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| **UČNI NAČRT PREDMETA / COURSE SYLLABUS** | | | | | | | | | | | | | | | | | |
| **Predmet:** | | | Izbrana poglavja iz matematike | | | | | | | | | | | | | | |
| **Course title:** | | | Selected topics in mathematics | | | | | | | | | | | | | | |
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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:** | | | | | | | | | | | | 64801 | | | | | |
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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. Gregor Dolinar | | | | | | | | | | | | |
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| **Jeziki /**  **Languages:** | | **Predavanja / Lectures:** | | | | **Slovenski, angleški/Slovenian, English** | | | | | | | | | | | |
| **Vaje / Tutorial:** | | | |  | | | | | | | | | | | |
| **Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:** | | | | | | | | |  | **Prerequisits:** | | | | | | | |
| Vpis v doktorski študij | | | | | | | | |  | Enrolment in the program | | | | | | | |
| **Vsebina:** | | | | | | | |  | | **Content (Syllabus outline):** | | | | | | | |
| Funkcionalna analiza:  -metrični prostori (pojem razdalje, lastnosti metričnih prostorov, primeri različnih metrik na evklidskih in funkcijskih prostorih)  -normirani prostori (pojem norme, zveza med normo in razdaljo)  -prostori s skalarnim produktom (Hilbertov prostor)  -omejeni linearni operatorji, matrike (princip skrčitve slik in negibna točka, spektralna teorija, lastne vrednosti in lastni vektorji)  -valčki  Diskretna matematika:  -osnove teorije grafov -prirejanja in pokritja v dvodelnih grafih, dualnost, Hallov pogoj, stabilna prirejanja  -problem pretoka v omrežjih, maksimalni pretok in minimalni prerez, izrek Forda in Fulkersona, dualnost, celoštevilski pretoki  -linearno programiranje, simpleksni postopek, primalni in dualni linearni programi, uporaba  Numerično reševanje parcialnih diferencialnih enačb z metodo končnih elemetov:  - metoda končnih differenc za robni problem drugega reda  - variacijska (šibka) oblika problema (ustrezni funkcijski prostori, ekvivalenca oblik)  - diskretizacija (triangulacije, baze z majhnim nosilcem, zapis problema v matrični obliki,  numerično računanje integralov)  - numerično reševanje s paketom FreeFEM++ | | | | | | | |  | | Functional analysis:  -metric spaces (notion of distance, properties of matric spaces, examples of different metrics on vector spaces and on functional spaces)  -normed vector spaces (notion of norm, relations between norms and metrics)  -spaces with scalar product (Hilbert space)  -bounded linear operators, matrices (contraction mapping principle and fixed point, spectral theory, eigenvalues and eigenvectors)  -wavelets  Discrete mathematics: -graphs, basics.  -matchings and coverings in bipartite graphs, duality, Hall marriage condition, stable matchings  -flow problems in networks, maximum flow and minimum cut, Ford/Fulkerson theorem, duality, flow integrality  -linear programming, simplex method, primal and dual programs, applications  Numerical solution of partial differential equations by the finite element method:  - finite element method for second order boundary value problem  - variational (weak) form of the problem (appropriate functional spaces, equivalence of classical and variational form)  - discretization (triangulation, bases with local support, matrix form notation)  - numerical integration  - numerical solution using FeeFEM++ open source package | | | | | | | |

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| **Temeljni literatura in viri / Readings:** | | | | | |
| [1] M. Pedersen, Functional Analysis in Applied Mathematics and Engineering, Chapman & Hall/CRC, 1999.  [2] J. T. Oden, L. Demkowicz, Applied Functional Analysis, CRC Press, 2010.  [3] R. Diestel, Graph Theory, Springer-Verlag, GTM 173, 3. izdaja, 2005. [4] J. M. Kleinberg, Éva Tardos, Algorithm design, Addison-Wesley, 2006.  [5] B. S. Jovanović, E. Süli, Analysis of finite difference schemes, Springer, 2014.  [6] J. N. Reddy, An Introduction to the Finite Element Method (Engineering Series), McGraw-Hill Education, 2005. | | | | | |
| **Cilji in kompetence:** | |  | | **Objectives and competences:** | |
| Namen predmeta je predstavitev nekaterih matematičnih pojmov in metod, ki se pogosto uporabljajo pri formulaciji in reševanju problemov v elektrotehniki. Pri tem je poudarek na poglobljenem razumevanju teh pojmov in še zlasti na korektni uporabi matematičnih metod pri reševanju problemov iz elektrotehnike. | |  | | Presentation of mathematical notions and methods which are frequently used in formulation and in solution of different problems which arise in electrical engineering. Deeper understanding of mathematical concepts and correct usage of mathematical methods are emphasized. | |
| **Predvideni študijski rezultati:** | | |  | **Intended learning outcomes:** | |
| Študentu bo osvojeno znanje omogočilo nove pristope k reševanju najzahtevnejših problemov, hkrati pa bo lažje kritično ocenil dobljene rezultate. | | |  | Students will be able to use new approaches in their attempts to solve the most difficult problems in electrical engineering and they will be also able to critically evaluate the obtained results. | |
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| **Metode poučevanja in učenja:** | | |  | **Learning and teaching methods:** | |
| V okviru predavanj so predstavljena vsa tri našteta področja. Študent izbere enega izmed naštetih področij. Od študenta se pričakuje poglobljeno znanje izbranega področja, na preostalih dveh področjih si pridobi zgolj temeljna znanja. | | |  | Lectures cover all three listed topics. Student choose one of the topic. Deeper understanding of the chosen topic and basic knowledge about the other two topics are required. | |
| **Načini ocenjevanja:** | Delež (v %) /  Weight (in %) | | | | **Assessment:** |
| Domače naloge z vseh treh področij  Seminarska naloga, pri kateri študent reši problem, ki je povezan z elektrotehniko, in pri tem uporabi pridobljena matematična znanja s poudarkom na enem izmed naštetih področij. | **60**  **40** | | | | Homeworks from all three topics  Seminar, where a student solve a problem, connected to electrical engineering, with mathematical methods from the chosen topic. |
| **Reference nosilca / Lecturer's references:** | | | | | |
| DOLINAR, Gregor, MOLNÁR, Lajos. Sequential endomorphisms of finite-dimensional Hilbert space effect algebras. Journal of physics. A, Mathematical and theoretical, ISSN 1751-8113, 2012, vol. 45, no. 6, 065207 (11 str.).  DOLINAR, Gregor, KUZMA, Bojan, OBLAK, Polona. On maximal distances in a commuting graph. The electronic journal of linear algebra, ISSN 1081-3810, 2012, vol. 23, str. 243-256.  DOLINAR, Gregor, MOLNÁR, Lajos. Automorphisms for the logarithmic product of positive semidefinite operators. Linear and Multilinear Algebra, ISSN 0308-1087, 2013, vol. 61, no. 2, 161-169.  DOLINAR, Gregor, HOU, Jin Chuan, KUZMA, Bojan, QI, Xiaofei. Spectrum nonincreasing maps on matrices. Linear Algebra and its Applications, ISSN 0024-3795. [Print ed.], 2013, vol. 438, iss. 8, str. 2504-3510  DOLINAR, Gregor, GUTERMAN, Aleksandr Emilevič, KUZMA, Bojan, OBLAK, Polona. Commuting graphs and extremal centralizers. Ars mathematica contemporanea, ISSN 1855-3966. [Tiskana izd.], 2014, vol. 7, no. 2, str. 453-459. | | | | | |