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| **UČNI NAČRT PREDMETA / COURSE SYLLABUS** | | | | | | | | | | | | | | | | | | | | |
| **Predmet:** | | | **ALTERNATIVNI IN KLASIČNI TERMOENERGETSKI SISTEMI** | | | | | | | | | | | | | | | | | |
| **Course title:** | | | **ALTERNATIVE AND CLASSICAL THERMAL ENERGY SYSTEMS** | | | | | | | | | | | | | | | | | |
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| **Študijski program in stopnja**  **Study programme and level** | | | | | **Študijska smer**  **Study field** | | | | | | | | | | | **Letnik**  **Academic year** | | **Semester**  **Semester** | | |
| **ENERGETIKA, 3. stopnja** | | | | | **-** | | | | | | | | | | | **1/2** | | **1/2/3** | | |
| **ENERGY TECHNOLOGY, 3. Degree** | | | | | **-** | | | | | | | | | | | **1/2** | | **1/2/3** | | |
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| **Vrsta predmeta / Course type** | | | | | | | | | | | | | | | Izbirni/Elective | | | | | |
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| **Univerzitetna koda predmeta / University course code:** | | | | | | | | | | | | | | | D | | | | | |
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| **Predavanja**  **Lectures** | **Seminar**  **Seminar** | | | **Vaje**  **Tutorial** | | | | **Klinične vaje**  **work** | | | | | | **Druge oblike študija** | | | **Samost. delo**  **Individ. work** | |  | **ECTS** |
| **30** | **-** | | | **-** | | | | **-** | | | | | | **-** | | | **150** | |  | **6** |
|  | | | | | | | | | | | | | | | | | | | | |
| **Nosilec predmeta / Lecturer:** | | | | | **JURIJ AVSEC** | | | | | | | | | | | | | | | |
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| **Jeziki /**  **Languages:** | | **Predavanja / Lectures:** | | | | **Slovenski/Slovene** | | | | | | | | | | | | | | |
| **Vaje / Tutorial:** | | | | **Slovenski/Slovene** | | | | | | | | | | | | | | |
| **Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:** | | | | | | | | | |  | | **Prerequisits:** | | | | | | | | |
| Ni obveznosti | | | | | | | | | |  | | None | | | | | | | | |
| **Vsebina:** | | | | | | | | | |  | | **Content (Syllabus outline):** | | | | | | | | |
| **1.Vodikove in metanolove tehnologije.** Globalna ekologija in vzroki prihodnje uporabe modernih tehnologij. Energija in energijske politike. Tehnologije pridobivanja vodika (klasične tehnologije, baker-klorov proces, žveplo-jodov proces, jedrska tehnologija za termomehansko pridobivanje vodika). Biološko pridobivanje vodika. Elektroliza. Uporaba obnovljivih virov energije za proizvodnjo vodika. Alternativni preostali direktni pretvorniki energije. Procesi za pridobivanje vodika. Pridobivanje ostalih biogoriv. Transport in shranjevanje vodika. Vodik kot pogonsko sredstvo v avtomobilih, vlakih in ladjah. Uporaba vodika v gorilnih celicah. Vodik kot pogonsko sredstvo letal in raket. Uporaba vodika v ogrevalnih in hladilnih procesih. Gorivne celice in vodikov motor.  **2. Sončni termoenergetski sistemi.** Sončno sevanje.Svetloba, toplota, elektrika in goriva pridobljena iz sončne energije.Sončni toplotni sistemi.Sončne termalne elektrarne.Shranjevanje sončne energije v hranilnikih.Uporaba sončne energije za procese hlajenja.Toplotni izmenjevalci za sončno energijo**.** Prihodnji razvoj na področju uporabe sončne energije.  **3. Energetski sistemi z uporabo biomase in biogoriv**  Bioplin-proizvodnja in uporaba. Biomasa in biogoriva, principi, proizvodnja, uporaba. Biološka proizvodnja vodika. Bioreaktorji-uvod, konstrukcija, principi, modeliranje. Proizvodnja elektrike iz biomase in biogoriv.  **4. Uporaba geotermalne energije**  Izraba geotermalne energije za gretje in hlajenje. Izraba geotermalne energije za pridobivanje električne energije in toplotne energije.  **5. Klasični termoenergetski sistemi.** Energijska analiza, eksergijska analiza in analiza življenjskega cikla sistemov. | | | | | | | | | |  | | **1. Hydrogen and methanol technologies.** Global ecology and reasons of application of modern technologies. Energy and energetic politics. Processes of hydrogen production (classical technology, copper-chlorine cycle, sulfur-iodine cycle, nuclear technology for thermomechanical hydrogen production). The application of renewable energy for hydrogen production. Biological production of hydrogen. Elecreolysis. Other alternative direct energy conversion machines. Processes for hydrogen production. Production of other biofuels. Transportation of hydrogen, storage of hydrogen. Hydrogen as a motor fuel in automotive engineering, trains, ships. The application of hydogen in fuel cell technology. Hydrogen as the fuel of aircrafts and rockets. The applications of fuel cells in refrigeration and heating processes. Fuel cells and hydrogen engine.  **2. Solar thermal energy systems.** Solar Radiation resources. Light, heat, electricity and fuels produced from solar energy.Solar thermal systems.Solar thermal power plants. Solar energy storage systems.Application of solar energy for refrigeration.Heat exchangers for solar energy.Future developments on application of solar energy.  **3. Energy systems with biomass and biofuels application**  Biogas-production and application. Biomass-biofuels, principles, production, application Biological hydrogen production. Bioreactors-introduction, design,principles, modelling. The electricity production from biofuels and biomass  **4.Application of geothermal energy**  Use of geothermal energy for heating and cooling processes. Geothermal power production systems.  **5. Classical thermal energy systems**. Energy analysis, exergy analysis and life cycle analysis of energy systems.. | | | | | | | | |
| **Temeljni literatura in viri / Readings:** | | | | | | | | | | | | | | | | | | | | |
| 1. I. Dincer, M. Rosen, Exergy: Energy, Environment and Sustainable Development, 2020, Elsevier Science; 3rd edition  2.R. O'Hayre, Ryan P. Fuel Cell Fundamentals J. Wiley & Sons, cop. 2016, 3rd edition.  3.D. Seddon, The Hydrogen Economy, WSPC, , 2022.  4.B. Bhushan, Nanotechnology, Springer, 2017.  5. B. Rogers, S. Pennathur, J. Adams, Nanotechnology, 2017, CRC Press.  6. T. Engel, P. Reid, Thermodynamics, 2018, Pearson.  7. A. Bejan, Advanced engineering thermodynamics, 2016, Wiley.  8. L.E. Reichl, A Modern Course in Statistical Physics, 2016, Wiley.  9. G.F. Naterer, Advanced heat transfer, 2021, CRC Press.  10. I. Dincer, M. Ozturk, Geothermal energy systems, 2021, Elsevier. | | | | | | | | | | | | | | | | | | | | |
| **Cilji in kompetence:** | | | | | | | | |  | | **Objectives and competences:** | | | | | | | | | |
| Prikazati najsodobnejše trende v energetiki;  Podati poglobljeno znanje s področja vodikovih sistemov, klasičnih in in alternativnih energetskih sistemov v energetiki;  Prikazati mejno uporabo predhodno pridobljenih znanj iz termomehanike, matematike, fizike, gradiv, trdnosti;  Razviti sposobnosti študentov za samostojno in kreativno reševanje inženirskih problemov. | | | | | | | | |  | | To show the trends in modern energetics  To provide detailed knowledge of theory, functional use, design and calculation methods of hydrogen systems, cllasical and alternative energy systems in energy technology;  to demonstrate limit use of previously accumulated knowledge of thermomechanics, mathematics, physics, materials etc.;  To further develop student's capabilities of independent thinking and creative solutions of engineering problems. | | | | | | | | | |
| **Predvideni študijski rezultati:** | | | | | | | | | |  | **Intended learning outcomes:** | | | | | | | | | |
