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| **UČNI NAČRT PREDMETA / COURSE SYLLABUS** | | | | | | | | | | | | | | | | | |
| **Predmet:** | | | Elektromagnetika | | | | | | | | | | | | | | |
| **Course title:** | | | Electromagnetics | | | | | | | | | | | | | | |
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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 | | | | |  | | | | | | | | 1 | |  | | |
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| **Vrsta predmeta / Course type** | | | | | | | | | | | | Izbirni/elective | | | | | |
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| **Univerzitetna koda predmeta / University course code:** | | | | | | | | | | | | 64804 | | | | | |
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| **Predavanja**  **Lectures** | **Seminar**  **Seminar** | | | **Vaje**  **Tutorial** | | | **Klinične vaje**  **work** | | | | **Druge oblike študija** | | | **Samost. delo**  **Individ. work** | |  | **ECTS** |
| **30** |  | | |  | | |  | | | |  | | | **95** | |  | **5** |
|  | | | | | | | | | | | | | | | | | |
| **Nosilec predmeta / Lecturer:** | | | | | Izr. prof. dr. Dejan Križaj | | | | | | | | | | | | |
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| **Jeziki /**  **Languages:** | | **Predavanja / Lectures:** | | | | **slovensko (angleško) / slovene (english)** | | | | | | | | | | | |
| **Vaje / Tutorial:** | | | | **slovensko (angleško) / slovene (english)** | | | | | | | | | | | |
| **Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:** | | | | | | | | |  | **Prerequisits:** | | | | | | | |
| Vpis v prvi letnik doktorskega programa, Priporočena so osnovna znanja osnove teorije elektromagnetnega polja, višja matematika in osnove numeričnih metod v elektrotehniki. | | | | | | | | |  | Enrolment in the 1st year of doctoral study programme,  Suggested basic knowledge of fundamentals of electrical engineering, higher mathematics, fundamentals of numerical methods in engineering. | | | | | | | |
| **Vsebina:** | | | | | | | |  | | **Content (Syllabus outline):** | | | | | | | |
| Predmet je sestavljen iz treh delov: 1) teorije elektromagnetnega polja, kjer se obnovi Maxwellove enačbe v integralni obliki in jih nadgradi v diferencialni notaciji. Poleg tega se obravnava Poyntingov teorem, Helmholtzovo enačbo, Greenove formule itd. ter prikaže način matematične formulacije elektromagnetnega polja za numerično reševanje. V drugem delu obravnavamo praktične vidike numeričnih simulacij v elektromagnetiki (možne poenostavitve enačb, mejni pogoji, robni pogoji, diskretizacija enačb in vzpostavitev mreže za numerično reševanje, izbira numerične metode). V tretjem delu izberemo konkreten primer iz elektromagnetike ( npr. elektrostatike, magnetostatike, tokovnega polja ali valovodnih struktur) ter ga opišemo in analiziramo z enim od računalniških orodij za numerične simulacije v elektromagnetiki. | | | | | | | |  | | The course is constructed of three parts:   1. Theoretical part in which we repeat Maxwell’s laws in integral form and transform them to a differential one. Poynting theorem, Helmholtz equation, Green formulation are introduced. Mathematical formulation of electromagnetic field for numerical computation is analysed. 2. Aspects of numerical simulations in electromagnetics are discussed (possible simplifications, boundary conditions, discretization of equations, meshing, methods for numerical computation). 3. A concrete practical example of an electromagnetic structure is analysed and suitably modelled using computational tools for numerical simulations in electromagnetics. | | | | | | | |

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| **Temeljni literatura in viri / Readings:** | | | | | | |
| A. R. Sinigoj: ELMG polje, Založba FE, Ljubljana, 1996.  P. P. Silvester, R. L. Ferrari: Finite elements for electrical engineers, University Press, Cambridge, 1996.  J. A. Stratton: Electromagnetic theory, McGraw-Hill, New York, 1941.  Gerard Meunier: The Finite Element Method for Electromagnetic Modeling, ISTE Ltd and John Wiley & Sons Inc, 2008.  Jianming Jin: The Finite Element Method in Electromagnetics, Wiley, 2014, ISBN111884198  W. B J Zimmerman: Multiphysics Modeling with Finite Element Method, World Scientific Publishing Company, 2006.  [www.comsol.com](http://www.comsol.com) | | | | | | |
| **Cilji in kompetence:** | |  | | **Objectives and competences:** | | |
| * poglobitev teorije elektromagnetnega polja * spoznavanje ter uporaba numeričnih metod v elektromagnetiki * reševanje konkretnega primera z uporabo računalniških orodij za numerično simulacijio * virtualno načrtovanje elektromagnetnih struktur in sklopov. | |  | | * In depth understanding of electromagnetic field * Understanding numerical methods in electrical engineering * Virtual design electromagnetic structures and systems * Solving a concrete simulation case | | |
| **Predvideni študijski rezultati:** | | |  | **Intended learning outcomes:** | | |
| * nadgradnja znanj teorije elektromagnetnega polja * uporaba numeričnih metod v elektromagnetiki * uporaba računalniških orodij za numerične simulacije v elektromagnetiki | | |  | * deeper understanding on the theory of electromagnetic field * understand and use computational methods in electromagnetics * understand and use computer tools for numerical simulations | | |
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| **Metode poučevanja in učenja:** | | |  | **Learning and teaching methods:** | | |
| Predavanja, samostojno raziskovalno delo, uporaba računalniških orodij, seminarsko delo. | | |  | Lectures, research work, usage of computer tools for numerical simulations. | |
| **Načini ocenjevanja:** | Delež (v %) /  Weight (in %) | | | | **Assessment:** | |
| Ocena seminarja in ustnega zagovora seminarja. | **50%**  **50%** | | | | Seminar and oral presentation of a seminar. | |
| **Reference nosilca / Lecturer's references:** | | | | | | |
| PEČAR, Borut, VRTAČNIK, Danilo, RESNIK, Drago, MOŽEK, Matej, ALJANČIČ, Uroš, DOLŽAN, Tine, AMON, Slavko, KRIŽAJ, Dejan. A strip-type microthrottle pump : modeling, design and fabrication. *Sensors*, vol. 13, no. 3, str. 3092-3108.  KRIŽAJ, Dejan, ISKRA, Ivan, REMŠKAR, Maja. (Quasi 3D) numerical simulation of operation of a capacitive type nanoparticle counter. *Journal of electrostatics*, Dec. 2011, vol. 69, no. 6, str. 533-539.  VUKADINOVIĆ, Mišo, MALIČ, Barbara, KOSEC, Marija, KRIŽAJ, Dejan. Modelling and characterization of thin film planar capacitors : inherent errors and limits of applicability of partial capacitance methods. *Measurement science & technology*, 2009, vol. 20, no. 11, str. 115106-1-115106-11.  KRIŽAJ, Dejan, JAN, Janja, VALENČIČ, Vojko. Modeling AC current conduction through a human tooth. *Bioelectromagnetics*, April 2004, vol. 25, no. 3, str. 185-195.  KRIŽAJ, Dejan, AMON, Slavko. Numerical analysis of edge effects in side illuminated strip detectors for digital radiology. *Nuclear instruments and methods in physics research. Section A, Accelerators, spectrometers, detectors and associated equipment*, 2000, vol. 439, str. 451-457. | | | | | | |