|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **UČNI NAČRT PREDMETA / COURSE SYLLABUS** | | | | | | | | | | | | | | | | | |
| **Predmet:** | | | Elektroenergetski sistemi | | | | | | | | | | | | | | |
| **Course title:** | | | Electric Power Systems | | | | | | | | | | | | | | |
|  | | | | |  | | | | | | | |  | |  | | |
| **Študijski program in stopnja**  **Study programme and level** | | | | | **Študijska smer**  **Study field** | | | | | | | | **Letnik**  **Academic year** | | **Semester**  **Semester** | | |
| Univerzitetni študijski program prve stopnje Elektrotehnika | | | | | **Energetika in mehatronika** | | | | | | | | 3. | | letni | | |
| 1st cycle academic study programme Electrical Engineering | | | | | **Power Engineering and Mechatronics** | | | | | | | | **3.** | | **summer** | | |
|  | | | | | | | | | | | | | | | | | |
| **Vrsta predmeta / Course type** | | | | | | | | | | | | Obvezni - strokovni/ compulsory professional | | | | | |
|  | | | | | | | | | | | |  | | | | | |
| **Univerzitetna koda predmeta / University course code:** | | | | | | | | | | | | 64163 | | | | | |
|  | | | | | | | | | | | | | | | | | |
| **Predavanja**  **Lectures** | **Seminar**  **Seminar** | | | **Vaje**  **Tutorial** | | | **Klinične vaje**  **work** | | | | **Druge oblike študija** | | | **Samost. delo**  **Individ. work** | |  | **ECTS** |
| **45** |  | | | **45** | | |  | | | |  | | | **85** | |  | **7** |
|  | | | | | | | | | | | | | | | | | |
| **Nosilec predmeta / Lecturer:** | | | | | Miloš Pantoš | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | | | |
| **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):** | | | | | | | |
| Delovanje elektroenergetskih sistemov, vloga generatorjev, vloga in zahteve bremen, model elektroenergetskega sistema za statično analizo, metode za izračun pretokov moči, izračun optimalnih pretokov moči glede na različne kriterije, napoved obremenitev in rezerve delovne moči, regulacija delovne moči in frekvence, regulacija napetosti in jalove moči, zagotavljanje sistemskih storitev, vpliv trga z električno energijo na delovanje elektroenergetskega sistema, zanesljivost elektroenergetskega sistema. | | | | | | | |  | | Power system operation, modeling of power system elements, methods for power flow calculation, optimal power flow calculation, short-term load forecasting, active power and frequency control, reactive power and voltage control, ancillary service procurement, impact of energy markets on power system operation, power system reliability, security of supply. | | | | | | | |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Temeljni literatura in viri / Readings:** | | | | | |
| 1. Gubina F., Delovanje elektroenergetskega sistema, Založba ULFE, 2006 2. Gubina, F., Ogorelec, A., Vodenje EES, SLOKO CIGRE, Ljubljana, 1997 3. Wood, A.J., Power generation, operation and control, Wiley, 1996 4. Kundur, P., Power System Stability and Control, Mc Graw Hill, 1994 5. Anders, G.J., Probability concepts in electric power systems, Wiley, 1990. | | | | | |
| **Cilji in kompetence:** | |  | | **Objectives and competences:** | |
| Študenti si bodo ustvarili celostno sliko o delovanju elektroenergetskega sistema in vlogi posameznih elementov (generator, breme, vod, transformator itn.) pri zagotavljanju kakovostne električne energije porabnikom. Predmet podaja osnove statične obravnave delovanja elektroenergetskega sistema po končanju prehodnih pojavov. Te analize zahtevajo pregled modelov elementov elektroenergetskega sistema za izračun pretokov moči. Sledi obravnava metod za izračun pretokov moči v omrežju in optimalnega delovanja elektroenergetskega sistema glede na različne kriterije. Študenti spoznajo vlogo rezerve moči ter regulacije frekvence in delovne moči, regulacije napetosti in jalove moči in zagotavljanje ostalih sistemskih storitev. Bistveni so tudi koncepti zanesljivosti v obratovanju elektroenergetskega