| Znanje in razumevanje:  Poglobljeno vrednotenje termoenergetskih procesov. Tremodinamično verdnotenje in presoja termoenergetskih procesov na osnovi prvega in drugega glavnega zakona termodinamike.  Usposobljenost za samostojno sintezo novega znanja in reševanje najzahtevnejših problemov iz področja termoenergetike.  Napovedovanje termoenergetskih procesov.  Prenesljive/ključne spretnosti in drugi atributi:  kombinirana uporaba različnih znanj za reševanje inženirskih problemov. | | | | | | | | | |  | Knowledge and understanding:  In-depth evaluation of thermoenergetic processes. Thermodynamic valuation and evaluation of thermoenergetic processes based on the first and second laws of thermodynamics.  Qualification for independent synthesis of new knowledge and solving the most demanding problems in the field of thermoenergetics.  Prediction of thermoenergetic processes.  Transferable/Key skills and other attributes:  combined use of different fundamental skills for s  olution of engineering problems. | | | | | | | | | |
| **Metode poučevanja in učenja:** | | | | | | | | | |  | **Learning and teaching methods:** | | | | | | | | | |
| predavanja  dialog  samostojno reševanje nalog  mentorsko delo pri izdelavi seminarskega dela  poučevanje in učenje poteka z didaktično uporabo IKT | | | | | | | | | |  | lectures  dialogue  individual solving of problems  mentor supervision in preparing of seminar work teaching and learning is done using didactic use of ICT | | | | | | | | | |
| **Načini ocenjevanja:** | | | | | | | Delež (v %) /  Weight (in %) | | | | | | **Assessment:** | | | | | | | |
| Način (pisni izpit, ustno izpraševanje, naloge, projekt):  pisni izpit  ustni izpit  seminarska naloga | | | | | | | **40%**  **40%**  **20%** | | | | | | Type (examination, oral, coursework, project):  written examination  oral examination  course work | | | | | | | |
| **Reference nosilca / Lecturer's references:** | | | | | | | | | | | | | | | | | | | | |
| NOVOSEL, Urška, ŽIVIĆ, Marija, **AVSEC, Jurij**. The production of electricity, heat and hydrogen with the thermal power plant in combination with alternative technologies. International Journal of Hydrogen Energy, ISSN 1879-3487. [Online ed.], mar. 2021, vol. 46, iss. 16, str. 10072-10081, doi: 10.1016/j.ijhydene.2020.01.253. [COBISS.SI-ID 1024385372], [JCR, SNIP, WoS do 18. 8. 2021: št. citatov (TC): 3, čistih citatov (CI): 3, čistih citatov na avtorja (CIAu): 1.00, Scopus do 17. 8. 2021: št. citatov (TC): 3, čistih citatov (CI): 3, čistih citatov na avtorja (CIAu): 1.00] kategorija: 1A2 (Z, A1/2); uvrstitev: SCI, Scopus, MBP; tip dela je verificiral OSICT točke: 33.33, št. avtorjev: 3  STRUŠNIK, Dušan, AVSEC, Jurij. Exergy-economic modelling of the integration of two black start diesel engines into the combined cycle gas turbine for rapid-cold start-up. Applied Thermal Engineering. [Online ed.]. 2023, vol. 227, 11 str. ISSN 1873-5606. DOI: 10.1016/j.applthermaleng.2023.120418. [COBISS.SI-ID 145904131], [JCR, SNIP, WoS, Scopus] kategorija: 1A1 (Z, A', A1/2); uvrstitev: SCIE, Scopus, MBP (COMPENDEX, INSPEC); tip dela je verificiral OSICT točke: 68.58, št. avtorjev: 2  **AVSEC, Jurij**, WANG, Zhaolin, NATERER, Greg F. Thermodynamic and transport properties of fluids and solids in a Cu-Cl solar hydrogen cycle. Journal of thermal analysis and calorimetry, ISSN 1388-6150. [Print ed.], jan. 2017, vol. 127, issue 1, str. 961-967, doi: 10.1007/s10973-016-5875-y. [COBISS.SI-ID 1024244316], [JCR, SNIP, WoS do 11. 3. 2019: št. citatov (TC): 3, čistih citatov (CI): 2, čistih citatov na avtorja (CIAu): 0.67, Scopus do 1. 3. 2019: št. citatov (TC): 3, čistih citatov (CI): 2, čistih citatov na avtorja (CIAu): 0.67] kategorija: 1A2 (Z, A1/2); uvrstitev: SCI, Scopus, MBP; tip dela je verificiral OSICT točke: 31.61, št. avtorjev: 3 | | | | | | | | | | | | | | | | | | | | |

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| **UČNI NAČRT PREDMETA / COURSE SYLLABUS** | | | | | | | | | | | | | | | | | | | | |
| **Predmet:** | | | **NAPREDNA KLASIČNA IN STATISTIČNA TERMOMEHANIKA** | | | | | | | | | | | | | | | | | |
| **Course title:** | | | **ADVANCED CLASSICAL AND STATISTICAL THERMOMECHANICS** | | | | | | | | | | | | | | | | | |
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| **Študijski program in stopnja**  **Study programme and level** | | | | | **Študijska smer**  **Study field** | | | | | | | | | | | **Letnik**  **Academic year** | | **Semester**  **Semester** | | |
| **ENERGETIKA, 3. stopnja** | | | | | **-** | | | | | | | | | | | **1/2** | | **1/2/3** | | |
| **ENERGY TECHNOLOGY, 3. Degree** | | | | | **-** | | | | | | | | | | | **1/2** | | **1/2/3** | | |
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| **Vrsta predmeta / Course type** | | | | | | | | | | | | | | | Izbirni/Elective | | | | | |
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| **Univerzitetna koda predmeta / University course code:** | | | | | | | | | | | | | | | D | | | | | |
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| **Predavanja**  **Lectures** | **Seminar**  **Seminar** | | | **Vaje**  **Tutorial** | | | | **Klinične vaje**  **work** | | | | | | **Druge oblike študija** | | | **Samost. delo**  **Individ. work** | |  | **ECTS** |
| **30** | **-** | | | **-** | | | | **-** | | | | | | **-** | | | **150** | |  | **6** |
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| **Nosilec predmeta / Lecturer:** | | | | | **JURIJ AVSEC** | | | | | | | | | | | | | | | |
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| **Jeziki /**  **Languages:** | | **Predavanja / Lectures:** | | | | **Slovenski/Slovene** | | | | | | | | | | | | | | |
| **Vaje / Tutorial:** | | | | **Slovenski/Slovene** | | | | | | | | | | | | | | |
| **Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:** | | | | | | | | | |  | | **Prerequisits:** | | | | | | | | |
| Ni obveznosti | | | | | | | | | |  | | None | | | | | | | | |
| **Vsebina:** | | | | | | | | | |  | | **Content (Syllabus outline):** | | | | | | | | |
| 1.Izbrana poglavja klasične in statistične termodinamike. Princip uporabe minimizacije pri generaciji entropije. Napredne eksergijske in energijske analize procesov. Transportni fenomeni. Statistična termomehanika. Izračun termodinamičnih in transportnih lastnosti s pomočjo napredne statistične termomehanike..  2 Nanoenergetika v 21. stoletju. Definicije in pojmi s področja mesomehanike mikromehanike in nanomehanike, uporaba nanomehanike in mikromehanike v tehniki. Meje veljavnosti zakonov klasične termomehanike v nanomehaniki. Uporaba nanotehnologije v energetiki. Uvod v teorijo MEMS-ov. Mikročrpalke in mikroturbine. Teorija vibracij mikronosilcev. Tokovi v mikrokanalih in nanokanalih. Nanotekočine z nanodelci in nanocevkami. Molekularne osnove za simulacije tokov v mikrofluidni tehniki. Uporaba II. Glavnega zakona termodinamike pri simulaciji tokov v mikro in nanokanalih. Lastnosti NEMS. Fizika zelo tankih plasti. Nanomateriali in njihove lastnosti. Nanotekočine in njihove lastnosti. Sodobne eksperimentalne metode v moderni mikromehaniki in nanomehaniki.  3.Analitične in numerične metode prenosa toplote in prenosa snovi v povezavi s toplotnimi prenosniki in prenosniki snovi. Sodobne metode za proučevanje enofaznih, dvofaznih in trifaznih tokov v povezavi s prenosom toplote in prenosom snovi. Razvoj trdnostnih, dinamičnih in vibracijskih modelov v povezavi s toplotnimi prenosniki. Optimiranje toplotnih prenosnikov, prenosnikov snovi in toplotnih pretvornikov. Razvoj novih konstrukcij toplotnih prenosnikov. Razvoj in analiza metod vzdrževanja in meritev za toplotne prenosnike in masne prenosnike. Elektromagnetni transport snovi.Prenosniki toplote v mikro in nano svetu. Termična, hidravlična in trdnostna analiza cevovodov. | | | | | | | | | |  | | 1.Selected chapters from classic and statistical themodynamics. Entropy generation minimization. Irriversible thermmechanics. Constructal low. Transport phenomena. Statistical thermomechanics. Kinetic theory of gases. Calculation of themodynamic and transport properties with advanced statistical thermomechanics.  