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| **UČNI NAČRT PREDMETA / COURSE SYLLABUS** | | | | | | | | | | | | | | | | | |
| **Predmet:** | | | Integrirani pogonski sistemi | | | | | | | | | | | | | | |
| **Course title:** | | | Integrated Drive Systems | | | | | | | | | | | | | | |
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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 | | | | | | | | 2 | | 1 | | |
| 2nd cycle masters study programme in Electrical Engineering | | | | | Mechatronics | | | | | | | | 2 | | 1 | | |
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| **Vrsta predmeta / Course type** | | | | | | | | | | | | Obvezni-strokovni / Compulsory professional | | | | | |
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| **Univerzitetna koda predmeta / University course code:** | | | | | | | | | | | | 64292 | | | | | |
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| **Predavanja**  **Lectures** | **Seminar**  **Seminar** | | | **Vaje**  **Tutorial** | | | **Klinične vaje**  **work** | | | | **Druge oblike študija** | | | **Samost. delo**  **Individ. work** | |  | **ECTS** |
| **30** |  | | | **45** | | |  | | | |  | | | **75** | |  | **6** |
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| **Nosilec predmeta / Lecturer:** | | | | | Rastko Fišer | | | | | | | | | | | | |
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| **Jeziki /**  **Languages:** | | **Predavanja / Lectures:** | | | | **slovenski / Slovenian** | | | | | | | | | | | |
| **Vaje / Tutorial:** | | | | **slovenski / Slovenian** | | | | | | | | | | | |
| **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):** | | | | | | | |
| Trendi razvoja električnih pogonskih motorjev in reguliranih pogonov. Prehodni pojavi, dinamična stanja elektromotorskih pogonov, energijske izgube med prehodnimi pojavi in njihovo zmanjšanje. Uporaba računalniških orodij in metod za modeliranje, simuliranje in vrednotenje obratovalnih stanj elektromotorskih pogonov.  Pogoni z motorji malih moči in posebnih konstrukcijskih izvedb. Mnogofazni motorji in pretvorniki. Pogonski sistemi z linearnimi motorji. Električni pogonski sistemi v cestnih in tirnih vozilih (glavni pogoni, pomožni pogoni). Sistemi električne vleke - klasični, moderni, smeri razvoja. Pogonski sistemi in pretvarjanje električne energije v vetrnih elektrarnah.  Nadzor stanja in diagnostika elektromotorskih pogonov. Detekcija električnih okvar in mehanskih poškodb pogonskih motorjev med obratovanjem. Avtomatizacija monitoringa v integriranem sistemu vodenja in nadzora elektromotorskih pogonov (on-line sistemi). Uporaba detekcije in diagnostike napak v kontroli kakovosti izdelave velikoserijskih motorjev. | | | | | | | |  | | State-of-the-art and future trends of electric motors and variable-speed drives. Transient states, dynamic operation of electric drives and servo systems, methods for reduction of energy losses during transients. Application of computer techniques for modelling, simulation and evaluation of operating states of electrical drives.  Small size electric motors, fractional horse power drives, optimization of motor designs for special purpose applications. Multi-phase motors and semiconductor converters. Linear motors and drive systems. Electrical motors and drives in automotive and railway applications (traction and auxiliary drives). Electromechanical energy converters in wind power plants.  Condition monitoring and diagnostics of electrical motors and drives. Special techniques and methods for on-line fault detection (electrical and mechanical types). Concepts of automated monitoring systems for supervision of drive reliability and health. Methods for quality control in mass-production of electrical motors. | | | | | | | |

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| **Temeljni literatura in viri / Readings:** | | | | | |
