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| **UČNI NAČRT PREDMETA / COURSE SYLLABUS** | | | | | | | | | | | | | | | | | |
| **Predmet:** | | | Diskretni signali in sistemi | | | | | | | | | | | | | | |
| **Course title:** | | | Discrete 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. | | letni | | |
| 1st cycle academic study programme Electrical Engineering | | | | | **Electronics** | | | | | | | | **3.** | | **summer** | | |
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| **Vrsta predmeta / Course type** | | | | | | | | | | | | Obvezni - strokovni/ compulsory professional | | | | | |
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| **Univerzitetna koda predmeta / University course code:** | | | | | | | | | | | | 64153 | | | | | |
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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:** | | | | | Andrej Levstek | | | | | | | | | | | | |
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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):** | | | | | | | |
| Vzorčenje, spekter idealno vzorčenega signala, rekonstrukcija časovno zveznega signala, teorem o vzorčenju. Vrste diskretnih signalov ( periodični, aperiodični, naključni)  Spektralna analiza diskretnih signalov (časovno diskretna Fouriereva transformacija TDFT, diskretni Fourierev transform - DFT).  Časovno diskretni linearni časovno nespremenljivi (LTI) sistemi (gradniki sistemov, kavzalnost, stabilnost). Opisovanje diskretnih LTI sistemov (diferenčna enačba, impulzni odziv, frekvenčni odziv, z-transformacija, sistemska funkcija). Lastnosti LTI sistema na osnovi lege polov in ničel sistemske funkcije (stabilnost, zrcaljenje ničel, fazni sukalnik, sistemi z linearno fazo, kaskadna vezava)  Diskretni filtri (bločna shema in diagram pretoka, strukture diskretnih filtrov, osnovne filtrske karakteristike). Načrtovanje FIR filtrov (načrtovanje z oknenjem, frekvenčne preslikave FIR sit, načrtovanje optimalnih FIR filtrov)  Načrtovanje IIR filtrov (impulzno invariantna metoda, bilinearna preslikava)  Sistemi z več frekvencami vzorčenja (decimacija, interpolacija, uporaba interpolacije pri rekonstrukciji)  Digitalna obdelava signalov (kvantizacijski šum, vpliv kvantizacije koeficientov, praktične izvedbe) | | | | | | | |  | | Sampling, spectrum of naturally sampled signal, reconstruction of countinuous-time signal, sampling theorem, frequency aliasing. Classification and properties of discrete signals(periodic, aperiodic, random signals)  Spectral analysis of discrete signals: discrete time Fourier transform TDFT, discrete Fourier transform DFT.  Discrete linear time invariant systems (LTI):  Characterization of LTI systems: difference equation, impulse response, frequency response, system function, z-transform.  Location of poles and zeroes: stability, phase shift, linear phase systems.  Discrete filters: block scheme, signal flow graph, structures, digital filter specifications.  FIR filter design: windowing, frequency transformations, equiripple filter design.  IIR filter design: invariant impulse response method, bilinear transformation.  Multirate systems: decimation, interpolation.  Effects of digital implementation: quantisation noise, effects of coefficient quantisation. | | | | | | | |

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| **Temeljni literatura in viri / Readings:** | | | | | |
| 1. S. Tomažič, S. Leonardis: Diskretni signali in sistemi, Založba FE in FRI, Ljubljana, 2004 2. S. K. Mitra, Digital signal processing: a computer based approach, fourth edition, McGraw-Hill, 2011 | | | | | |
| **Cilji in kompetence:** | |  | | **Objectives and competences:** | |
| Osnovne lastnosti časovno diskretnih signalov. Zveze med diskretnimi in časovno zveznimi signali.  Uporaba DFT-ja za spektralno analizo zveznih signalov.  Digitalna obdelava signalov z digitalnimi filtri. Posebnosti FIR sistemov, ki jih časovno zveznih sistemih ne moremo realizirati.  Pomen pravilne izbire strukture sistema na degradacijo karakteristike zaradi končne točnosti koeficientov. | |  | | Basic properties of discrete signals.  Relations between discrete and continuous-time signals due to sampling and reconstruction.  Spectral analysis of analogue signals using DFT  Advantages and drawbacks of FIR filters  Advantages and drawbacks of IIR filters  Significance of proper structure selection for fixed point implementations | |
| **Predvideni študijski rezultati:** | | |  | **Intended learning outcomes:** | |
| Študent bo pridobil osnovno znanje, ki mu bo omogočalo načrtovanje digitalne obdelave signalov z računalnikom. Poznavanje vplivov končne natančnosti koeficientov na frekvenčni odziv mu bo omogočilo izbiro ustreznih struktur za realizacijo diskretnega sistema z uporabo splošnih ali signalnih procesorjev. | | |  | Students should be able to:  Chose suitable filter type: IIR or FIR  Design simple digital signal processing on computer  Select proper structure for real time implementation | |
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| **Metode poučevanja in učenja:** | | |  | **Learning and teaching methods:** | |
| Predavanja, avditorne in laboratorijske vaje, domače naloge. | | |  | Lectures, tutorial, homework | |
| **Načini ocenjevanja:** | Delež (v %) /  Weight (in %) | | | | **Assessment:** |
| Način: laboratorijske vaje, domače naloge, projekt, pisni izpit, ustni izpit.  Ocene od 1 do vključno 5 so negativne, ocene od vključno 6 do 10 so pozitivne.  Pozitivna ocena laboratorijskih vaj je pogoj za pristop k izpitu.  Prispevki k oceni:  domače naloge  laboratorijske vaje  pisni izpit  ustni izpit | 10%  10%  40%  40% | | | | Type: laboratory exercises, homework, project, written exam, oral exam.  Negative grades: from 1 to 5, positive grades: from 6 to 10.  Positive evaluation of laboratory exercises is a prerequisite for the exam.  Contributions to final grade:  coursework  laboratory exercises  written exam  oral examination |
| **Reference nosilca / Lecturer's references:** | | | | | |
| 1. LEVSTEK, Andrej, MEDIČ, Igor, PERŠIČ, Boštjan. Frequency domain analysis of the influence of circuit parameters on oscillation frequency. *AEÜ*, ISSN 1434-8411. [Print ed.], 2003, vol. 57, no. 6, str. 423-425.  2. LEVSTEK, Andrej, FURLAN, Jože. Microscopic electric field in the surroundings of ionized impurities in semiconductor. *Journal of electrostatics*, ISSN 0304-3886. [Print ed.], 2003, vol. 57, str. 59-68.  3. FURLAN, Jože, GORUP, Žarko, LEVSTEK, Andrej, AMON, Slavko. Thermally assisted tunneling and the Poole-Frenkel effect in homogenous a-Si. *Journal of applied physics*, ISSN 0021-8979, 2003, vol. 94, no. 12, str. 7604-7610.  4. LEVSTEK, Andrej, PIRC, Matija. Načrtovanje umetne linije za standardni sukani par. *Elektrotehniški vestnik*, ISSN 0013-5852. [Slovenska tiskana izd.], 2008, letn. 75, št. 3, str. 91-96.  5. LEVSTEK, Andrej. Amplitude stabilization in quadrature oscillator for low harmonic distortion = Stabilizacija amplitude v kvadraturnem oscilatorju za nizko harmonično popačenje. *Informacije MIDEM*, ISSN 0352-9045, 2013, letn. 43, št. 3, str. 185-192. | | | | | |