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| **UČNI NAČRT PREDMETA / COURSE SYLLABUS** | | | | | | | | | | | | | | | | | |
| **Predmet:** | | | Digitalna obdelava signalov | | | | | | | | | | | | | | |
| **Course title:** | | | Digital Signal Processing | | | | | | | | | | | | | | |
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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 | | | | | Informacijsko komunikacijske tehnologije | | | | | | | | 3. | | letni | | |
| 1st cycle academic study programme Electrical Engineering | | | | | Information and communications technologies | | | | | | | | 3. | | summer | | |
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| **Vrsta predmeta / Course type** | | | | | | | | | | | | Obvezni - strokovni/ compulsory professional | | | | | |
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| **Univerzitetna koda predmeta / University course code:** | | | | | | | | | | | | 64174 | | | | | |
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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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|  | | | | | Sašo Tomažič | | | | | | | | | | | | |
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| **Jeziki /**  **Languages:** | | **Predavanja / Lectures:** | | | | slovenski | | | | | | | | | | | |
| **Vaje / Tutorial:** | | | | slovenski | | | | | | | | | | | |
| **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):** | | | | | | | |
| Osnove časovno diskretnih signalov (signali, klasifikacija signalov, časovni in frekvenčni prostor). Vzorčenje (teorem o vzorčenju, vzorčenje v časovnem in frekvenčnem prostoru). Časovno-diskretni sistemi (linearni časovno neodvisni diskretni sistemi, kavzalnost, diferenčne enačbe in linearni diskretni sistemi, impulzni odziv, strukture časovno-diskretnih sistemov, možnosti realizacije). Frekvenčna analiza časovno diskretnih signalov. Diskretna Fourierova transformacija (algoritmi za izračun, hitra Fourierova transformacija, hitro računanje odziva filtrov s pomočjo FFT, okenske funkcije). Transformacija Z (transformacija Z in inverzna transformacija Z , pomen v digitalni obdelavi signalov, racionalna Z transformacija, lega polov in časovni potek signala). Analiza in sinteza časovno diskretnih sistemov v frekvenčnem prostoru (prenosna funkcija sistema, analiza sistemov z racionalno prenosno funkcijo v prostoru Z, stabilnost, frekvenčni odziv). Frekvenčno selektivna sita. Načrtovanje digitalnih filtrov (sita s končnim odzivom FIR, sita z neskončnim odzivom IIR). Generatorji diskretni naključnih signalov(Enakomerna porazdelitev verjetnosti, Gaussov in beli šum). Kvantizacija signala (analogno-digitalna pretvorba, kvantizatorji, napake kvantizacije). | | | | | | | |  | | Fundamentals of time-discrete signals (signals, signal classification, time and frequency space). Sampling (sampling theorem, effects of sampling in time and frequency domain). Discrete-time systems (linear time- invariant discrete systems, causality, differential equations and discrete linear systems, impulse response , the discrete - time systems structure, implementation) . Frequency analysis of discrete - time signals. Discrete Fourier transform (Fast Fourier transform algorithms, fast discrete filtering using FFT). Z-transform (Z transform and inverse Z transform , application in digital signal processing , rational Z transform, time behaviour and roots of rational Z transform) . Analysis and synthesis of discrete time systems in frequency domain (transfer function of the system, analysis of systems with rational Z transfer function, stability, frequency response). Digital filter design (finite response filters, the infinite response filters). Random signal generators (uniform distribution, Gaussian white noise). Signal quantisation (analogue-to- digital conversion, quantizers, and quantization errors). | | | | | | | |

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| **Temeljni literatura in viri / Readings:** | | | | | |
| 1. Sašo Tomažič, Savo Leonardis, Diskretni signali in sistemi Založba FE in FRI, 2004.  2. John G. Proakis, Dimitris K. Manolakis, Digital Signal Processing (4th Edition) Prentice Hall; 4 edition, 2006 | | | | | |
| **Cilji in kompetence:** | |  | | **Objectives and competences:** | |
| Spoznavanje s temeljnimi orodji za digitalno obdelavo signalov. Razumevanje postopkov in posledic zajema, analize in obdelave signalov v diskretni – digitalni obliki ter njihove rekonstrukcije v analogni prostor. Pridobitev sposobnosti izbora primernega načina digitalnega zajema signalov, razumevanje posledic digitalizacije in obvladovanje osnovnih postopkov za analizo signalov v časovnem in frekvenčnem prostoru. Usposobljenost za načrtovanje temeljnih sistemov za digitalno filtriranje signalov. Pridobljena znanja študentu koristijo pri razumevanju delovanja kompleksnih digitalnih komunikacijskih naprav. | |  | | Knowing the basic tools for digital signal processing. Understanding the processes and consequences of capture, analysis and signal processing in discrete - digital form and their reconstruction back to the analog domain. Competence for the selection of a suitable method of digital signal acquisition, understanding the implications of digitalization and understanding the basic signal analysis in time and frequency domain. The ability to use basic systems for digital filtering and signal enhancement. Understanding digital signal processing as a building block of complex digital communication devices. | |
| **Predvideni študijski rezultati:** | | |  | **Intended learning outcomes:** | |
| Razumevanje digitalnih signalov v časovnem in v frekvenčnem prostoru, znanje načrtovanja digitalnih filtrov in sistemov. | | |  | Understanding of digital signals in the time and frequency domain, fundamental applicative knowledge of digital filters and systems. | |
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| **Metode poučevanja in učenja:** | | |  | **Learning and teaching methods:** | |
| Predavanja s teoretičnimi izhodišči in praktično naravnane laboratorijske vaje z možnostjo dela v skupini. | | |  | Lectures with DSP theory and practically oriented lab assignments encouraging teamwork. | |
| **Načini ocenjevanja:** | Delež (v %) /  Weight (in %) | | | | **Assessment:** |
| Način: laboratorijske vaje, 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:  laboratorijske vaje  pisni izpit  ustni izpit | 25%  75% | | | | Type: laboratory exercises, 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:  laboratory exercises  written exam  oral examination |
| **Reference nosilca / Lecturer's references:** | | | | | |
| 1. KOS, Anton, TOMAŽIČ, Sašo, UMEK, Anton. Suitability of smartphone inertial sensors for real-time biofeedback applications. Sensors, 2016, vol. 16, no. 3, str. 1-21.  2. KOS, Anton, TOMAŽIČ, Sašo, SALOM, Jakob, TRIFUNOVIĆ, Nemanja, VALERO, Mateo, MILUTINOVIĆ, Veljko. New benchmarking methodology and programming model for big data processing. International journal of distributed sensor networks, 2015, vol. 2015, str. 1-7.  3. STANČIN, Sara, TOMAŽIČ, Sašo. Time- and computation-efficient calibration of MEMS 3D accelerometers and gyroscopes. Sensors, 2014, vol. 14, no. 8, str. 14885-14915.  4. STANČIN, Sara, TOMAŽIČ, Sašo. Early improper motion detection in golf swings using wearable motion sensors : the first approach. Sensors, 2013, vol. 13, no. 6, str. 7505-7521.  5. STANČIN, Sara, TOMAŽIČ, Sašo. Angle estimation of simultaneous orthogonal rotations from 3D gyroscope measurements. Sensors, 2011, vol. 11, no. 9, str. 8536-8549. | | | | | |