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| **UČNI NAČRT PREDMETA / COURSE SYLLABUS** | | | | | | | | | | | | | | | | | |
| **Predmet:** | | | Industrijska elektronika | | | | | | | | | | | | | | |
| **Course title:** | | | Industrial Electronics | | | | | | | | | | | | | | |
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| **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 | | | | | | | | 1 | | 1 | | |
| 2nd cycle masters study programme in Electrical Engineering | | | | | Mechatronics | | | | | | | | 1 | | 1 | | |
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| **Vrsta predmeta / Course type** | | | | | | | | | | | | Obvezni-strokovni / Compulsory professional | | | | | |
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| **Univerzitetna koda predmeta / University course code:** | | | | | | | | | | | | 64229 | | | | | |
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| **Predavanja**  **Lectures** | **Seminar**  **Seminar** | | | **Vaje**  **Tutorial** | | | **Klinične vaje**  **work** | | | | **Druge oblike študija** | | | **Samost. delo**  **Individ. work** | |  | **ECTS** |
| **45** |  | | | **30** | | |  | | | |  | | | **75** | |  | **6** |
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| **Nosilec predmeta / Lecturer:** | | | | | Peter Zajec | | | | | | | | | | | | |
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| **Jeziki /**  **Languages:** | | **Predavanja / Lectures:** | | | | **slovenski / Slovene** | | | | | | | | | | | |
| **Vaje / Tutorial:** | | | | **slovenski / Slovene** | | | | | | | | | | | |
| **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):** | | | | | | | |
| a) Pasivne komponente: upor, termistor, varistor, kondenzator in dušilka: U/I in ostale statične karakteristike. Dinamične in termične omejitve. Kriteriji dimenzioniranja/izbire pasivnih komponent.  b) Lastnosti in karakteristike polprevodniške diode, bipolarnega in unipolarnega tranzistorja. Nadomestna vezja in matematične predstavitve polprevodniških elementov za enosmerne razmere in majhne izmenične napetostno-tokovne spremembe.  c) Operacijski ojačevalnik. Lastnosti idealnega operacijskega ojačevalnika in odstopanja realnega: vpliv končnega ojačenja, vhodne in izhodne upornosti, mirovnega toka, preostale napetosti, slabljenja sofazne napetosti.  Osnovna linearna in nelinearna vezja z operacijskim ojačevalnikom: seštevalnik, odštevalnik, integrator, diferenciator, logaritemski in eksponencialni ojačevalnik, množilnik. Pomembna vezja merilne in regulacijske tehnike (tokovno/napetostni in napetostni/tokovni pretvornik, mostična vezja z operacijskim ojačevalnikom, instrumentacijski ojačevalnik, merilnik temenske ter efektivne vrednosti, precizijski polvalni in polnovalni usmernik, referenčna vezja, regulatorji, omejevalniki porasta napetosti, omejevalnik napetosti).  Aktivni filtri. Preklopna vezja z in brez preklopne histereze in funkcijski generatorji. Zaporedno in vzporedno vezje stabilizatorja napetosti. | | | | | | | |  | | a) Passive components: resistor, thermistor, varistor, capacitor and choke: U/I and other static characteristics. Dynamic and thermal constraints. Criteria for sizing and selection of passive components.  b) Properties and characteristics of semiconductor diodes, bipolar and unipolar transistors. Equivalent circuits and mathematical representation of semiconductor components for DC conditions and small signal analysis.  c) Operational amplifier. Characteristics of an ideal operational amplifier and the deviations of the real: the impact of the frequency bandwidth, input and output resistance, the bias current, offset voltage, common mode attenuation. The basic linear and nonlinear operational amplifier circuits: adder, subtractor, integrator, differentiator, logarithmic and exponential amplifier, multiplier. Important circuits for measurement and control techniques (current/voltage and voltage/current converter), bridge circuits with operational amplifier, instrumentation amplifier, peak and effective values meter, precision half-wave and full-wave rectifier, reference circuits, controllers, limiters and voltage limiter). Active filters. Switching circuits with and without switching hysteresis and function generators. Series and parallel circuit voltage stabilizer. | | | | | | | |

