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| **UČNI NAČRT PREDMETA / COURSE SYLLABUS** | | | | | | | | | | | | | | | | | |
| **Predmet:** | | | Obratovanje elektroenergetskega sistema v tržnem okolju | | | | | | | | | | | | | | |
| **Course title:** | | | Power System Operation in Market Environment | | | | | | | | | | | | | | |
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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:** | | | | | | | | | | | | 64808 | | | | | |
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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. Miloš Pantoš | | | | | | | | | | | | |
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| **Jeziki /**  **Languages:** | | **Predavanja / Lectures:** | | | | slovenski | | | | | | | | | | | |
| **Vaje / Tutorial:** | | | |  | | | | | | | | | | | |
| **Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:** | | | | | | | | |  | **Prerequisits:** | | | | | | | |
| Vpis na doktorski študij. | | | | | | | | |  | Enrollment into the program. | | | | | | | |
| **Vsebina:** | | | | | | | |  | | **Content (Syllabus outline):** | | | | | | | |
| Vpliv trga z električno energijo na delovanje elektroenergetskega sistema: vloga proizvajalcev, vloga in zahteve odjemalcev, vloga in omejitve prenosnega in razdelilnega omrežja, nove metode za analizo stacionarnih stanj in občutljivostne analize, izračun optimalnih pretokov moči glede na različne kriterije. Sistemske storitve: napoved obremenitev in rezerve delovne moči, regulacija delovne moči in frekvence, regulacija napetosti in jalove moči, nove metode za ocenjevanje napetostne stabilnosti, zagotavljanje sistemskih storitev. Zanesljivost elektroenergetskega sistema, zanesljivostni indeksi v dobavi električne energije porabnikom, zadostnost izgradnje omrežja. Uporaba verjetnostnih konceptov v delovanju sistemov in pri trgovanju z električno energijo in drugimi energenti. | | | | | | | |  | | Impact of electricity market on power system operation: the role of producers, consumers, transmission and distribution networks and their technical constraints, methods for static analyses, sensitivity analyses, optimal power flow calculation. Ancillary services: load forecasting, reserves, active power and frequency control, reactive power and voltage control, methods for voltage collapse proximity assessment, ancillary service procurement. Power system reliability, security of supply, reliability indices, network adequacy. Deterministic and stochastic concepts in power system operation and energy markets. | | | | | | | |

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| **Temeljni literatura in viri / Readings:** | | | | | |
| 1. Gubina F, (2006) Delovanje elektroenergetskega sistema, Založba ULFE, Ljubljana 2. Pantoš M, Božič D (2014) Načrtovanje elektroenergetskega sistema, Založba ULFE, Ljubljana 3. Pantoš M (2012) Exploitation of electric-drive vehicles in electricity markets. IEEE transactions on power systems 27/2:682-694 4. Pantoš M (2011) Stochastic optimal charging of electric-drive vehicles with renewable energy. Energy 36/11:6567-6576 5. Rejc M, Pantoš M (2011) Short-term transmission-loss forecast for the Slovenian transmission power system based on a fuzzy-logic decision approach. IEEE transactions on power systems 26/3:1511-1521 6. Šmon I, Pantoš M, Gubina F (2008) An improved voltage-collapse protection algorithm based on local phasors. Electric power systems research 78/3:434-440 7. Pantoš M (2013) Stochastic generation-expansion planning and diversification of energy transmission paths. Electric power systems research 98:1-10 8. Božič D, Pantoš M (2013) Assessment of investment efficiency in a power system under performance-based regulation. Energy 51/1:330-338 9. Pantoš M (2011) Market-based congestion management in electric power systems with increased share of natural gas dependent power plants. Energy 36/7:4244-4255 | | | | | |
| **Cilji in kompetence:** | |  | | **Objectives and competences:** | |
| Študenti si bodo ustvarili celostno sliko o delovanju elektroenergetskega sistema v tržnih razmerah. Poleg osnov o delovanju elektroenergetskih sistemov bo poudarek tudi na različnih modelih trgov z električno energijo: fizični trgi, finančni trgi, bilateralno trgovanje, organizirani trgi, dražba, urno trgovanje, sprotno trgovanje, izravnalni trg, trgovanje s čezmejnimi prenosnimi zmogljivostmi, zagotavljanje sistemskih storitev itn. Osrednja tema predmeta pa je predstavitev vpliva omenjenih načinov trgovanja na obratovanje elektroenergetskega sistema. | |  | | Students will obtain an overview of power system operation in market environment. This course presents models of energy markets: physical market, financial markets, bilateral trading, organized markets: auction, intra-day market, continuous market, balancing market, cross-border trading, ancillary service procurement etc. Focus of this course is the impact of energy market on power system operation. | |
| **Predvideni študijski rezultati:** | | |  | **Intended learning outcomes:** | |
| Znanje in razumevanje:  Študenti bodo razumeli delovanje elektroenergetskih sistemov, spoznali načine trgovanja z električno energijo in vplive trgovanja na obratovanje elektroenergetskih sistemov. S pridobljenim znanjem bodo študenti sposobni reševati osnovne probleme na področju obratovanja elektroenergetskih sistemov in trgovanja z električno energijo.  Uporaba:  Splošni pregled na področju delovanja elektroenergetskih sistemov in trgovanja z električno energijo.  Refleksija:  Razumevanje pomena analiz pri zagotavljanju zanesljivega delovanja elektroenergetskega sistema in pri trgovanju z električno energijo. Zmožnost povezovanja specifičnih strokovnih znanj v celotno sliko.  Prenosljive spretnosti:  Sposobnost sodelovanja pri vodenju obratovanja elektroenergetskih sistemov in pri trgovanju z električno energijo. | | |  | Knowledge and understanding:  Students will understand operation of power systems and different energy markets and their impact on power system operation. With gained knowledge, they will be able to solve some basic problems in the field of power system operation and trading with electric energy.  Application:  Review and general knowledge of power system operation and electric energy markets.  Reflection:  Understanding of analyses in the frame of reliable operation of power systems and trading with electric energy. 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 trading with electric energy. | |
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| **Metode poučevanja in učenja:** | | |  | **Learning and teaching methods:** | |
| Predavanja ali seminarske naloge. | | |  | Lectures or seminars. | |
| **Načini ocenjevanja:** | Delež (v %) /  Weight (in %) | | | | **Assessment:** |
| Način: seminarska naloga.  Ocene od 1 do vključno 5 so negativne, ocene od vključno 6 do 10 so pozitivne.  Prispevki k oceni:  seminarska naloga | 100 % | | | | Type: coursework.  Negative grades: from 1 to 5, positive grades: from 6 to 10.  Contributions to final grade:  coursework |
| **Reference nosilca / Lecturer's references:** | | | | | |
| PANTOŠ, Miloš. Exploitation of electric-drive vehicles in electricity markets. IEEE transactions on power systems, 2012, vol. 27, no. 2, str. 682-694.  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  PANTOŠ, Miloš. Stochastic optimal charging of electric-drive vehicles with renewable energy. Energy, 2011, vol. 36, no. 11, str. 6567-6576.  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.  ARTAČ, Gašper, FLYNN, Damian, KLADNIK, Blaž, PANTOŠ, Miloš, GUBINA, Andrej, GOLOB, Robert. A new method for determining the demand reserve offer function. Electric power systems research, 2013, vol. 100, str. 55-64. | | | | | |