2.Definitions and concepts related to mesomechanics micromechanics and nanomechanics, the application of nanomechanics and micromechanics in technology. The limits of classical thermomechanics in the nanomechanics. The application of nanotechnology in energetics. Introduction to MEMS. Micropumps, microturbines. Theory of micro beams vibrations. Liquid flows in microchannels and nanochanels. Nanofluids, nanoparticles and nanotubes. Molecular based microfluidic simulation models. The application of II. Law of thermodynamics for the simulation of flow in microchannels and nanochannels. Mechanical properties of NEMS. Nanomaterials and their properties. Nanofluids and their properties. Modern experimental techniques in the field nanomechanics and micromechanics.  3. The analytical and numerical techniques for heat transfer and mass transfer phenomena in relation with heat exchangers and mass exchangers. Modern techniques for one phase, two phase and three phase fluid flow in connection with heat and mass transfer. The dynamical and vibrational theories in connection with heat and mass exchangers. Optimization procedures for heat and mass exchangers. The optimization procedures for heat and mass exchangers and heat transformers. The development of new construction of heat and mass exchanger.The development and analysis of maintenance and experimental techniques for heat and mass exchangers. Electromagnetic transport of materials. Micro and nano heat exchangers.  Thermal, hydraulic and mechanical analysis of pipes | | | | | | | | |
| Temeljni literatura in viri / Readings: | | | | | | | | | | | | | | | | | | | | |
| 1. I. Dincer and H. Ishaq, Renewable Hydrogen Production, 2021, Elsevier  2.D. Seddon, The Hydrogen Economy, WSPC, 2022.  3. B. Rogers, S. Pennathur, J. Adams, Nanotechnology, 2017, CRC Press.  4. T. Engel, P. Reid, Thermodynamics, Statistical thermodynamics and kinetics, 2018, Pearson  5. A. Bejan, Advanced engineering thermodynamics, 2016, Wiley  6. A. Bejan, Heat transfer, 2022, Wiley  8. L.E. Reichl, A Modern Course in Statistical Physics, 2016, Wiley  9. I. Dincer, M.a. Rosen, Exergy, 2020, elsevier Science.  10. S. Turns, D.C. Haworth, Introduction to combustion concepts, 2020, McGraw-Hill Education | | | | | | | | | | | | | | | | | | | | |
| **Cilji in kompetence:** | | | | | | | | |  | | **Objectives and competences:** | | | | | | | | | |
| Prikazati najsodobnejše trende v energetiki  Podati poglobljeno znanje s področja termodinamike, nanomehanike, prenosa toplote in zgorevanja v energetiki;  Prikazati mejno uporabo predhodno pridobljenih znanj iz mehanike, matematike, fizike, gradiv, trdnosti;  Razviti sposobnosti študentov za samostojno in kreativno reševanje inženirskih problemov. | | | | | | | | |  | | To show the trends in modern energetics.  To provide detailed knowledge of theory, functional use, design and calculation methods ihn thermodynamics, nanomechanics, heat transfer and combustion science in energy technology;  To demonstrate limit use of previously accumulated knowledge of mechanics, mathematics, physics, materials etc.;  To further develop student's capabilities of independent thinking and creative solutions of engineering problems. | | | | | | | | | |
| **Predvideni študijski rezultati:** | | | | | | | | | |  | **Intended learning outcomes:** | | | | | | | | | |
| Znanje in razumevanje:  Poglobljeno vrednotenje termoenergetskih procesov. Tremodinamično verdnotenje in presoja termoenergetskih procesov na osnovi prvega in drugega glavnega zakona termodinamike.  Usposobljenost za samostojno sintezo novega znanja in reševanje najzahtevnejših problemov iz področja termoenergetike.  Napovedovanje termoenergetskih procesov.  Prenesljive/ključne spretnosti in drugi atributi:  kombinirana uporaba različnih znanj za reševanje inženirskih problemov. | | | | | | | | | |  | Knowledge and understanding:  In-depth evaluation of thermoenergetic processes. Thermodynamic valuation and evaluation of thermoenergetic processes based on the first and second laws of thermodynamics.  Qualification for independent synthesis of new knowledge and solving the most demanding problems in the field of thermoenergetics.  Prediction of thermoenergetic processes.  Transferable/Key skills and other attributes:  combined use of different fundamental skills for solution of engineering problems. | | | | | | | | | |
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| **Metode poučevanja in učenja:** | | | | | | | | | |  | **Learning and teaching methods:** | | | | | | | | | |
| predavanja  dialog  samostojno reševanje nalog  mentorsko delo pri izdelavi seminarskega dela  poučevanje in učenje poteka z didaktično uporabo IKT | | | | | | | | | |  | lectures  dialogue  individual solving of problems  mentor supervision in preparing of seminar work teaching and learning is done using didactic use of ICT | | | | | | | | | |
| **Načini ocenjevanja:** | | | | | | | Delež (v %) /  Weight (in %) | | | | | | **Assessment:** | | | | | | | |
| Način (pisni izpit, ustno izpraševanje, naloge, projekt):  pisni izpit  ustni izpit  seminarska naloga | | | | | | | **40%**  **40%**  **20%** | | | | | | Type (examination, oral, coursework, project):  written examination  oral examination  course work | | | | | | | |
| **Reference nosilca / Lecturer's references:** | | | | | | | | | | | | | | | | | | | | |
| HOLIK, Mario, ŽIVIĆ, Marija, VIRAG, Zdravko, BARAC, Antun, VUJANOVIĆ, Milan, **AVSEC, Jurij**. Thermo-economic optimization of a Rankine cycle used for waste-heat recovery in biogas cogeneration plants. Energy conversion and management, ISSN 0196-8904. [Print ed.], mar. 2021, art. 113897, vol. 232, str. 1-11, doi: 10.1016/j.enconman.2021.113897. [COBISS.SI-ID 51435523], [JCR, SNIP, WoS do 26. 9. 2021: št. citatov (TC): 3, čistih citatov (CI): 3, čistih citatov na avtorja (CIAu): 0.50] kategorija: 1A1 (Z, A'', A', A1/2); uvrstitev: SCI, Scopus, MBP; tip dela je verificiral OSICT točke: 29.37, št. avtorjev: 6  STRUŠNIK, Dušan, AVSEC, Jurij. Exergoeconomic machine-learning method of integrating a thermochemical Cu%Cl cycle in a multigeneration combined cycle gas turbine for hydrogen production. International Journal of Hydrogen Energy, ISSN 1879-3487. [Online ed.], 2022, vol. 47, iss. 39, str. 17121-17149, graf. prikazi, doi: 10.1016/j.ijhydene.2022.03.230. [COBISS.SI-ID 104668675], [JCR, SNIP, WoS do 19. 7. 2022: št. citatov (TC): 2, čistih citatov (CI): 2, čistih citatov na avtorja (CIAu): 1.00, Scopus do 21. 8. 2022: št. citatov (TC): 3, čistih citatov (CI): 3, čistih citatov na avtorja (CIAu): 1.50] kategorija: 1A2 (Z, A1/2); uvrstitev: SCI, Scopus, MBP; tip dela je verificiral OSICT  BRICL, Martin, AVSEC, Jurij. Design of thermal power plant modernization and rehabilitation model for the new market demands and challenges. Thermal science, ISSN 2334-7163. [Online ed.], 2021, vol. 25, iss. 4A, str. 2701-2711, graf. prikazi, doi: 10.2298/TSCI200111188B. [COBISS.SI-ID 18525955], [JCR, SNIP, WoS do 12. 8. 2021: št. citatov (TC): 0, čistih citatov (CI): 0, čistih citatov na avtorja (CIAu): 0, Scopus do 31. 8. 2021: št. citatov (TC): 0, čistih citatov (CI): 0, čistih citatov na avtorja (CIAu): 0] kategorija: 1A3 (Z); uvrstitev: SCI, Scopus, MBP; tip dela je verificiral OSICT točke: 30.28, št. avtorjev: 2 | | | | | | | | | | | | | | | | | | | | |

