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| **UČNI NAČRT PREDMETA / COURSE SYLLABUS** | | | | | | | | | | | | | | | | | |
| **Predmet:** | | | Optimizacija pri automatizaciji načrtovanja elektronskih vezij | | | | | | | | | | | | | | |
| **Course title:** | | | Optimization in Electronic Design Automation | | | | | | | | | | | | | | |
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| **Študijski program in stopnja**  **Study programme and level** | | | | | **Študijska smer**  **Study field** | | | | | | | | **Letnik**  **Academic year** | | **Semester**  **Semester** | | |
| Doktorski študijski program tretje stopnje Elektrotehnika | | | | | Ni smeri | | | | | | | | 1 | |  | | |
| 3rd cycle: doctoral study programme Electrical Engineering | | | | |  | | | | | | | |  | |  | | |
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| **Vrsta predmeta / Course type** | | | | | | | | | | | | izbirni / elective | | | | | |
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| **Univerzitetna koda predmeta / University course code:** | | | | | | | | | | | | 64815 | | | | | |
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| **Predavanja**  **Lectures** | **Seminar**  **Seminar** | | | **Vaje**  **Tutorial** | | | **Klinične vaje**  **work** | | | | **Druge oblike študija** | | | **Samost. delo**  **Individ. work** | |  | **ECTS** |
|  | **30** | | |  | | |  | | | |  | | | **95** | |  | **5** |
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| **Nosilec predmeta / Lecturer:** | | | | | prof. dr. Tadej Tuma | | | | | | | | | | | | |
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| **Jeziki /**  **Languages:** | | **Predavanja / Lectures:** | | | | **Slovensko / English** | | | | | | | | | | | |
| **Vaje / Tutorial:** | | | | **Slovensko / English** | | | | | | | | | | | |
| **Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:** | | | | | | | | |  | **Prerequisits:** | | | | | | | |
| Izpolnjevanje vpisnih pogojev za doktorski študijski program.  Priporočena so osnovna znanja metod računalniškega načrtovanja analognih elektronskih vezij in izkušnje pri uporabi programskega orodja SPICE. | | | | | | | | |  | Enrollment in the doctoral study program.  Suggested basic knowledge of EDA theory and some experience in using SPICE circuit simulators. | | | | | | | |
| **Vsebina:** | | | | | | | |  | | **Content (Syllabus outline):** | | | | | | | |
| 1) Definicija pojmov in opis optimizacijskih postopkov. Neomejeni postopki: gradientni postopki prvega in drugega reda, direktni postopki, genetski algoritmi. Omejeni postopki: omejitve parametrov, uporaba kazenskih funkcij, transformacija parametrov. Občutljivost analognih vezij v frekvenčnem in časovnem prostoru.  2) Predstavitev optimizacijskega programskega paketa. Aplikacija simpleksnega algoritma in njegova paralelizacija. Izbira začetne točke. Definicija meril in oblikovanje kriterijske funkcije. Vključevanje robnih vrednosti v kriterijsko funkcijo. Lastnosti kriterijske funkcije (profil, šum). Demonstracija zagona programa in pridobivanje rezultatov.  3) Srednje velik optimizacijski primer iz industrijskega okolja, katerega je še mogoče obravnavati na posameznih delovnih postajah. Individualna optimizacija večjega analognega sklopa z uporabo masivno paralelnega računalnika in analiza rezultatov. | | | | | | | |  | | 1) Term definition and optimization method overview. Unconstrained methods: first and second order gradient algorithms, direct algorithms and genetic algorithms. Constrained methods: parameter constrains, penalty functions, parameter space transformations. Analog circuit sensitivity in frequency and time.  2) Introduction to an analog circuit optimization tool. The simplex algorithm and its parallelization. Choosing a seed. Measurement definition and cost function formulation. Including design corners into the cost function. Cost function properties (cost profile and noise). A demo run of the tool and result interpretation.  3) A medium size circuit is run by each student on a personal computer. A large analog optimization case is run on a computer farm. | | | | | | | |

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| **Temeljni literatura in viri / Readings:** | | | | | |
| 1. TUMA, Tadej, BÜRMEN, Arpad. Circuit simulation with SPICE OPUS : theory and practice, (Modeling and simulation in science, engineering and technology). Boston; Basel; Berlin: Birkhäuser, cop. 2009. XVI, 399 str.  2. Spletna stran fakultetnega orodja [www.spiceopus.si](http://www.spiceopus.si)  3. Spletna stran Fakultetnega orodja PyOPUS (<http://fides.fe.uni-lj.si/pyopus/>)  4. BRATKOVIČ, Franc. Računalniško načrtovanje vezij, Občutljivost in optimizacija. 2. dopolnjena izd. Ljubljana: Fakulteta za elektrotehniko in računalništvo, 1994. VII, 273 str. | | | | | |
| **Cilji in kompetence:** | |  | | **Objectives and competences:** | |
| Teoretična znanja na področju optimizacije analognih elektronskih vezij. Pridobiti praktične izkušnje pri delu s programskih orodjem SPICE. | |  | | Theoretical knowledge of optimization procedures in EDA. Employing optimization techniques in practical circuit simulation. | |
| **Predvideni študijski rezultati:** | | |  | **Intended learning outcomes:** | |
| Študent je sposoben samostojno načrtovati analogna integrirana vezija. | | |  | Student is capable of independent analogue integrated circuit design. | |
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| **Metode poučevanja in učenja:** | | |  | **Learning and teaching methods:** | |
| Individualne konzultacije, vodeno seminarsko delo, samostojno projektno delo. | | |  | Individual consultation, directed seminar work, independent project work. | |
| **Načini ocenjevanja:** | Delež (v %) /  Weight (in %) | | | | **Assessment:** |
| Način: samostojen laboratorijski projekt. Ocene od 1 do vključno 5 so negativne, ocene od vključno 6 do 10 so pozitivne.  Prispevki k oceni:  Laboratorijski projekt | 100% | | | | Type: independent laboratory project. Negative grades: from 1 to 5, positive grades: from 6 to 10.  Contributions to final grade:  laboratory project |
| **Reference nosilca / Lecturer's references:** | | | | | |
| TUMA, Tadej, BÜRMEN, Arpad. Circuit simulation with SPICE OPUS : theory and practice, (Modeling and simulation in science, engineering and technology). Boston; Basel; Berlin: Birkhäuser, cop. 2009.  PUHAN, Janez, BÜRMEN, Arpad, TUMA, Tadej, FAJFAR, Iztok. Teaching assembly and C language concurrently. Int. J. Electr. Eng. Educ., Apr. 2010, vol. 47, no. 2, str. 120-131,  OLENŠEK, Jernej, BÜRMEN, Arpad, PUHAN, Janez, TUMA, Tadej. Automated analog electronic circuits sizing. V: QING, Anyong. Differential evolution : fundamentals and applications in electrical engineering. [Piscataway]: IEEE Press; Singapore: J. Wiley & Sons, cop. 2009, str. [353]-367.  BÜRMEN, Arpad, OLENŠEK, Jernej, TUMA, Tadej. Mesh adaptive direct search with second directional derivative-based Hessian update. Computational optimization and applications, ISSN 0926-6003. [Print ed.], Dec. 2015, vol. 62, no. 3, str. 693-715.  KORINŠEK, Gašper, DERLINK, Maja, VIRANT-DOBERLET, Meta, TUMA, Tadej. An autonomous system of detecting and attracting leafhopper males using species- and sex-specific substrate borne vibrational signals. Computers and electronics in agriculture, ISSN 0168-1699. [Print ed.], 2016, vol. 123, str. 29-39. | | | | | |