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| **UČNI NAČRT PREDMETA / COURSE SYLLABUS** | | | | | | | | | | | | | | | | | |
| **Predmet:** | | | Signali in sistemi | | | | | | | | | | | | | | |
| **Course title:** | | | Signals and Systems | | | | | | | | | | | | | | |
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| **Študijski program in stopnja**  **Study programme and level** | | | | | **Študijska smer**  **Study field** | | | | | | | | **Letnik**  **Academic year** | | **Semester**  **Semester** | | |
| Univerzitetni študijski program prve stopnje Elektrotehnika | | | | | **Elektronika** | | | | | | | | 3. | | zimski | | |
| 1st cycle academic study programme Electrical Engineering | | | | | **Electronics** | | | | | | | | **3.** | | **winter** | | |
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| **Vrsta predmeta / Course type** | | | | | | | | | | | | Obvezni- strokovni/  compulsory professional | | | | | |
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| **Univerzitetna koda predmeta / University course code:** | | | | | | | | | | | | 64145 | | | | | |
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| **Predavanja**  **Lectures** | **Seminar**  **Seminar** | | | **Vaje**  **Tutorial** | | **Klinične vaje**  **work** | | | | | **Druge oblike študija** | | | **Samost. delo**  **Individ. work** | |  | **ECTS** |
| **45** |  | | | **45** | |  | | | | |  | | | **85** | |  | **7** |
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| **Nosilec predmeta / Lecturer:** | | | | | Franc Smole | | | | | | | | | | | | |
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| **Jeziki /**  **Languages:** | | **Predavanja / Lectures:** | | | | | slovenski/Slovenian | | | | | | | | | | |
| **Vaje / Tutorial:** | | | | | slovenski/Slovenian | | | | | | | | | | |
| **Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:** | | | | | | | | |  | **Prerequisits:** | | | | | | | |
| Vpis v letnik. | | | | | | | | |  | Enrolment in the year of the course. | | | | | | | |
| **Vsebina:** | | | | | | | |  | | **Content (Syllabus outline):** | | | | | | | |
| Definicije in razvrstitev signalov in sistemov. Ponazarjanje signalov. Fourierjeva in Laplaceova predstavitev signalov. Analiza zveznih signalov. Korelacija in konvolucija. Matematični modeli sistemov in metode reševanja. Impulzni, stopničasti in sinusni odziv. Uporaba transformacij pri reševanju sistemov. Vhodne, izhodne in prenosne funkcije. Frekvenčna karakteristika. Bodejevi diagrami, polarni diagrami.  Osnovne povezave med sistemi. Povratni sistemi. Absolutna in relativna stabilnost. Routhov in Nyquistov stabilnostni kriterij.  Fazni in ojačevalni razloček. Frekvenčna kompenzacija. Analiza občutljivosti povratnih sistemov.  Prostor stanj, spremenljivke prostora stanj. Enačbe v prostoru stanj in njihovo reševanje. Trajektorije v prostoru stanj. Ravnotežne točke. Vodljivost in spoznavnost. Stanja ravnotežja in stabilnost stanj ravnotežja.  Topologija električnih vezij. Topološki postopki analize električnih vezij. Sistematično reševanje električnih vezij v prostoru stanj.  Osnove filtriranja. Prenos signalov brez popačenj. Aproksimacija idealne frekvenčne karakteristike. Frekvenčne preslikave. Sinteza prevajalne funkcije pasivnih filtrov. Realizacija aktivnih filtrov. Filtri SC. Računalniško načrtovanje analognih filtrov. | | | | | | | |  | | Definitions and classification of signals and systems. Signal expressions. Fourier and Laplace representation of signals. Analysis of continuous signals. Correlation and convolution. Mathematical models and system analysis methods. Unit impulse, unit step and sine response. Using transformations in solving systems. Input, output and transfer functions. Frequency characteristics. Bode diagrams, polar diagrams.  Basic connections between systems. Feedback systems. Absolute and relative stability. Routh and Nyquist stability criterion.  Gain and phase margins. Frequency compensation. Sensitivity analysis of feedback systems.  State space, state space variables. Equations in state space and solving them. Trajectories in state space. Equilibrium points. Controllability and observability. State of equilibrium and stability conditions of equilibrium.  Topology of electrical circuits. Topological analysis of electric circuits. Systematically solving electrical circuits in the state space.  Basics of filtering. Transmission of signals without distortion. An approximation of the ideal frequency characteristics. Frequency mapping. Synthesis of transfer functions of passive filters. Realization of active filters. SC filters. Computer aided design of analog filters. | | | | | | | |