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| **UČNI NAČRT PREDMETA / COURSE SYLLABUS** | | | | | | | | | | | | | | | | | | | | |
| **Predmet:** | | | **PRAVNA REGULATIVA V ENERGETIKI** | | | | | | | | | | | | | | | | | |
| **Course title:** | | | **LAW REGULATION IN ENERGY TECHNOLOGY** | | | | | | | | | | | | | | | | | |
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| **Študijski program in stopnja**  **Study programme and level** | | | | | **Študijska smer**  **Study field** | | | | | | | | | | | **Letnik**  **Academic year** | | **Semester**  **Semester** | | |
| **ENERGETIKA, 3. stopnja** | | | | | **-** | | | | | | | | | | | **1/2** | | **1/2/3** | | |
| **ENERGY TECHNOLOGY, 3. Degree** | | | | | **-** | | | | | | | | | | | **1/2** | | **1/2/3** | | |
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| **Vrsta predmeta / Course type** | | | | | | | | | | | | | | | Izbirni/Elective | | | | | |
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| **Univerzitetna koda predmeta / University course code:** | | | | | | | | | | | | | | | D | | | | | |
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| **Predavanja**  **Lectures** | **Seminar**  **Seminar** | | | **Vaje**  **Tutorial** | | | | **Klinične vaje**  **work** | | | | | | **Druge oblike študija** | | | **Samost. delo**  **Individ. work** | |  | **ECTS** |
| **30** | **-** | | | **-** | | | | **-** | | | | | | **-** | | | **150** | |  | **6** |
|  | | | | | | | | | | | | | | | | | | | | |
| **Nosilec predmeta / Lecturer:** | | | | | **BORUT BRATINA** | | | | | | | | | | | | | | | |
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| **Jeziki /**  **Languages:** | | **Predavanja / Lectures:** | | | | **Slovenski/Slovene** | | | | | | | | | | | | | | |
| **Vaje / Tutorial:** | | | | **Slovenski/Slovene** | | | | | | | | | | | | | | |
| **Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:** | | | | | | | | | |  | | **Prerequisits:** | | | | | | | | |
| NI OBVEZNOSTI | | | | | | | | | |  | | NONE | | | | | | | | |
| **Vsebina:** | | | | | | | | | |  | | **Content (Syllabus outline):** | | | | | | | | |
| Področje energetike je pravno natančno regulirana dejavnost. Temeljni predpis v Sloveniji je energetski zakon EZ, ki mora biti usklajen z evropskimi uredbami in direktivami. Pri tem predmetu se bo ločeno obravnavala statusno pravna organiziranost proizvajalcev energije, distributerjev in porabnikov ter regulatorjev trga in pogodbena razmerja med udeleženci na trgu z energijo. | | | | | | | | | |  | | The field of energy technology is very strictly regulated by law. The regulation in Slovenia is Law of energy technology wich must be accompanied with EU regulations and directices. Acquiring knowlwdgw about organization's structure of energy producers, distributors, consumers and market regulators on the one side and contractual and other obligations questions on other side. | | | | | | | | |
| **Temeljni literatura in viri / Readings:** | | | | | | | | | | | | | | | | | | | | |
| Energetski zakon EZ in drugi predpisi izdani na njegovi podlagi  Sklep o ustanovitvi Agencije republike Slovenije za energijo  Uredbe, direktive in drugi pravni akti EU na področju energetike  Ustrezni članki in druga literatura iz tega področja | | | | | | | | | | | | | | | | | | | | |
| **Cilji in kompetence:** | | | | | | | | |  | | **Objectives and competences:** | | | | | | | | | |
| Cilj je usposobiti študente, da bodo poznali temeljne značilnosti pravne regulative tega kompleksnega in interdisciplinarnega področja, kjer se prepleta delovanje državnih regulatorjev trga, javne službe, javno-zasebnega partnerstva in ne nazadnje delovanje konkurenčnega trga z energijo.  Študentje bodo razumeli soobstoj javnega in zasebnega interesa ter razlikovali značilnosti upravnega in civilnega prava. | | | | | | | | |  | | The main goal is to qualifying students to have knowledge of domestic and european legislative system of this complex and interdisciplinary field where are mixing the public and private interests, the state as regualtor, public services, public private partnership and not at least the functioning of free market for energy.  The students will understand cohabitation of public and private interests and the difference between public and privat law. | | | | | | | | | |
| **Predvideni študijski rezultati:** | | | | | | | | | |  | **Intended learning outcomes:** | | | | | | | | | |
| Znanje in razumevanje:  Raven znanja: študentje bodo imeli poglobljeno in sistematično znanje za razumevanje energetske zakonodaje in drugih predpisov. Pri delu bodo sposobni uporabljati teoretična znanja in pravne predpise ter bodo znali razlikovati značilnosti delovanje države kot regulatorja trga, izvajanje gospodarske javne službe in delovanje trga z energijo.  Etični vidik:  Znali bodo analizirati in rešiti etične dileme ter delovati proaktivno v sodelovanju z drugimi pri iskanju rešitev.  Metodološko znanje s področja discipline:  Razumeli bodo metodološke pristope na področju civilnega in upravnega prava. | | | | | | | | | |  | Knowledge and understanding:  Knowledge base:  The students have a great depth and systematic understanding of regulation of energy technology.They can work with theoretical knowledge and use legal regulations. They will distinguish the characteristic of state acting as regulator from public services and free energymarket.  Ethical issues:  They can analyse and manage the implications of etihical dilemmas and work proactively with others to formulate solutions.  Disciplinary methodologies:  They have a comprehensive understanding of methodologies applicable to the civil and public. | | | | | | | | | |
| **Metode poučevanja in učenja:** | | | | | | |  | | | | | | **Learning and teaching methods:** | | | | | | | |
| Uvodna klasična predavanja  Seminarske vaje s študijami primera  poučevanje in učenje poteka z didaktično uporabo IKT | | | | | | | | | |  | Classic lectures  Case study  teaching and learning is done using didactic use of ICT | | | | | | | | | |
| **Načini ocenjevanja:** | | | | | | | Delež (v %) /  Weight (in %) | | | | | | **Assessment:** | | | | | | | |
| Način (pisni izpit, ustno izpraševanje, naloge, projekt):  Pisni izpit  Seminarska naloga  Ustni izpit | | | | | | | **33%**  **33%**  **34%** | | | | | | Type (examination, oral, coursework, project):  Written exam  Coursework  Oral exam | | | | | | | |
| **Reference nosilca / Lecturer's references:** | | | | | | | | | | | | | | | | | | | | |
| JOVANOVIČ, Dušan, BRATINA, Borut, Outsourcing the corporate governance officer (potential business model) Lex localis, Apr. 2016, vol. 14, no.2, str. 265-277  PODGORELEC, Peter, BRATINA, B**orut, The municipality as controling shareholding and the applicability of law relating to groups of companies, Lex localis, 2014, vol.12, no.1, str 127-143.**  KOCBEK, Marijan (avtor in urednik), BRATINA, Borut in drugi soavtorji, Veliki komentar zakona o gospodarskih družbah (nova slovenska zakonodaja), Ljubljana: IUS Software, GV založba, 2014  JOVANOVIČ, Dušan, BRATINA, Borut, Modeli upravljanja javnih podjetij v Sloveniji, Podjetje in delo, letnik 40, št. 6/7, Ljubljana: GV založba.  TOMAŽIČ, Luka Martin, BRAČIČ, Siuzana, BRATINA, Borut, Vulnerable Consumers, their Healt and UrgentSupply of Electrical Energy in Slovenia Legal Framework, Medicine, Law &Society, Vol.11, no. 2, pp 91-106, University of Maribor Press, October 2018. | | | | | | | | | | | | | | | | | | | | |

