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| **UČNI NAČRT PREDMETA / COURSE SYLLABUS** | | | | | | | | | | | | | | | | | |
| **Predmet:** | | | Generatorji in transformatorji | | | | | | | | | | | | | | |
| **Course title:** | | | Generators and transformers | | | | | | | | | | | | | | |
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| **Študijski program in stopnja**  **Study programme and level** | | | | | **Študijska smer**  **Study field** | | | | | | | | **Letnik**  **Academic year** | | **Semester**  **Semester** | | |
| Podiplomski magistrski študij druge stopnje Elektrotehnika | | | | | Mehatronika, Elektroenergetika | | | | | | | | 1 | | 1 | | |
| 2nd cycle masters study programme in Electrical Engineering | | | | | Mechatronics, Electrical Power Engineering | | | | | | | | 1 | | 1 | | |
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| **Vrsta predmeta / Course type** | | | | | | | | | | | | Obvezni-strokovni/ Compulsory professional | | | | | |
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| **Univerzitetna koda predmeta / University course code:** | | | | | | | | | | | | 64218 | | | | | |
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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:** | | | | | Damijan Miljavec | | | | | | | | | | | | |
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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):** | | | | | | | |
| Izgube v jedru, navitjih in dodatne izgube v generatorjih in transformatorjih. Vezave navitij (Y, D, Z). Vezava V (open delta). Problem magnetenja v generatorjih in transformatorjih. Dinamična analiza kratkih stikov pri generatorjih in transformatorjih. Vklopni pojav v generatorjih in transformatorjih. Segrevanje, ohlajenje in različni tipi hlajenja (ONAN, ONAF, OFAF…). Dušenje kratkih stikov. Osnovni preizkusi generatorjev in transformatorjev. Spremljanje staranja izolacije v generatorjih in transformatorjih.  Obratovalna stanja (otočno obratovanja, obratovanje na togem omrežju, sinhronski kompenzator). Nihanja generatorja. Sinhronska reaktanca. Tranzientna reaktanca. Subtranzientna reaktanca. Sistem »ne-enoto«. Generatorji in transformatorji predstavljeni s simetričnimi komponentami. | | | | | | | |  | | The losses in the core, windings and additional losses in generators and transformers. Type of windings (Y, D, Z). Magnetization problems of generators and transformers. Dynamic analysis of short circuits in generators and transformers.  Inrush phenomenon of generators and transformers. Various types of cooling (ONAN, ONAF, OFAF ...). Attenuation of short circuits.  Basic tests of generators and transformers. Monitoring the aging of insulation in generators and transformers. Operating conditions (isolated operation, operating on a rigid network, synchronous compensator). Oscillations in generators. Synchronous reactance. Transient reactance. Sub-transient reactance. “Per-unit” system. Generators and transformers presented by symmetrical components. | | | | | | | |

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| **Temeljni literatura in viri / Readings:** | | | | | |
| 1. Jereb Peter, Damijan Miljavec: Vezna teorija električnih strojev, Založba FE in FRI 2008 2. Bharat Heavy Electricals Limited: Transformers, McGraw-Hill, 2005 3. S.V. Kulkarni, S.A. Khaparde: Transformer Engineering, Marcel Dekker, Inc., 2004 4. James H. Harlow: Electric Power Transformer Engineering, CRC Press, 2003 5. Aa. Carlson, J. Fuhr, G. Schemel, F. Wegscheider: Testing of Power Transformers,    1. Pro Print GmbH for ABB, Düsseldorf, 2003 6. [Ion Boldea](http://www.google.hr/search?hl=sl&tbo=p&tbm=bks&q=inauthor:%22Ion+Boldea%22) Variable Speed Generators, Taylor & Francis, 12. dec. 2010. 7. Juha Pyrhonen, Tapani Jokinen, Valeria Hrabovcova, Design of Rotating Electrical Machines, John Wiley & Sons, 2009. | | | | | |
| **Cilji in kompetence:** | |  | | **Objectives and competences:** | |
| Pridobitev poglobljenega znanja o lastnostih, konstrukcijskih značilnostih in možnostih uporabe različnih vrst generatorjev in transformatorjev. | |  | | Acquiring in-depth knowledge of different types of generators and transformers, their properties, design features and applicability. | |
| **Predvideni študijski rezultati:** | | |  | **Intended learning outcomes:** | |
| Poudarek je na aplikativnih znanjih in razumevanjih, ki jih bodoči projektant oziroma uporabnik potrebuje pri izbiri, dimenzioniranju in uporabi generatorjev in transformatorjev. | | |  | The emphasis is on applied knowledge and on understandings how to select right type of generator and transformer regarding their properties and field of use. | |
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| **Metode poučevanja in učenja:** | | |  | **Learning and teaching methods:** | |
| Predavanja, demonstracije, delo z računalniškimi orodji, laboratorijske vaje, seminarske naloge, projektno delo | | |  | Lectures, demonstrations, work with computer tools, laboratory work, coursework, project work. | |
| **Načini ocenjevanja:** | Delež (v %) /  Weight (in %) | | | | **Assessment:** |
| 1. 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   2. Način: laboratorijske vaje, projekt.  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 * projekt | 10%  45%  45%  10%  90% | | | | 1. 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   2. Type: laboratory exercises, project.  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 * project |
| **Reference nosilca / Lecturer's references:** | | | | | |
| 1. VUKOTIĆ, Mario, MILJAVEC, Damijan. Design of a permanent-magnet flux-modulated machine with a high torque density and high power factor. IET electric power applications, ISSN 1751-8660, 2016, vol. 10, iss. 1, str. 36-44. 2. VIDMAR, Gregor, MILJAVEC, Damijan. A universal high-frequency three-phase electric-motor model suitable for the delta and star winding connections. IEEE transactions on power electronics, ISSN 0885-8993, Aug. 2015, vol. 30, no. 8, str. 4365-4376. 3. VIDMAR, Gregor, MILJAVEC, Damijan, AGREŽ, Dušan. Measurement and evaluation of EDM bearing currents by the normalized Joule integral. Measurement science & technology, ISSN 0957-0233, 2014, vol. 25, no. 7, str. 1-10. 4. GOTOVAC, Gorazd, LAMPIČ, Gorazd, MILJAVEC, Damijan. Analytical model of permeance variation losses in permanent magnets of the multipole synchronous machine. IEEE transactions on magnetics, ISSN 0018-9464, Feb. 2013, vol. 49, no. 2, str. 921-928. 5. JEREB, Peter, MILJAVEC, Damijan. Vezna teorija električnih strojev. 1. izd. Ljubljana: Fakulteta za elektrotehniko, 2009. | | | | | |