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| **UČNI NAČRT PREDMETA / COURSE SYLLABUS** | | | | | | | | | | | | | | | | | |
| **Predmet:** | | | Načrtovanje in vzdrževanje elektroenergetskih sistemov | | | | | | | | | | | | | | |
| **Course title:** | | | Power System Planning and Maintenance | | | | | | | | | | | | | | |
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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 | | 2 | | |
| 2nd cycle masters study programme in Electrical Engineering | | | | | Electrical Power Engineering | | | | | | | | 1 | | 2 | | |
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| **Vrsta predmeta / Course type** | | | | | | | | | | | | Obvezni-strokovni / Compulsory professional | | | | | |
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| **Univerzitetna koda predmeta / University course code:** | | | | | | | | | | | | 64219 | | | | | |
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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:** | | | | | Miloš Pantoš | | | | | | | | | | | | |
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| **Jeziki /**  **Languages:** | | **Predavanja / Lectures:** | | | | Slovenski, v primeru večjega števila tujih študentov tudi angleški. | | | | | | | | | | | |
| **Vaje / Tutorial:** | | | | Slovenski, v primeru večjega števila tujih študentov tudi angleški. | | | | | | | | | | | |
| **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):** | | | | | | | |
| Napoved porabe (metoda ekspertov, časovne serije, matematični modeli, korelacija in vplivni faktorji, scenariji, analiza porasta porabe), napoved potreb po moči, ocena zanesljivosti, rezerva moči, elementi načrtovanja, postopki načrtovanja elektroenergetskega sistema, kriteriji načrtovanja, načrtovanje elektroenergetskega sistema v tržnih pogojih, okoljevarstveni vidiki pri načrtovanju, ekonomika v načrtovanju razvoja elektroenergetskega sistema, načrtovanje izgradnje elektrarn, načrtovanje omrežij, metode za prostorsko načrtovanje omrežij, metode optimiranja.  Gospodarjenje s sredstvi, ekonomika gospodarjenja in vzdrževanja, tveganja, stroški in dobiček, negotovosti, analiza dobrobiti in SWOT analiza, projektno vodenje, strateško vodenje, vzdrževanje elementov elektroenergetskega sistema, staranje elementov in življenjska doba, remonti, revitalizacija, metode vzdrževanja (popravilo po okvari brez vzdrževanja, obratovanje do uničenja elementa, časovno zasnovano vzdrževanje, nadzorno vzdrževanje, zanesljivostno vzdrževanje, vzdrževanje pred uporabo), vodenje vzdrževanja, orodja za vzdrževanje, vzdrževanje in proizvodnja, vzdrževanje in kakovost, varnost pri vzdrževanju, zagotavljanje kakovosti. | | | | | | | |  | | Long-term load (energy) forecasting (Delphi method, time series, mathematical models, correlation, impact factors, scenarios, consumption growth analysis), long-term load (power) forecasting, reliability assessment, power reserves, introduction to planning, methods and procedures of power system expansion planning, planning criteria, power system expansion planning in the market environment, environmental aspects in planning, economics in planning, planning of power plants, planning of networks, optimization methods.  Asset management, economic in asset management, risk assessment, costs and profit, uncertainties and stochastics, cost/benefit analysis, SWOT analysis, project and strategic management, maintenance of power system, aging and lifecycle of equipment, renovation, refurbishment, outages, maintenance methods (repair, operational maintenance, corrective maintenance, scheduled maintenance, preventive maintenance, reliability centred maintenance), maintenance management, tools in maintenance procedures, maintenance and electric energy production, maintenance and quality of supply, safety in maintenance, quality assurance. | | | | | | | |

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| **Temeljni literatura in viri / Readings:** | | | | | |