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| **UČNI NAČRT PREDMETA / COURSE SYLLABUS** | | | | | | | | | | | | | | | | | | | | |
| **Predmet:** | | | **IZBRANA POGLAVJA IZ TEORIJE ROBUSTNEGA VODENJA** | | | | | | | | | | | | | | | | | |
| **Course title:** | | | **SELECTED CHAPTERS FROM THE ROBUST CONTROL THEORY** | | | | | | | | | | | | | | | | | |
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| **Študijski program in stopnja**  **Study programme and level** | | | | | **Študijska smer**  **Study field** | | | | | | | | | | | **Letnik**  **Academic year** | | **Semester**  **Semester** | | |
| **ENERGETIKA, 3. stopnja** | | | | | **-** | | | | | | | | | | | **1/2** | | **1/2/3** | | |
| **ENERGY TECHNOLOGY, 3. Degree** | | | | | **-** | | | | | | | | | | | **1/2** | | **1/2/3** | | |
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| **Vrsta predmeta / Course type** | | | | | | | | | | | | | | | Izbirni/Elective | | | | | |
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| **Univerzitetna koda predmeta / University course code:** | | | | | | | | | | | | | | | D | | | | | |
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| **Predavanja**  **Lectures** | **Seminar**  **Seminar** | | | **Vaje**  **Tutorial** | | | | **Klinične vaje**  **work** | | | | | | **Druge oblike študija** | | | **Samost. delo**  **Individ. work** | |  | **ECTS** |
| **30** | **-** | | | **-** | | | | **-** | | | | | | **-** | | | **150** | |  | **6** |
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| **Nosilec predmeta / Lecturer:** | | | | | **AMOR CHOWDHURY** | | | | | | | | | | | | | | | |
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| **Jeziki /**  **Languages:** | | **Predavanja / Lectures:** | | | | **Slovenski/Slovene** | | | | | | | | | | | | | | |
| **Vaje / Tutorial:** | | | | **Slovenski/Slovene** | | | | | | | | | | | | | | |
| **Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:** | | | | | | | | | |  | | **Prerequisits:** | | | | | | | | |
| Ni posebnih obveznosti | | | | | | | | | |  | | No prerequisits | | | | | | | | |
| **Vsebina:** | | | | | | | | | |  | | **Content (Syllabus outline):** | | | | | | | | |
| * Problemi in cilji avtomatizacije. * Sodobni pristopi k vodenju procesov. * Linearna algebra, metrika H∞ in H2 * Performančne omejitve senzorjev, aktuatorjev in sistemov v energetiki * Specifikacija regulacijskih zahtev * Stabilnost in performance povratno-zančnih vodenih sistemov * Odstopanja modelov in robustnost * Parametrizacija stabilizirajočih regulatorjev * Riccatijeva algebraična enačba * H2 in H∞ optimalna regulacija * Linearna kvadratična regulacija * H∞ robustna regulacija * Študij izbranih tipičnih problemov vodenja v energetiki. | | | | | | | | | |  | | * Problems and goals of automation. * Modern approach to robust control. * Linear algebra, H∞ and H2 metrics * Sensors, Actuators and systems performance limitation * Control specifications * Stability and performance of loop feedback systems * Stabilizing Controller parameterization * Riccati algebraic eqution * H∞ and H2 optimal control * Linear quadratic control * H∞ robust control * Study of typical control problems in energetic | | | | | | | | |
| **Temeljni literatura in viri / Readings:** | | | | | | | | | | | | | | | | | | | | |
| * R. Dorf, R. Bishop: Modern Control Systems 13th edition,Pearson, London, 2016 * L. Fortuna, M. Frasca, A. Buscarino: Optimal and Robust Control Advanced Topics with MATLAB, second edition, CRCPress, 2022 * Kang-Zhi Liu, Y. Yao: Robust Control: Theory and Applications, 1st edition, Wiley, 2016 * Chia-Chi Tsui: Robust Control System Design Advanced State Space Techniques, third edition, Taylor&Francis, 2022 * Kemin Zhou: Robust optimal control, Prentice Hall, 2015 * Doyle J. C., Francis, B., Tannenbaum A.: Feedback Control Theory, Macmillan Publishing Co., New York, 2017 | | | | | | | | | | | | | | | | | | | | |
| **Cilji in kompetence:** | | | | | | | | |  | | **Objectives and competences:** | | | | | | | | | |
| Študenti pridobijo poglobljeno znanje in veščine za analizo in načrtovanje robustnih sistemov pri procesni avtomatizaciji. | | | | | | | | |  | | The objective of this course is to give students profound knowledge and skills to analysis and design of robust systems of process control. | | | | | | | | | |
| **Predvideni študijski rezultati:** | | | | | | | | | |  | **Intended learning outcomes:** | | | | | | | | | |
| Znanje in razumevanje:  Po zaključku tega predmeta bo študent sposoben:   * poglobljenega pristopa k reševanju problema robustnega načrtovanja in izvedbe avtomatizacije, * razumeti in raziskovati sisteme za vodenje sistemov, raziskovalne rezultate uporabiti v praksi, objavljati rezultate dela. | | | | | | | | | |  | Knowledge and understanding:  On completion of this course the student will be able to:   * deepen study and solve the design and implementation problems in autoimmunization, * understand and to research the systems of robust control systems, to apply a research work to application, to publish the research work. | | | | | | | | | |
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| **Metode poučevanja in učenja:** | | | | | | | | | |  | **Learning and teaching methods:** | | | | | | | | | |
| Predavanja,  seminarske vaje,  domača naloga  poučevanje in učenje poteka z didaktično uporabo IKT | | | | | | | | | |  | Lectures,  tutorial,  coursework  teaching and learning is done using didactic use of ICT | | | | | | | | | |
| **Načini ocenjevanja:** | | | | | | | Delež (v %) /  Weight (in %) | | | | | | **Assessment:** | | | | | | | |
| * Pisni izpit, * ustni izpit, * seminarska naloga. | | | | | | | **40 %**  **40 %**  **20 %** | | | | | | * Written examination, * oral examination, * coursework. | | | | | | | |
| **Reference nosilca / Lecturer's references:** | | | | | | | | | | | | | | | | | | | | |
| IGREC, Dalibor, **CHOWDHURY, Amor**, ŠTUMBERGER, Bojan, SARJAŠ, Andrej. *Robust tracking system design for a synchronous reluctance motor - SynRM based on a new modified bat optimization algorithm*. Applied soft computing, ISSN 1568-4946. [Print ed.], aug. 2018, vol. 69, str. 568-584, doi: 10.1016/j.asoc.2018.05.002. [COBISS.SI-ID 1024306524], [JCR, SNIP, WoS do 3. 8. 2018: št. citatov (TC): 0, čistih citatov (CI): 0, čistih citatov na avtorja (CIAu): 0, Scopus do 30. 6. 2018: št. citatov (TC): 0, čistih citatov (CI): 0, čistih citatov na avtorja (CIAu): 0]  **kategorija: 1A1** (Z, A', A1/2); uvrstitev: SCI, Scopus, MBP; tip dela je verificiral OSICT  točke: 31.84, št. avtorjev: 4  SADEK, Uroš, SARJAŠ, Andrej, **CHOWDHURY, Amor**, SVEČKO, Rajko. *FPGA-based optimal robust minimal-order controller structure of a DC-DC converter with Pareto front solution*. Control engineering practice, ISSN 0967-0661. [Print ed.], Oct. 2016, vol. 55, str. 149-161, doi: 10.1016/j.conengprac.2016.06.016. [COBISS.SI-ID 19704342], [JCR, SNIP, WoS do 11. 11. 2018: št. citatov (TC): 3, čistih citatov (CI): 3, čistih citatov na avtorja (CIAu): 0.75, Scopus do 29. 6. 2018: št. citatov (TC): 3, čistih citatov (CI): 3, čistih citatov na avtorja (CIAu): 0.75]  **kategorija: 1A2** (Z, A1/2); uvrstitev: SCI, Scopus, MBP; tip dela je verificiral OSICT  točke: 24.4, št. avtorjev: 4  SARJAŠ, Andrej, SVEČKO, Rajko, **CHOWDHURY, Amor**. *An H∞ modified robust disturbance observer design for mechanical- positioning systems*. International journal of control, automation, and systems, ISSN 1598-6446. [Print ed.], June 2015, vol. 13, no. 3, str. 1-10, doi: 10.1007/s12555-013-0531-9. [COBISS.SI-ID 18339862], [JCR, SNIP, WoS do 27. 