|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **UČNI NAČRT PREDMETA / COURSE SYLLABUS** | | | | | | | | | | | | | | | | | |
| **Predmet:** | | | Digitalno procesiranje v mehatroniki II | | | | | | | | | | | | | | |
| **Course title:** | | | Digital Processing in Mechatronics II | | | | | | | | | | | | | | |
|  | | | | |  | | | | | | | |  | |  | | |
| **Študijski program in stopnja**  **Study programme and level** | | | | | **Študijska smer**  **Study field** | | | | | | | | **Letnik**  **Academic year** | | **Semester**  **Semester** | | |
| Podiplomski magistrski študijski program druge stopnje Elektrotehnika | | | | | Mehatronika | | | | | | | | 2 | | 1 | | |
| 2nd cycle masters study programme in Electrical Engineering | | | | | Mechatronics | | | | | | | | 2 | | 1 | | |
|  | | | | | | | | | | | | | | | | | |
| **Vrsta predmeta / Course type** | | | | | | | | | | | | Obvezni-strokovni / Compulsory professional | | | | | |
|  | | | | | | | | | | | |  | | | | | |
| **Univerzitetna koda predmeta / University course code:** | | | | | | | | | | | | 64291 | | | | | |
|  | | | | | | | | | | | | | | | | | |
| **Predavanja**  **Lectures** | **Seminar**  **Seminar** | | | **Vaje**  **Tutorial** | | | **Klinične vaje**  **work** | | | | **Druge oblike študija** | | | **Samost. delo**  **Individ. work** | |  | **ECTS** |
| 45 |  | | | 30 | | |  | | | |  | | | 75 | |  | 6 |
|  | | | | | | | | | | | | | | | | | |
| **Nosilec predmeta / Lecturer:** | | | | | Vanja Ambrožič | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | | | |
| **Jeziki /**  **Languages:** | | **Predavanja / Lectures:** | | | | slovenski / Slovenian | | | | | | | | | | | |
| **Vaje / Tutorial:** | | | | slovenski / Slovenian | | | | | | | | | | | |
| **Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:** | | | | | | | | |  | **Prerequisits:** | | | | | | | |
| Vpis v letnik predmeta | | | | | | | | |  | Enrolment in the year of the course | | | | | | | |
| **Vsebina:** | | | | | | | |  | | **Content (Syllabus outline):** | | | | | | | |
| Sodobne arhitekture mikroprocesorskih sistemov. Digitalni signalni procesorji. Razvojna programska in aparaturna orodja. Operacijski sistemi za aplikacije v realnem času. Programski jeziki. Diskretne prenosne funkcije, algoritmi in programiranje regulacijskih elementov (transcendentne funkcije, integratorji, derivatorji, regulatorji..). Digitalna analiza signalov, spektralna analiza ter diskretna in hitra Fourierjeva transformacija (DFT, FFT). Teoretična zasnova in realizacija digitalnih filtrov. Praktične aplikacije mikroprocesorjev na sistemih energetske elektronike: elektromotorski pogoni z izmeničnimi stroji, aktivni močnostni filtri, transportni sistemi. | | | | | | | |  | | Modern architectures of microprocessor systems. Digital signal processors. Hardware and software development tools. Operating systems for real time applications. Program languages. Discrete transfer functions, algorithms and programming of control elements (transcendental functions, integrators, derivations, controllers…). Digital signal analysis, spectral analysis and Fast Fourier transform (DFT, FFT). Theoretical concept and realization of digital filters. Practical applications of microprocessors on power electronics systems: AC drives, active power filters, transport systems. | | | | | | | |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Temeljni literatura in viri / Readings:** | | | | | |
| 1. Pisno gradivo - prirejeno za predmet 2. Vanja Ambrožič: Mikroračunalniki v močnostni elektroniki, Fakulteta za elektrotehniko, Ljubljana, 2001 3. S. M. Kuo, B. H. Lee, Real-Time Digital Signal Processing, John Wiley, 2001 4. Vanja Ambrožič: Sodobne regulacije pogonov z izmeničnimi stroji, Univerza v ljubljani, Fakulteta za elektrotehniko, 1996 | | | | | |
| **Cilji in kompetence:** | |  | | **Objectives and competences:** | |
| Cilj predmeta je seznaniti študente s sodobnimi mikroprocesorskimi sistemi za obdelovanje signalov v realnem času in regulacije v visokodinamičnih mehatronskih sistemih. | |  | | Objective of the course in to get the students acquainted with modern microprocessor systems that can process the signals in real time and control high dynamics mechatronic systems. | |