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| **Temeljni literatura in viri / Readings:** | | |
| 1. A. V. Oppenheim, A. S. Willsky, Signals & Systems, Prentice Hall Int., 1997.  2. R. D. Sturm, D. E. Kirk, Contemporary Linear Systems Using MATLAB,  BookWare copanion series, 1999.  3. C. L. Phillips, J. M. Parr, E. A. Riskin, Signals, Systems, and Transforms, Prentice Hall, 2008.  4. Douglas K. Linder, Introduction to Signals and Systems, WCB/McGraw-Hill, 2003.  5. C. M. Close, D. K. Frederick and J. C. Newell: Modeling and Analysis of Dynamic Systems,  John Wiley & Sons, 2002.  6. K. L. Su, Analog Filters, Kluwer Academic Publishers Group, 2010.  7. Rolf Schaumann, Mac E. Van Valkenburg, Design of analog filters, Oxford University Press, 2003.  8. F. Smole, Signali in sistemi – gradivo za laboratorijske vaje, 2015.  9. F. Smole, Signali in sistemi – učbenik, 2015. | | |
| **Cilji in kompetence:** |  | **Objectives and competences:** |
| Spoznati vrste signalov, usvojiti metode za njihov opis in obdelavo. Usvojiti temeljna znanja teorije sistemov, ki omogoča sistematično analizo in načrtovanje sistemov. Spoznati sodobna računalniška orodja za analizo in simulacijo sistemov. Prikazati uporabo splošne teorije sistemov pri sistematičnem reševanju električnih vezij, pri analizi in načrtovanju filtrov. |  | To recognize various signal forms and methods for their description and processing. To acquire basic knowledge about systems theory, which enables systematic analysis and design of the systems. To learn about the use of modern computer tools for systems analysis and simulation. To present the implementation of basic system theory into systematic solutions for analysis and design of electric circuits and filters. |

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| **Predvideni študijski rezultati:** | |  | **Intended learning outcomes:** | |
| Študenti usvojijo pojme splošne teorije signalov in sistemov, se naučijo sistemskega razmišljanja, se naučijo uporabljati matematično znanje v sistemski teoriji, spoznajo metode modeliranja, postopke analize in sinteze. | |  | Students acquire knowledge regarding general theory about signals and systems, develop systemic thinking, learn how to apply mathematical skills in systems theory and discover the methods of modeling and procedures of analysis and synthesis. | |
| **Metode poučevanja in učenja:** | |  | **Learning and teaching methods:** | |
| predavanja, avditorne in laboratorijske vaje | |  | lectures, auditory practice, laboratory assignments | |
| **Načini ocenjevanja:** | | Delež (v %)  Weight (in %) | | | **Assessment:** | |
| Način: laboratorijske vaje, pisni izpit, ustni izpit. Opravljene laboratorijske vaje so pogoj za pristop h končnemu izpitu.  Ocene od 1 do vključno 5 so negativne, ocene od vključno 6 do 10 so pozitivne.  Prispevki k oceni:  pisni izpit  ustni izpit | | 50%  50% | | | Type: laboratory exercises, written exam, oral exam. Conducted laboratory assignments present a condition for undertaking the final exam.  Negative grades: from 1 to 5, positive grades: from 6 to 10.  Contributions to final grade:  written exam  oral examination | |
| **Reference nosilca / Lecturer's references:** | | | | |
| 1. SEIF, Johannes Peter, DESCOEUDRES, Antoine, FILIPIČ, Miha, SMOLE, Franc, TOPIČ, Marko, HOLMAN, Zachary Charles, DE WOLF, Stefaan, BALLIF, Christophe. Amorphous silicon oxide window layers for high-efficiency silicon heterojunction solar cells. Journal of applied physics, 2014, vol. 115, no. 2, str. 1-8.  2. FILIPIČ, Miha, HOLMAN, Zachary, SMOLE, Franc, DE WOLF, Stefaan, BALLIF, Christophe, TOPIČ, Marko. Analysis of lateral transport through the inversion layer in amorphous silicon/crystalline silicon heterojunction solar cells. Journal of applied physics, 2013, vol. 114, no. 7, str. 1-7.  3. HOLMAN, Zachary, FILIPIČ, Miha, LIPOVŠEK, Benjamin, DE WOLF, Stefaan, SMOLE, Franc, TOPIČ, Marko, BALLIF, Christophe. Parasitic absorption in the rear reflector of a silicon solar cell: simulation and measurement of the sub-bandgap reflectance for common dielectric/metal reflectors. Solar energy materials and solar cells, [Print ed.], Jan. 2014, vol. 120, part A, str. 426-430.  4. FILIPIČ, Miha, BERGINC, Marko, SMOLE, Franc, TOPIČ, Marko. Analysis of electron recombination in dye-sensitized solar cell. Current applied physics, Jan. 2012, vol. 12, no. 1, str. 238-246.  5. NERAT, Marko, SMOLE, Franc, TOPIČ, Marko. A simulation study of the effect of the diverse valence-band offset and the electronic activity at the grain boundaries on the performance of polycrystalline Cu(In,Ga)Se2 solar cells. Thin Solid Films, [Print ed.], 2011, vol. 519, no. 21, str. 7497-7502. | | | | |