8. 2018: št. citatov (TC): 5, čistih citatov (CI): 4, čistih citatov na avtorja (CIAu): 1.33, Scopus do 28. 8. 2018: št. citatov (TC): 4, čistih citatov (CI): 3, čistih citatov na avtorja (CIAu): 1.00]  **kategorija: 1A3 (Z)**; uvrstitev: SCI, Scopus, MBP; tip dela je verificiral OSICT  točke: 24.53, št. avtorjev: 3  SARJAŠ, Andrej, **CHOWDHURY, Amor**, SVEČKO, Rajko. *Multi-criteria optimal pole assignment robust controller design for uncertainty systems using an evolutionary algorithm*. International Journal of Systems Science, ISSN 0020-7721, 2016, vol. 47, iss. 12, str. 2792-2807, ilustr., doi: 10.1080/00207721.2015.1024188. [COBISS.SI-ID 18589974], [JCR, SNIP, WoS do 27. 8. 2018: št. citatov (TC): 1, čistih citatov (CI): 0, čistih citatov na avtorja (CIAu): 0, Scopus do 2. 7. 2018: št. citatov (TC): 2, čistih citatov (CI): 1, čistih citatov na avtorja (CIAu): 0.33]  **kategorija: 1A1** (Z, A', A1/2); uvrstitev: SCI, Scopus, MBP; tip dela je verificiral OSICT  točke: 39.23, št. avtorjev: 3  SEMENIČ, Nikolaj, SARJAŠ, **Andrej, CHOWDHURY**, Amor, SVEČKO, Rajko. *Quasipolynomial Approach to simultaneous robust control of time-delay systems*. Mathematical problems in engineering, ISSN 1024-123X. [Print ed.], 2014, vol. 2014, article ID 930697, 1-10 str. https://dk.um.si/IzpisGradiva.php?id=66213. [COBISS.SI-ID 18067478], [JCR, SNIP, WoS do 4. 12. 2014: št. citatov (TC): 0, čistih citatov (CI): 0, čistih citatov na avtorja (CIAu): 0, Scopus do 14. 10. 2015: št. citatov (TC): 1, čistih citatov (CI): 1, čistih citatov na avtorja (CIAu): 0.25]  **kategorija: 1A3** (Z); uvrstitev: SCI, Scopus, MBP; tip dela je verificiral OSICT  točke: 17.42, št. avtorjev: 4 | | | | | | | | | | | | | | | | | | | | |

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| **UČNI NAČRT PREDMETA / COURSE SYLLABUS** | | | | | | | | | | | | | | | | | | | | |
| **Predmet:** | | | **IZBRANA POGLAVJA IZ FIZIKE IN TEORIJE REAKTORJEV** | | | | | | | | | | | | | | | | | |
| **Course title:** | | | **SELECTED TOPICS ON REACTOR PHYSICS AND THEORY** | | | | | | | | | | | | | | | | | |
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| **Študijski program in stopnja**  **Study programme and level** | | | | | **Študijska smer**  **Study field** | | | | | | | | | | | **Letnik**  **Academic year** | | **Semester**  **Semester** | | |
| **ENERGETIKA, 3. stopnja** | | | | | **-** | | | | | | | | | | | **1/2** | | **1/2/3** | | |
| **ENERGY TECHNOLOGY, 3. Degree** | | | | | **-** | | | | | | | | | | | **1/2** | | **1/2/3** | | |
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| **Vrsta predmeta / Course type** | | | | | | | | | | | | | | | Izbirni/Elective | | | | | |
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| **Univerzitetna koda predmeta / University course code:** | | | | | | | | | | | | | | | D | | | | | |
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| **Predavanja**  **Lectures** | **Seminar**  **Seminar** | | | **Vaje**  **Tutorial** | | | | **Klinične vaje**  **work** | | | | | | **Druge oblike študija** | | | **Samost. delo**  **Individ. work** | |  | **ECTS** |
| **30** | **-** | | | **-** | | | | **-** | | | | | | **-** | | | **150** | |  | **6** |
|  | | | | | | | | | | | | | | | | | | | | |
| **Nosilec predmeta / Lecturer:** | | | | | **IVAN KODELI** | | | | | | | | | | | | | | | |
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| **Jeziki /**  **Languages:** | | **Predavanja / Lectures:** | | | | **Slovenski/Slovene** | | | | | | | | | | | | | | |
| **Vaje / Tutorial:** | | | | **Slovenski/Slovene** | | | | | | | | | | | | | | |
| **Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:** | | | | | | | | | |  | | **Prerequisits:** | | | | | | | | |
| Opravljen izpit iz predmeta Jedrske in sevalne naprave ali ekvivalent. | | | | | | | | | |  | | Successful completion of the Nuclear and Radiation Facilities course or the equivalent. | | | | | | | | |
| **Vsebina:** | | | | | | | | | |  | | **Content (Syllabus outline):** | | | | | | | | |
| Model jedrskega reaktorja v enogrupnem približku difuzijske enačbe.  Večgrupna teorija difuzije nevtronov.  Osnove transportne enačbe in računalniški programi.  Računanje spektrov hitrih in termičnih nevtronov.  Celična metoda izračunov za primere heterogene mreže reaktorske sredice.  Uvod v projektiranje sredice jedrskega reaktorja.  Nadzor reaktivnosti.  Analiza sprememb isotopske sestave jedrskega goriv.  Izbrana poglavja iz varstva pred sevanji.  Nuklearni podatki.  Ocena negotovosti, verifikacija in validacija reaktorskih preračunov. | | | | | | | | |  | | The one-speed difffusion model of a nuclear reactor.  The multi-group diffusion theory.  Fast and thermal spectrums clculations.  Transport theory – basis and computer codes.  Cell calculation for heterogeneous core lattices.  An introduction to nuclear reactor core design.  Reactivity control.  Analysis of core isotopic composition changes.  Selected topics on radiation protection.  Nuclear data.  Uncertainty analysis, verification and validation of reactor computations. | | | | | | | | | |
| **Temeljni literatura in viri / Readings:** | | | | | | | | | | | | | | | | | | | | |
| A. Hébert Applied Reactor Physics, Presses internationales Polytechnique, 2020  Robert E. Masterson, Nuclear Engineering Fundamentals: A Practical Perpective, CRC Press, 2017.  J. K. Shultis, R. E. Faw, Fundamentals of Nuclear Science and Engineering, CRC Press, 2017  SERPENT-2 program: <https://serpent.vtt.fi/mediawiki/index.php/Main_Page>  P. K. Romano, N. E. Horelik, B.R. Herman, A. G. Nelson, B. Forget, K. Smith, “OpenMC: A State-of-the-Art Monte Carlo Code for Research and Development,” Ann. Nucl. Energy, 82, 90–97 (2015).  E. Sartori, Y. Azmy, Nuclear Computational Science: A Century in Review, Springer, Dec. 2014  Yoshiaki Oka, Nucler Reactor Design, Springer Verlag, Japan, 2014.  J. J. Duderstadt and J. L Hamilton, Nuclear Reactor Analysis, John Wiley & Sons, 1976.  Bell-Glasstone, Nuclear reactor theory,Van Nostrand, 1970  S. Glasstone and M. C. Edlund, The Elements of NUCLEAR REACTOR THEORY, Van Nostrand, 1960.  izbrani članki iz znanstvene literature / selected scientific articles (Nuclear Technology, Nuclear Engineering and Design)I. Kodeli, S, Slavić, XSUN-2017, Windows interface environment for transport and sensitivity-uncertainty software TRANSX-2, PARTISN and SUSD3D, OECD/NEA Data Bank, NEA-1882 XSUN-2017 (2017) | | | | | | | | | | | | | | | | | | | | |
| **Cilji in kompetence:** | | | | | | | | |  | | **Objectives and competences:** | | | | | | | | | |
| Poglobljeno znanje reaktorske fizike, predvsem iz teorije transporta nevtronov in reaktorske kinetike.  Poglobljeno znanje iz računskih metod, ki se uporabljajo za projektiranje in analize reaktorjev.  Poglobljeno znanje metod, ki se uporabljajo za analize zgorevanja in izotopske sestave goriva. | | | | | | | | |  | | To gain the advanced knowledge of reactor physics, in particular in neutron transport theory and in reactor kinetics.  To gain the advanced knowledge of calculation methods for reactor design and analysis.  To gain the advanced knowledge of methods for burn-up and isotopic composition analysis of reactor fuel | | | | | | | | | |
| **Predvideni študijski rezultati:** | | | | | | | | | |  | **Intended learning outcomes:** | | | | | | | | | |