| **Predvideni študijski rezultati:** | | |  | **Intended learning outcomes:** | |
| **Znanje in razumevanje**: Študent se bo naučil programirati mikroprocesorske sisteme za hitre aplikacije v realnem času. Razumel bo prednosti in omejitve pri realizaciji procesorsko reguliranih sistemov energetske elektronike, ki so sestavni del mehatronskega sklopa, pri čemer se bo seznanil z najsodobnejšimi orodji na tem področju.  **Uporaba**: Pri predmetu je močno poudarjeno povezovanje med teorijo in prakso, saj bo študent pridobljeno znanje vseskozi preverjal na realnem procesorskem modelu, ki ga srečujemo v industrijski praksi.  **Refleksija**: Študent bo imel možnost povezovanja matematičnega ozadja, njegovega zapisa v računalniških algoritmih in praktične aplikacije na področju procesiranja signalov v realnem času, kar je prisotno v industrijskih aplikacijah.  **Prenosljive spretnosti**: Opisana problematika vključuje uporabo visokosofisticirane in hitro se spreminjajoče mikroprocesorske tehnike. Zato mora študent posegati po spremljanju sprotnih sprememb prek strokovne literature in svetovnega spleta, kar mu bo zelo koristilo pri nadaljnjem inženirskem delu. | | |  | **Knowledge and understanding:**  The student will learn how to program microprocessor for fast application in a real time. He will understand the advantages and limitations in realization of processor controlled systems of power electronics that form a mechatronic system. He will also get acquainted with modern tools in this field.  **Application**: A strong connection between theory and praxis is emphasized. The student will test the acquired knowledge on a real processor model that is common in the industrial praxis.  **Reflection**: The student will have the possibility of connecting the mathematical background, its translation into computer algorithms, and practical application in the field of real time signal processing, as in industrial applications.  **Transferable skills:** This subject includes application of highly sophisticated and fast changing microprocessor technics. Therefore, the student has to follow the changes through specialized literature and internet, which is useful for his future engineering work. | |
|  | | |  |  | |
| **Metode poučevanja in učenja:** | | |  | **Learning and teaching methods:** | |
| Predavanja in obvezne laboratorijske vaje na laboratorijskih mikroprocesorskih sistemih. | | |  | Oral lectures and mandatory laboratory exercises on laboratory microprocessor models. | |
| **Načini ocenjevanja:** | Delež (v %) /  Weight (in %) | | | | **Assessment:** |
| 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 pisnem izpitu, pozitivna ocena pisnega izpita pa pogoj za opravljanje ustnega izpita.  Laboratorijske vaje  Pisni in ustni izpit | 50%  50% | | | | Negative grades: from 1 to 5, positive grades: from 6 to 10.  Positive evaluation of laboratory exercises is a prerequisite for the written exam; its positive evaluation is a prerequisite for the oral exam.  Laboratory exercises  Written and oral exam |
| **Reference nosilca / Lecturer's references:** | | | | | |
| 1. AMBROŽIČ, Vanja, ZAJEC, Peter. Električni servo pogoni. 1. izd. V Ljubljani: Slovensko združenje elektroenergetikov CIGRÉ-CIRED, 2016. 2. KONTARČEK, Andraž, NEMEC, Mitja, BAJEC, Primož, AMBROŽIČ, Vanja. Single open-phase fault detection with fault-tolerant control of an inverter-fed permanent magnet synchronous machine. Automatika, ISSN 0005-1144, 2014, vol. 55, no. 4, str. 474-486. 3. DROBNIČ, Klemen, NEMEC, Mitja, FIŠER, Rastko, AMBROŽIČ, Vanja. Simplified detection of broken rotor bars in induction motors controlled in field reference frame. Control engineering practice, ISSN 0967-0661. [Print ed.], Aug. 2012, vol. 20, no. 8, str. 761-769. 4. MAKUC, Danilo, DROBNIČ, Klemen, AMBROŽIČ, Vanja, MILJAVEC, Damijan, FIŠER, Rastko, NEMEC, Mitja. Parameters estimation of induction motor with faulty rotor. Przeglęad Elektrotechniczny, ISSN 0033-2097, 2012, rok 88, 1a, str. 41-46, ilustr. 5. NEMEC, Mitja, DROBNIČ, Klemen, NEDELJKOVIĆ, David, FIŠER, Rastko, AMBROŽIČ, Vanja. Detection of broken bars in induction motor through the analysis of supply voltage modulation. IEEE transactions on industrial electronics, ISSN 0278-0046. [Print ed.], Aug. 2010, vol. 57, no. 8, str. 2879-2888. | | | | | |