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| **UČNI NAČRT PREDMETA / COURSE SYLLABUS** | | | | | | | | | | | | | | | | | |
| **Predmet:** | | | Motnje v elektroenergetskem sistemu | | | | | | | | | | | | | | |
| **Course title:** | | | Power System Disturbances | | | | | | | | | | | | | | |
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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 | | | | | Elektroenergetika | | | | | | | | 1 | | 1 | | |
| 2nd cycle masters study programme in Electrical Engineering | | | | | 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:** | | | | | | | | | | | | 64217 | | | | | |
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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:** | | | | | Rafael Mihalič | | | | | | | | | | | | |
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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):** | | | | | | | |
| Normalna in nenormalna stanja v EES, tokovne in napetostne preobremenitve v EES, pomen določitve tokovnih obremenitev v EES na dimenzioniranje elementov EES in na koordinacijo nadtokovne medfazne in zemeljskostične zaščite, fizikalno ozadje pojavov ob medfaznih in zemeljskostičnih napakah, izračun kratkostičnih in zemeljskostičnih veličin s teorijo simetričnih komponent, določitev značilnih kratkostičnih in zemeljskostičnih veličin glede na standarde, princip in metode izračuna kratkostičnih in zemeljskostičnih veličin s programskimi orodji, prekinitve vodov, metode in smisel ozemljevanja nevtralne točke, načini ozemljevanja nevtralne točke, vpliv ozemljevanja na zemeljskostične razmere in stikalne prenapetosti v omrežju, osnovne značilnosti obratovanja ozemljenih in neozemljenih omrežij, osnovni principi izklapljanja kratkostičnih in zemeljskostičnih tokov in fizikalna slika dogajanja v stikalnih napravah ob izklopu kratkostičnih veličin. | | | | | | | |  | | Normal and emergency conditions in electric power systems (EPS), current and voltage stresses in EPS, significance of current stresses determination in EPS for dimensioning process as well as earth and phase overcurrent protection coordination, physical background of phenomena during phase-to-phase and earth faults, phase-to-phase and earth-fault currents calculation by applying symmetrical components approach, calculation of characteristic fault parameters according to appropriate standards, principles and methods for phase-to-phase and earth-fault current calculation applying computer software tools, electrical conductor interruption, methods and reasons for neutral-point earthing, impact of neutral earthing on earth-fault currents and switching overvoltages in EPS, basic principles of fault currents switching and description of physical conditions in switching devices during fault current switching. | | | | | | | |

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| **Temeljni literatura in viri / Readings:** | | | | | |
| 1. Roeper, Richard: Kratkostični tokovi v trifaznih omrežjih :časovni potek in izračun veličin, Ljubljana : Fakulteta za elektrotehniko, 1987 2. International standard IEC 60909: Short-circuit currents in three-phase a.c. systems 3. Papič, P. Žunko: Elektroenergetska tehnika I, Založba FE in FRI, 2005. 4. Das, J. C.: Power system analysis : short-circuit load flow and harmonics, New York : Marcel Dekker, cop. 2002. | | | | | |
| **Cilji in kompetence:** | |  | | **Objectives and competences:** | |
| Poznavanje vzrokov za nastanek kratkostičnih in zemeljskostičnih okvar,  obvladovanje metod za izračun kratkostičnih in zemeljskostičnih okvar,  poznavanje uporabe rezultatov izračuna kratkostičnih in zemeljskostičnih okvar pri dimenzioniranju elementov EES in koordiniranju nadtokovne zaščite,  poznavanje metod za omejevanje kratkostičnih in zemeljskostičnih tokov,  poznavanje vplivnih veličin, ki določajo višino okvarnih tokov. | |  | | Gaining knowledge regarding line-to-line and earth-faults origin, capability for applying phase-to-phase and earth-fault current calculations methods, knowledge regarding application of line-to-line and earth-fault currents calculation results in dimensioning process of EPS elements and overcurrent protection coordination, mastering methods for restraining/limiting line-to-line and earth-fault currents, identifying and understanding EPS parameters influencing fault-current level. | |