| Poglobljeno znanje teorije reaktorjev.  Poglobljeno znanje metod za analize fizikalnih parametrov jedrskih reaktorjev.  Znanje za tehnološko vodenje in načrtovanje pri jedrskem reaktorju.  Znanje za raziskovalno delo v reaktorski fiziki in tehnologiji. | | | | | | | | | |  | Advanced knowledge of reactor theory.  Advanced knowledge of methods for reactor parameters analysis.  Knowledge for technological planning and management of nuclear reactor.  Knowledge for research work in reactor physics and technology. | | | | | | | | | |
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| **Metode poučevanja in učenja:** | | | | | | | | | |  | **Learning and teaching methods:** | | | | | | | | | |
| predavanja  vaje  seminarji  konzultacije  poučevanje in učenje poteka z didaktično uporabo IKT | | | | | | | | | |  | lectures  exercises  seminars  consultation  teaching and learning is done using didactic use of ICT | | | | | | | | | |
| **Načini ocenjevanja:** | | | | | | | Delež (v %) /  Weight (in %) | | | | | | **Assessment:** | | | | | | | |
| pisni izpit  seminarska naloga | | | | | | | **50%**  **50%** | | | | | | written examination  coursework | | | | | | | |
| **Reference nosilca / Lecturer's references:** | | | | | | | | | | | | | | | | | | | | |
| **Kodeli**, S. van der Marck, Consistency Among the Results of the ASPIS Iron88, PCA Replica, and PCA ORNL Benchmark Experiments, Nuclear Science and Engineering, (2023), DOI: <https://doi.org/10.1080/00295639.2023.2199673>  S. O. von Tiedemann, D. M. Collins, M. R. Gilbert, **I. Kodeli**, Nuclear Data Uncertainty Propagation and Implications for Radioactive Waste Management of Fusion Steels, Fusion Engineering and Design 188 (2023) 113409  I. A. Kodeli, E. Sartori, SINBAD - Radiation shielding benchmark experiments, Annals of Nuclear Energy 159 (2021) 108254 | | | | | | | | | | | | | | | | | | | | |

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| **UČNI NAČRT PREDMETA / COURSE SYLLABUS** | | | | | | | | | | | | | | | | | | | | |
| **Predmet:** | | | **IZBRANA POGLAVJA IZ VODENJA ELEKTROENERGETSKIH SISTEMOV** | | | | | | | | | | | | | | | | | |
| **Course title:** | | | **SELECTED TOPICS FROM THE POWER SYSTEM CONTROL** | | | | | | | | | | | | | | | | | |
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| **Študijski program in stopnja**  **Study programme and level** | | | | | **Študijska smer**  **Study field** | | | | | | | | | | | **Letnik**  **Academic year** | | **Semester**  **Semester** | | |
| **ENERGETIKA, 3. stopnja** | | | | | **-** | | | | | | | | | | | **1/2** | | **1/2/3** | | |
| **ENERGY TECHNOLOGY, 3. Degree** | | | | | **-** | | | | | | | | | | | **1/2** | | **1/2/3** | | |
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| **Vrsta predmeta / Course type** | | | | | | | | | | | | | | | Izbirni/Elective | | | | | |
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| **Univerzitetna koda predmeta / University course code:** | | | | | | | | | | | | | | | D | | | | | |
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| **Predavanja**  **Lectures** | **Seminar**  **Seminar** | | | **Vaje**  **Tutorial** | | | | **Klinične vaje**  **work** | | | | | | **Druge oblike študija** | | | **Samost. delo**  **Individ. work** | |  | **ECTS** |
| **30** | **-** | | | **-** | | | | **-** | | | | | | **-** | | | **150** | |  | **6** |
|  | | | | | | | | | | | | | | | | | | | | |
| **Nosilec predmeta / Lecturer:** | | | | | **DRAGO DOLINAR** | | | | | | | | | | | | | | | |
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| **Jeziki /**  **Languages:** | | **Predavanja / Lectures:** | | | | **Slovenski/Slovene** | | | | | | | | | | | | | | |
| **Vaje / Tutorial:** | | | | **Slovenski/Slovene** | | | | | | | | | | | | | | |
| **Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:** | | | | | | | | | |  | | **Prerequisits:** | | | | | | | | |
| Ni pogojev. | | | | | | | | | |  | | None. | | | | | | | | |
| **Vsebina:** | | | | | | | | | |  | | **Content (Syllabus outline):** | | | | | | | | |
| * Izbrane vsebine iz vodenja EES iz okvira ENTSOe združenja. * Izbrana poglavja iz analize paralelnega delovanja sinhronskega generatorja, sinteze primarnih regulatorjev in sekundarne regulacije. * Analiza različnih obratovalnih stanj z vidika proizvodnje delovne in jalove moči. * Analiza sekundarnih regulacijskih sistemov v elektrarnah. * Izbrane vsebine iz regulacij v EES s posebnim poudarkom na izboljšanih učinkih terciarne regulacije - optimizacija. Izbrana poglavja iz analize stabilnosti in sinteze stabilizatorjev kolesnega kota. * Numerična analiza sistema vodenja EES s pomočjo modernih programskih okolji. * Analiza zahtev in zanesljivosti računalniških sistemov uporabljenih za vodenje kompleksnih energetskih sistemov. | | | | | | | | | |  | | * Selected topics from the field of electric power system (EPS) control from the frame of ENTSOe union. * Selected topics from analysis of parallel operation of synchronous generator and load-frequency control (LFC). Analysis of different operating possibilities from a viewpoint of LFC. * Analysis of secondary control systems in EPS. * Optimization of LFC in electric power system. * Selected topics from the design of power system stabilizers. * Numerical analysis of EPS control using modern programs. * Analysis of requirements of computer systems used for power system control, automation of large-scale systems, control functions, performances and reliability of control systems used in power systems. | | | | | | | | |
| **Temeljni literatura in viri / Readings:** | | | | | | | | | | | | | | | | | | | | |
| * D. Dolinar, B. Polajžer. *Dinamika EES*, UM-FERI, Maribor, 2010. * A.R. Bergen, V. Vittal. *Power system analysis*, Second Edition, Prentice-Hall Series, New Jersey, 2000. * J. Machowski, J.W. Bialek, J.R. Bumby. *Power System Dynamics: Stability and Control*, Second Edition, John Wiley & Sons, Chichester, 2008. | | | | | | | | | | | | | | | | | | | | |
| **Cilji in kompetence:** | | | | | | | | |  | | **Objectives and competences:** | | | | | | | | | |
| Pridobiti poglovljena znanja o vodenju energetskih sistemov. Znanja bodo prispevala k snovanju sistemov vodenja energetskih sistemov nove generacije. | | | | | | | | |  | | The main objective is to acquire appropriate skills about control of power systems. This knowledge can initiate design and production of control systems of new generation. | | | | | | | | | |
| **Predvideni študijski rezultati:** | | | | | | | | | |  | **Intended learning outcomes:** | | | | | | | | | |
| Znanje in razumevanje:   * Usposobljenost za vodenje najzahtevnejših delovnih procesov in znanstveno raziskovalnih projektov s področja vodenja energetskih sistemov.   Prenesljive/ključne spretnosti in drugi atributi:   * Pridobljena znanja morajo vzpodbuditi razvoj lastne kreativnosti udeležencev v smislu uvajanja bolj sodobnih sistemov vodenja. | | | | | | | | | |  | Knowledge and understanding:   * To give students competences to conduct the most complex work and scientific research projects with broad expertise from the field of power system control.   Transferable/Key Skills and other attributes:   * Acquired knowledge will actuate creativeness of participants to introduce more advanced control systems. | | | | | | | | | |
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| **Metode poučevanja in učenja:** | | | | | | | | | |  | **Learning and teaching methods:** | | | | | | | | | |
| predavanja,  seminarska naloga.  poučevanje in učenje poteka z didaktično uporabo IKT | | | | | | | | | |  | lectures,  seminar assignment.  teaching and learning is done using didactic use of ICT | | | | | | | | | |
| **Načini ocenjevanja:** | | | | | | | Delež (v %) /  Weight (in %) | | | | | | **Assessment:** | | | | | | | |