| 1. R. Fišer, K. Drobnič, Interno študijsko gradivo v pisni in elektronski obliki (Internal study  material).  2. P. Krause, O. Wasynczuk, S. Sudhoff, S. Pekarek, Analysis of Electric Machinery and Drive  Systems, IEEE Press, Wiley, 2013.  3. R. Krishnan, Permanent Magnet Synchronous and Brushless DC Motor Drives, CRC Press, 2010.  4. M. Jadrić, B. Frančić, Dinamika električnih strojeva, Graphis, 2004.  5. A. M. Trzynadlowski, Control of Induction Motors, Academic Press, 2001.  6. C. M.Ong, Dynamic Simulation of Electric Machinery, Prentice Hall, 1998.  7. I. Boldea, S. A. Nasar, Linear Motion Electromagnetic Devices, Taylor&Francis, 2001.  8. U. Riefenstahl, Elektrische Antriebstechnik, B.G. Teubner Stuttgart, Leipzig, 2000.  9. P. Tavner, L. Ran, J. Penman, H. Sedding, Condition Monitoring of Rotating Electrical Machines,  IEEE Press, Wiley, 2008. | | | | | |
| **Cilji in kompetence:** | |  | | **Objectives and competences:** | |
| Pridobiti poglobljena teoretična in praktična znanja o sodobnih izvedbah integriranih elektromotorskih pogonov. | |  | | Student will be provided with theoretical and practical knowledge on electrical drives integrated in modern mechatronic systems. | |
| **Predvideni študijski rezultati:** | | |  | **Intended learning outcomes:** | |
| Študent bo spoznal zgradbo in principe delovanja zahtevnih integriranih pogonskih sistemov. Seznanil se bo z vrsto posebnih izvedb pogonskih motorjev, ki odstopajo od običajne konstrukcije s ciljem zagotavljanja optimalnega obratovanja. Razumel bo vlogo in izvedbo vezij močnostne elektronike v sklopu pogonskih sistemov. Z uporabo matematičnega modeliranja bo sposoben razviti in uporabljati simulacijske modele obratovalnih stanj električnih pogonov. | | |  | Student will get knowledge about operating principles of integrated drive systems. He will be acquainted with several particular types of electric motors, which are designed for special purpose applications in order to assure optimal operation. Student will understand the purpose and design of power electronic converters which are important part of controlled drives. Using techniques of mathematical modelling he will be able to develop and use simulation models of complex electrical drives. | |
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| **Metode poučevanja in učenja:** | | |  | **Learning and teaching methods:** | |
| Predavanja, laboratorijske vaje s predhodnimi pripravami, individualni seminar. | | |  | Lectures, laboratory exercises with preliminary instructions, individual seminar work. | |
| **Načini ocenjevanja:** | Delež (v %) /  Weight (in %) | | | | **Assessment:** |
| Način: laboratorijske vaje, individualni seminar, 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 * individualni seminar * ustni izpit | 20%  60%  20% | | | | Type: laboratory exercises, individual seminar work, 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 final grade:   * laboratory exercises * individual seminar work * oral examination |
| **Reference nosilca / Lecturer's references:** | | | | | |
| 1. **FIŠER, Rastko**, LAVRIČ, Henrik, BUGEZA, Miroslav, MAKUC, Danilo. Computations of magnetic field anomalies in synchronous generator due to rotor excitaton coil faults. *IEEE transactions on magnetics*, May 2013, vol. 49, no. 5, str. 2303-2306. 2. GAŠPARIN, Lovrenc, ČERNIGOJ, Andrej, **FIŠER, Rastko**. Additional cogging torque components due to asymmetry in stator back iron of PM synchronous motors. *Compel*, 2011, vol. 30, no. 3, str. 894-905. 3. **FIŠER, Rastko**, LAVRIČ, Henrik, BUGEZA, Miroslav, MAKUC, Danilo. FEM modeling of inter-turn short-circuits in excitation winding of turbogenerator. *Przeglęad Elektrotechniczny*, 2011, rok 87, 3, str. 49-52. 4. ČERNIGOJ, Andrej, GAŠPARIN, Lovrenc, **FIŠER, Rastko**. Native and additional cogging torque components of PM synchronous motors - evaluation and reduction. *Automatika*, 2010, god. 51, br. 2, str. 157-165. 5. GAŠPARIN, Lovrenc, ČERNIGOJ, Andrej, MARKIČ, Stojan, **FIŠER, Rastko**. Additional cogging torque components in permanent-magnet motors due to manufacturing imperfections. *IEEE transactions on magnetics*, Mar. 2009, vol. 45, no. 3, str. 1210-1213. | | | | | |