| 1. F. Gubina: Načrtovanje in vzdrževanje EES; skripta, knjižnica FE 2. H. Lee Willis: Aging Power Delivery Infrastructures, ISBN: 0824705394; knjižnica FE 3. R. Billinton: Reliability Evaluation of Power Systems, ISBN: 0306452596; knjižnica FE 4. R. Sullivan: Power System Planning, ISBN: 0070618003; knjižnica FE 5. M. Pantoš, D. Božič. Načrtovanje elektroenergetskega sistema. Založba FE, 2014. | | | | | |
| **Cilji in kompetence:** | |  | | **Objectives and competences:** | |
| Študentje si bodo ustvarili celostno sliko o načrtovanju in vzdrževanju elektroenergetskih sistemov, spoznali bodo različne metode napovedovanja porabe električne energije in moči in s tem povezano problematiko rezerve proizvodnih in prenosnih zmogljivosti. Poseben poudarek se namenja ocenjevanju zanesljivosti oskrbe z električno energijo. Študentje bodo spoznali postopke načrtovanja EES na podlagi uporabe optimizacijskih metod z upoštevanjem tržnih razmer, okoljevarstvenih vprašanj in ekonomike. Študentje se bodo seznanili z metodami vzdrževanja elementov EES, vprašanjem gospodarjenja s sredstvi, načrtovanjem remontov, revitalizacij, pomenom zanesljivosti oskrbe, ki se navezuje na koncepte vzdrževanja, kakovosti, in ekonomike vzdrževanja. Cilj predmeta je tudi podati znanje o varnosti pri vzdrževanju. | |  | | Students will become familiar with principles in power system planning and maintenance, different methods for long-term load forecasting (energy and power), power system reserve (production and transmission), reliability of supply. Students will gain knowledge in the field of power system expansion planning in the market environment applying different optimization methods with respect to the environmental constraints and economics. Further, they will get familiar with methods and tools for power system maintenance, asset management, outage planning, revitalization, the importance of power system reliability in the context of maintenance procedures, quality of supply, maintenance economics. Students will gain basic knowledge in the field of safety issues in the maintenance process. | |
| **Predvideni študijski rezultati:** | | |  | **Intended learning outcomes:** | |
| Znanje in razumevanje:  Študent bo razumel koncepte načrtovanja in vzdrževanja elektroenergetskega sistema. Pridobljeno znanje bo študent sposoben nadgraditi v praksi.  Uporaba:  Širši pregled na področju načrtovanja in vzdrževanja elektroenergetskih sistemov, zagotavljanja zanesljivosti oskrbe, ekonomike elektroenergetskih sistemov, okoljevarstvenih vprašanjih, upravljanje s tveganji in gospodarjenja s sredstvi.  Prenosljive spretnosti:  Sposobnost sodelovanja pri oblikovanju razvojnih načrtov (konceptov, programov) na področju energetike. | | |  | Knowledge and understanding:  Students will understand basic concepts of power system planning and maintenance. The obtained knowledge will be upgradable in the practice.  Application:  Review in the field of power system planning and maintenance, reliability of supply, economics in power systems, environmental issues, risk assessment and asset management.  Transferable skills:  Ability to participate in the development plans (concepts, programs) in the field of energy. | |
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| **Metode poučevanja in učenja:** | | |  | **Learning and teaching methods:** | |
| Predavanja in vaje za utrjevanje pridobljenega znanja. | | |  | Lectures and exercises. | |
| **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 vaj je pogoj za pristop k izpitu.  Prispevki k oceni:   * laboratorijske vaje * pisni izpit * ustni izpit | 50%  25%  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. PANTOŠ, Miloš, BOŽIČ, Dušan. Načrtovanje elektroenergetskega sistema. Založba FE, 2014. 2. BOŽIČ, Dušan, PANTOŠ, Miloš. Impact of electric-drive vehicles on power system reliability. Energy, 2015, vol. 83, str. 511-520. 3. 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 4. PANTOŠ, Miloš. Stochastic optimal charging of electric-drive vehicles with renewable energy. Energy, 2011, vol. 36, no. 11, str. 6567-6576. 5. 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. | | | | | |