminimalni sistemi, nelinearni in časovno-spremenljivi sistemi, kombinirani zvezno-diskretni sistemi)   * predstavitev težavnih lastnosti s pomočjo kvalitativnih in kvantitativnih funkcij **analize,** * predstavitev nekaterih možnosti **načrtovanja vodenja**, ki vključujejo tudi koncepte optimalnosti (na impliciten oz. ekspliciten način):   problem optimalnega vodenja (principi  in kriteriji, linearni kvadratični regulator,  observatorji stanj, kombinacija metod  optimalnega načrtovanja z modernimi  metodami načrtovanja),  adaptivno načrtovanje,  hierarhično in porazdeljeno vodenje,  sistemi mrežnega vodenja,   * razširitev rezultatov na razvoj ekspertnih sistemov, * **tehnologija izvedbe vodenja** kompleksnih sistemov (računalniški sistemi za vodenje in programirljivi krmilniki, programska oprema, omrežne tehnologije, industrijski informacijski sistemi). | | | | | | | |  | | Contents of the course will concentrate mainly to the following:   * **introduction to complex systems** (description and mathematical representation of complex systems: model uncertainty, multivariable and large-scale systems, systems with time-delays, non-minimum-phase systems, nonlinear and time-varying systems, combined continuous – discrete event systems) * presentation of performance limitations using **analysis**, * presentation of corresponding **control design** approaches, which include also the concepts of optimal control strategies (in implicit or explicit manner):   optimal control problem (principles and  criterions, linear quadratic controller,  state observers, combination of optimal  control with modern design methods),  adaptive control design,  hierarchical and distributed control,  network control systems,   * results extension to expert system development * **- control implementation technology** for complex systems (computer control systems and programmable logic controllers, corresponding software, network technologies, industrial information systems). | | | | | | | |

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| **Temeljna literatura in viri / Readings:** | | | | | |
| [1] S. Skogestad, I. Postlethwaite, Multivariable Feedback Control, Analysis and Design, John Wiley and Sons Ltd, Chichester, 2006.  [2] P. Jackson: Introduction to Expert Systems, Addison - Wesley, Harlow, 1999.  [3] Astrom, Wittenmark, Adaptive control, Addison-Wesley Longman Publishing Co., Inc. Boston, MA, USA, 1994.  [4] R. Karba, M. Atanasijević-Kunc, Multivariabilni sistemi, Založba FE in FRI, 2010.  [5] M. Atanasijević-Kunc, Multivariabilni sistemi, predstavitev, analiza in načrtovnje skozi primere, Založba FE in FRI, 2004.  [6] J. Stenerson, Fundamentals of Programmable Logic Controllers, Sensors and Communication, Third Edition, Pearson/Prentice Hall, 2004. | | | | | |
| **Cilji in kompetence:** | |  | | **Objectives and competences:** | |
| Cilji predmeta so:   * predstaviti lastnosti dinamičnih sistemov, ki jih uvrščajo med težavne za vodenje, * predstaviti matematična orodja za obravnavo teh lastnosti, * predstaviti nekatere značilne metode in pristope načrtovanja tovrstnih sistemov, * predstaviti praktične vidike realizacije vodenja kompleksnih sistemov.   Glede na širino področja bomo lahko problematiko prilagodili tudi specifičnim potrebam posameznega študenta. | |  | | Objectives and competences are:   * to present properties of dynamic systems which introduce difficulties to control design, * to present mathematical tools enabling analysis of mentioned problems, * to present some of algorithms and methods which are suitable for such systems design, * to present practical implementation problems of complex control systems.   Taking into account extensiveness of indicated theory, adaptation to student's specifics is also possible. | |
| **Predvideni študijski rezultati:** | | |  | **Intended learning outcomes:** | |
| * poznavanje in razumevanje lastnosti dinamičnih sistemov, * razumevanje, zakaj je dosegljiva kvaliteta obnašanja nekaterih sistemov omejena, * poznavanje nekaterih značilnih metod načrtovanja vodenja kompleksnih sistemov, * razumevanje problemov, ki so pomembni pri realizaciji načrtanih rezultatov vodenja. | | |  | * Knowledge and understanding of dynamic systems’ properties, * Understanding the limitations of reachable system operation quality, * Understanding of some design algorithms which are suitable for complex systems, * Understanding the implementation problems of complex control algorithms. | |
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| **Metode poučevanja in učenja:** | | |  | **Learning and teaching methods:** | |
| Predavanja in seminarsko delo | | |  | Lectures and seminar work | |
| **Načini ocenjevanja:** | Delež (v %) /  Weight (in %) | | | | **Assessment:** |
| Seminarsko delo / ustni zagovor | **50% / 50%** | | | | Seminar work and oral defence |
| |  | | --- | | **Reference nosilca / Lecturer's references:** | | 1. Glavan M, Gradišar D, Atanasijević-Kunc Maja, Strmčnik S, Mušič G. (2013) Input variable selection for model-based production control and optimisation. Int J Adv Man Tech 68:2743-2759 2. Atanasijević-Kunc M, Logar V, Karba R, Papić M, Kos A (2011) Remote multivariable control design using a competition game. IEEE Trans Edu 54:97-103 3. Atanasijević-Kunc M, Kunc V (2010) RF mixers comprising active feedback load Inf MIDEM, 40:163-166 4. Atanasijević-Kunc M, Karba R (2006) Multivariable control design with expert-aided support. WSEAS Trans Sys, 10:2299-2306 5. Karba R, Atanasijević-Kunc M (2010) Multivariabilni sistemi. Založba UL FE-FRI, Ljubljana | | | | | | |