sistema. | |  | | Students will obtain an overview of operation of electric power systems (generators, loads, transmission lines, transformers etc.). This course presents methods for power flow calculation, explains optimal power flows and the optimization objectives. Students will become familiar with the role of system reserves, ancillary services especially with active power and frequency control and reactive power and voltage control, the impact of energy markets on power system operation, concepts of reliable operation of power systems, security of supply. Also they will lean how to forecast the system loading – consumption. | |
| **Predvideni študijski rezultati:** | | |  | **Intended learning outcomes:** | |
| Znanje in razumevanje:  Študenti bodo razumeli delovanje elektroenergetskih sistemov. S pridobljenim znanjem bodo študenti sposobni reševati osnovne probleme na področju obratovanja elektroenergetskih sistemov.  Uporaba:  Splošni pregled na področju delovanja elektroenergetskih sistemov.  Refleksija:  Razumevanje pomena statičnih analiz pri zagotavljanju zanesljivega delovanja in načrtovanja elektroenergetskega sistema in zmožnost povezovanja specifičnih strokovnih znanj v celotno sliko.  Prenosljive spretnosti:  Sposobnost sodelovanja pri vodenju obratovanja elektroenergetskih sistemov ter sodelovanja pri oblikovanju razvojnih programov elektroenergetskih sistemov. | | |  | Knowledge and understanding:  Students will understand operation of power systems. With gained knowledge, they will be able to solve some basic problems in the field of power system operation.  Application:  Review and general knowledge of power system operation.  Reflection:  Understanding of statistical analyses in the frame of reliable operation of power systems and ability to integrate the gained knowledge with the existing in a complex picture.  Transferable skills:  Ability to collaborate in different tasks considering power system operation and determination of development programs, action plans in the field of power system planning. | |
|  | | |  |  | |
| **Metode poučevanja in učenja:** | | |  | **Learning and teaching methods:** | |
| Predavanja, avditorne in laboratorijske vaje za utrjevanje pridobljenega znanja. | | |  | Lectures and exercises. | |
| **Načini ocenjevanja:** | Delež (v %) /  Weight (in %) | | | | **Assessment:** |
| Način: avditorne in laboratorijske vaje, pisni izpit, ustni izpit.  Ocene od 1 do vključno 5 so negativne, ocene od vključno 6 do 10 so pozitivne.  Pozitivna ocena vaj je pogoj za pristop k izpitu.  Prispevki k oceni:  avditorne in laboratorijske vaje  pisni izpit  ustni izpit | 50%  25%  25% | | | | Type: auditory and laboratory exercises, written exam, oral exam.  Negative grades: from 1 to 5, positive grades: from 6 to 10.  Positive evaluation of auditory and laboratory exercises is a prerequisite for the exam.  Contributions to final grade:  auditory and laboratory exercises  written exam  oral examination |
| **Reference nosilca / Lecturer's references:** | | | | | |
| 1. BOŽIČ, Dušan, PANTOŠ, Miloš. Impact of electric-drive vehicles on power system reliability. Energy, 2015, vol. 83, str. 511-520.  2. PANTOŠ, Miloš. Market-based congestion management in electric power systems with increased share of natural gas dependent power plants. Energy, 2011, vol. 36, no. 7, str. 4244-4255  3. PANTOŠ, Miloš. Stochastic optimal charging of electric-drive vehicles with renewable energy. Energy, 2011, vol. 36, no. 11, str. 6567-6576.  4. REJC, Matej, PANTOŠ, Miloš. Short-term transmission-loss forecast for the Slovenian transmission power system based on a fuzzy-logic decision approach. IEEE transactions on power systems, 2011, vol. 26, no. 3, str. 1511-1521.  5. DOLINAR, Matjaž, DOLINAR, Drago, PANTOŠ, Miloš. Voltage security constrained minimization of power losses in an electric power system. Compel, 2009, vol. 28, iss. 3, str. 613-625. | | | | | |