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| **Temeljni literatura in viri / Readings:** | | | | | |
| 1. P. Šuhel: Sistemi industrijske elektronike: Operacijski ojačevalniki, Univerza v Ljubljani, Fakulteta za elektrotehniko, Ljubljana, 1990. 2. P. Zajec: Interna skripta-zapiski predavanj 3. T.E. Price: Analog Electronics, Prentice Hall, London, 1997. 4. J.M. Jacob: Analog Integrated Circuit Applications, Prentice Hall, New Jersey, 2000. 5. R.F. Coughlin & F.F.Driscoll: Operational Amplifiers and Linear Integrated Circuits, Prentice Hall, New Jersey, 2001. | | | | | |
| **Cilji in kompetence:** | |  | | **Objectives and competences:** | |
| Podaja in usvojitev razumevanja o delovanju, izbiri in dimenzioniranju pasivnih in polprevodniških elektronskih komponent na primeru osnovnih in kompleksnejših vezij s področij merilne, procesne in krmilno regulacijske tehnike.  Seznanitev študenta z lastnostmi realnih elektronskih komponent in vezij je osnova za kritično presojo delovanja celotnega mehatronskega sistema in prepoznavo morebitnih napak in odstopanj. | |  | | To provide basic understanding of the operation, selection and dimensioning of passive electronic components and semiconductor in the case of basic and more complex circuits in the fields of measurement and control techniques.  Acquaintance with the characteristics of real electronic components and circuits is the basis for critical assessment of the whole mechatronic system and identification of possible errors and deviations. | |
| **Predvideni študijski rezultati:** | | |  | **Intended learning outcomes:** | |
| Razumevanje delovanja in fizikalnih omejitev pasivnih ter aktivnih analognih in digitalnih komponent. Poznavanje analiznih in načrtovalskih korakov pri reševanju problemov delnih in kompleksnih vezij. Poznavanje sestavnih delov vezij ter procesiranja signalov v specifičnih vezjih s področja merilne in krmilno-regulacijske tehnike. Razumevanje in uporaba naučenih principov pri prepoznavanju in analizi obravnavanih komponent v enostavnejših kot tudi kompleksnejših vezjih. | | |  | Understanding the operation and physical limitations of passive and active analogue and digital components. To gain deeper knowledge during the analysis and design steps in problem solving of partial and complex circuits. Knowledge of specific circuits and signal processing in the field of measurement and closed-loop control techniques. Understanding and application of learned principles in the identification and analysis of the components discussed in simple as well as complex circuits. | |
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| **Metode poučevanja in učenja:** | | |  | **Learning and teaching methods:** | |
| Predavanja s sprotnim avditornim utrjevanjem snovi na primeru računskih nalog. Praktično utrjevanje snovi na laboratorijskih vajah. | | |  | Lectures with a number of practical tutorial examples. Laboratory work for practical verification of lecture material. | |
| **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 | 20%  40%  40% | | | | 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 the final grade:   * laboratory exercises * written exam * oral examination |
| **Reference nosilca / Lecturer's references:** | | | | | |
| 1. PETKOVŠEK, Marko, LEBAN, Aleš, NEMEC, Mitja, VONČINA, Danijel, ZAJEC, Peter. Series active power filter for high-voltage synchronous generators, Informacije MIDEM, ISSN 0352-9045, Dec. 2013, vol. 43, no. 4, str. 228-234. 2. FLISAR, Uroš, VONČINA, Danijel, ZAJEC, Peter. Voltage sag independent operation of induction motor based on Z-source inverter, Compel, ISSN 0332-1649, 2012, vol. 31, no. 6, str. 1931-1944. 3. RUPAR, Uroš, LAHAJNAR, Franci, ZAJEC, Peter. Iterative-learning-based torque-ripple compensation in a transverse flux motor, IET control theory & applications, ISSN 1751-8644, 2012, vol. 6, no. 3, str. 341-348. 4. PETKOVŠEK, Marko, KOSMATIN, Peter, ZEVNIK, Ciril, VONČINA, Danijel, ZAJEC, Peter. Measurement system for testing of bipolar plates for PEM electrolyzers, Informacije MIDEM, ISSN 0352-9045, mar. 2012, letn. 42, št. 1, str. 60-67. 5. OSTROŽNIK, Simon, BAJEC, Primož, ZAJEC, Peter. A study of a hybrid filter, IEEE transactions on industrial electronics, ISSN 0278-0046, Mar. 2010, vol. 57, no. 3, str. 935-942. | | | | | |