| **Predvideni študijski rezultati:** | | |  | **Intended learning outcomes:** | |
| Slušatelj bo spoznal fizikalno ozadje nastanka napetostnih in predvsem tokovnih obremenitev v elektroenergetskem sistemu (EES) ob nastopu motenj (kratkostičnih, zemeljskostičnih napak v sistemu), pomen poznavanja kratkostičnih in zemeljskostičnih veličin za dimenzioniranje EES in sistema nadtokovne zaščite, način njihovega izračuna in standarde s tega področja. V smislu obnašanja sistema ob motnjah bo spoznal tudi načine in metode ozemljevanja elektroenergetskih omrežij ter osnovne metode in fizikalne principe za izločitev elementov EES, ki so vzrok motenj. | | |  | Student obtains knowledge about physical background of phenomena leading to appearance of overvoltages and current overloading in EPS (line-to-line faults, earth-faults). Further, knowledge regarding significance of fault-current calculation for dimensioning process of EPS elements and setting-up overcurrent protection. Student will be able to calculate fault currents according to standards, understand methods for EPS neutral-point handling and basic methods as well as physical principles for elimination of EPS elements that represent a source of system disturbances. | |
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| **Metode poučevanja in učenja:** | | |  | **Learning and teaching methods:** | |
| Predavanja in laboratorijske vaje | | |  | Lectures and laboratory practice | |
| **Načini ocenjevanja:** | Delež (v %) /  Weight (in %) | | | | **Assessment:** |
| 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 | 25%  50%  25% | | | | 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 final grade:   * laboratory exercises * written exam * oral examination |
| **Reference nosilca / Lecturer's references:** | | | | | |
| 1. AŽBE, Valentin, MIHALIČ, Rafael. Fault-current limitation in Slovenian electric-power transmission system. V: 23. mednarodno posvetovanje Komunalna energetika, 13. do 15. maj 2014, Maribor, Slovenija = 23rd International Expert Meeting Power Engineering, May 13th to 15th 2014, Maribor, Slovenia. Maribor: Fakulteta za elektrotehniko, računalništvo in informatiko, 2014, str. 1-11, ilustr. <http://ke.powerlab.uni-mb.si/arhiv/document.aspx?id=117>. [COBISS.SI-ID [10733140](http://cobiss.izum.si/scripts/cobiss?command=DISPLAY&base=COBIB&RID=10733140)] 2. MIHALIČ, Rafael. Moderni načini načrtovanja koordinirane nadtokovne zaščite. Elektrotehniški vestnik, ISSN 0013-5852. [Slovenska tiskana izd.], 1999, let. 66, št. 3, str. 153-161, graf. prikazi. [COBISS.SI-ID [1533012](http://cobiss.izum.si/scripts/cobiss?command=DISPLAY&base=COBIB&RID=1533012)], [[SNIP](http://www.cobiss.si/scripts/cobiss?command=SEARCH&base=snip&select=(sc=0013-5852+and+PY=1999))] 3. AŽBE, Valentin, MIHALIČ, Rafael. Analysis of methods for limiting fault currents in high-voltage electric-power networks. V: 8th International Conference on Deregulated Electricity Market Issues in South-Eastern Europe, 24-25 September 2013, Cavtat, Croatia. DEMSEE 2013. [S. l.: s. n.], 2013, str. 1-6, ilustr. [COBISS.SI-ID [10474580](http://cobiss.izum.si/scripts/cobiss?command=DISPLAY&base=COBIB&RID=10474580)] 4. AŽBE, Valentin, MIHALIČ, Rafael. Ukrepi za učinkovito obvladovanje kratkostičnih moči v prenosnih elektroenergetskih omrežjih. V: Enajsta konferenca slovenskih elektroenergetikov, Laško, 27.-29. maj 2013. [Ljubljana: Slovensko društvo elektroenergetikov CIGRÉ - CIRED], 2013, str. 1-10, ilustr. [COBISS.SI-ID [9910612](http://cobiss.izum.si/scripts/cobiss?command=DISPLAY&base=COBIB&RID=9910612)] 5. MIHALIČ, Rafael, AŽBE, Valentin. Koordinacija nadtokovne zaščite v termoelektrarni Šoštanj. V: Referati in predstavitve, paneli, kataložni zapis, ostalo. Ljubljana: Slovensko društvo elektroenergetikov CIGRÉ - CIRED, 2009, str. 1-6, ilustr. [COBISS.SI-ID [7098196](http://cobiss.izum.si/scripts/cobiss?command=DISPLAY&base=COBIB&RID=7098196)] | | | | | |