| Način (pisni izpit, ustno izpraševanje, naloge, projekt):   * izdelana seminarska naloga, * predstavitev seminarske naloge, * ustni izpit | | | | | | | **50%**  **10%**  **40%** | | | | | | Type (examination, oral, coursework, project):   * completed seminar assignment, * presentation of seminar assignment , * oral exemination | | | | | | | |
| **Reference nosilca / Lecturer's references:** | | | | | | | | | | | | | | | | | | | | |
| POLAJŽER, Boštjan, ŠTUMBERGER, Gorazd, **DOLINAR, Drago**. Detection of voltage sag sources based on the angle and norm changes in the instantaneous current vector written in Clarkeʼs components. *International journal of electrical power & energy systems*, ISSN 0142-0615. [Print ed.], Jan. 2015, vol. 64, str. 967-976, ilustr. [COBISS.SI-ID [18298646](https://plus.si.cobiss.net/opac7/bib/18298646?lang=sl)], [[JCR](https://plus.si.cobiss.net/opac7/jcr?c=sc=0142-0615+and+PY=2015&r1=true&lang=sl), [SNIP](https://plus.si.cobiss.net/opac7/snip?c=sc=0142-0615+and+PY=2015&r1=true&lang=sl), [WoS](http://gateway.isiknowledge.com/gateway/Gateway.cgi?GWVersion=2&SrcAuth=Alerting&SrcApp=Alerting&DestApp=WOS&DestLinkType=FullRecord&UT=000344444200097) do 2. 7. 2018: št. citatov (TC): 6, čistih citatov (CI): 6, čistih citatov na avtorja (CIAu): 2.00, [Scopus](http://www.scopus.com/inward/record.url?partnerID=2dRBettD&eid=2-s2.0-84907732014) do 28. 5. 2018: št. citatov (TC): 6, čistih citatov (CI): 6, čistih citatov na avtorja (CIAu): 2.00]  kategorija: 1A1 (Z, A', A1/2); uvrstitev: SCI, Scopus, MBP; tip dela je verificiral OSICT  PETRUN, Martin, STEENTJES, Simon, HAMEYER, Kay, **DOLINAR, Drago**. Modeling the influence of varying magnetic properties in soft magnetic materials on the hysteresis shape using the flux tube approach. *Journal of applied physics*, ISSN 0021-8979, 2015, vol. 117, iss. 17, str. 17A708-1-17A708-4, doi: [10.1063/1.4906956](https://doi.org/10.1063/1.4906956). [COBISS.SI-ID [18422038](https://plus.si.cobiss.net/opac7/bib/18422038?lang=sl)], [[JCR](https://plus.si.cobiss.net/opac7/jcr?c=sc=0021-8979+and+PY=2015&r1=true&lang=sl), [SNIP](https://plus.si.cobiss.net/opac7/snip?c=sc=0021-8979+and+PY=2015&r1=true&lang=sl), [WoS](http://gateway.isiknowledge.com/gateway/Gateway.cgi?GWVersion=2&SrcAuth=Alerting&SrcApp=Alerting&DestApp=WOS&DestLinkType=FullRecord&UT=000354984100055) do 11. 11. 2018: št. citatov (TC): 2, čistih citatov (CI): 2, čistih citatov na avtorja (CIAu): 0.50, [Scopus](http://www.scopus.com/inward/record.url?partnerID=2dRBettD&eid=2-s2.0-84923697582) do 28. 11. 2018: št. citatov (TC): 2, čistih citatov (CI): 2, čistih citatov na avtorja (CIAu): 0.50]  kategorija: 1A2 (Z, A1/2); uvrstitev: SCI, Scopus, MBP; tip dela je verificiral OSICT  POPOVIĆ, Jelena, KLOPČIČ, Beno, PETRUN, Martin, POLAJŽER, Boštjan, **DOLINAR, Drago**. Optimization of resistance spot welding transformer windings using analytical successive approximation and differential evolution. *IEEE transactions on magnetics*, ISSN 0018-9464, Apr. 2014, vol. 50, no. 4, str. 1-4. [COBISS.SI-ID [17778710](https://plus.si.cobiss.net/opac7/bib/17778710?lang=sl)], [[JCR](https://plus.si.cobiss.net/opac7/jcr?c=sc=0018-9464+and+PY=2014&r1=true&lang=sl), [SNIP](https://plus.si.cobiss.net/opac7/snip?c=sc=0018-9464+and+PY=2014&r1=true&lang=sl), [WoS](http://gateway.isiknowledge.com/gateway/Gateway.cgi?GWVersion=2&SrcAuth=Alerting&SrcApp=Alerting&DestApp=WOS&DestLinkType=FullRecord&UT=000343032900095) do 23. 7. 2017: št. citatov (TC): 4, čistih citatov (CI): 4, čistih citatov na avtorja (CIAu): 0.80, [Scopus](http://www.scopus.com/inward/record.url?partnerID=2dRBettD&eid=2-s2.0-84942412224) do 27. 9. 2018: št. citatov (TC): 8, čistih citatov (CI): 7, čistih citatov na avtorja (CIAu): 1.40]  kategorija: 1A2 (Z, A1/2); uvrstitev: SCI, Scopus, MBP; tip dela je verificiral OSICT  PETRUN, Martin, **DOLINAR, Drago**, KLOPČIČ, Beno, ŠTUMBERGER, Gorazd*. Transformer and method for setting winding coils : CN103811156 (B), 2017-11-24*. [S. l.]: China National intellectual property administration, PRC, 2017. 15 f., ilustr. [https://worldwide.espacenet.com/publicationDetails/biblio?CC=CN&NR=103811156B&KC=B&FT=D&ND=4&date=20171124&DB=worldwide.espacenet. com&locale=en\_EP#](https://worldwide.espacenet.com/publicationDetails/biblio?CC=CN&NR=103811156B&KC=B&FT=D&ND=4&date=20171124&DB=worldwide.espacenet.com&locale=en_EP). [COBISS.SI-ID [21534742](https://plus.si.cobiss.net/opac7/bib/21534742?lang=sl)]  patentna družina: CN103811156 (A), 2014-05-21; P201200201, 2012-06-14; SI24127 (A), 2013-12-31; DE102013009588 (A1), 2013-12-19; P201200202, 2012-06-14; SI24125 (A), 2013-12-31; CN103777156 (B), 2018-08-21; DE102013009587 (A1), 2013-12-19  kategorija: 2E (Z, A1/2); tip dela še ni verificiran | | | | | | | | | | | | | | | | | | | | |

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| **UČNI NAČRT PREDMETA / COURSE SYLLABUS** | | | | | | | | | | | | | | | | | | | | |
| **Predmet:** | | | **NEKATERA POGLAVJA UPORABNE MATEMATIKE** | | | | | | | | | | | | | | | | | |
| **Course title:** | | | **SOME TOPICS OF APPLIED MATHEMATICS** | | | | | | | | | | | | | | | | | |
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| **Študijski program in stopnja**  **Study programme and level** | | | | | **Študijska smer**  **Study field** | | | | | | | | | | | **Letnik**  **Academic year** | | **Semester**  **Semester** | | |
| **ENERGETIKA, 3. stopnja** | | | | | **-** | | | | | | | | | | | **1/2** | | **1/2/3** | | |
| **ENERGY TECHNOLOGY, 3. Degree** | | | | | **-** | | | | | | | | | | | **1/2** | | **1/2/3** | | |
|  | | | | | | | | | | | | | | | | | | | | |
| **Vrsta predmeta / Course type** | | | | | | | | | | | | | | | Izbirni/Elective | | | | | |
|  | | | | | | | | | | | | | | |  | | | | | |
| **Univerzitetna koda predmeta / University course code:** | | | | | | | | | | | | | | | D | | | | | |
|  | | | | | | | | | | | | | | | | | | | | |
| **Predavanja**  **Lectures** | **Seminar**  **Seminar** | | | **Vaje**  **Tutorial** | | | | **Klinične vaje**  **work** | | | | | | **Druge oblike študija** | | | **Samost. delo**  **Individ. work** | |  | **ECTS** |
| **30** | **-** | | | **-** | | | | **-** | | | | | | **-** | | | **150** | |  | **6** |
|  | | | | | | | | | | | | | | | | | | | | |
| **Nosilec predmeta / Lecturer:** | | | | | **BRIGITA FERČEC** | | | | | | | | | | | | | | | |
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| **Jeziki /**  **Languages:** | | **Predavanja / Lectures:** | | | | **Slovenski/Slovene** | | | | | | | | | | | | | | |
| **Vaje / Tutorial:** | | | | **Slovenski/Slovene** | | | | | | | | | | | | | | |
| **Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:** | | | | | | | | | |  | | **Prerequisits:** | | | | | | | | |
| Osnovno znanje iz matematične analize, algebre in teorije verjetnosti. | | | | | | | | | |  | | Basic knowledge of mathematical analysis, algebra and probability theory. | | | | | | | | |
| **Vsebina:** | | | | | | | | | |  | | **Content (Syllabus outline):** | | | | | | | | |
| * **Kvalitativna teorija navadnih diferencialnih enačb** (singularne točke dvo-dimenzialnih linearnih sistemov NDE, osnovne lastnosti rešitev in trajektorij sistemov NDE, fazni portreti dvo-dimenzionalnih avtonomnih sistemov, stabilnost rešitev sistemov NDE in stabilnost po prvi aproksimaciji, bifurkacije singularnih točk, bifurkacije periodičnih rešitev, kvalitativna študija nekaterih tehničnih modelov). * **Osnove diskretnih dinamičnih sistemov (**rekurzivni   sistemi (linearne rekurzije s konstantnimi koeficienti),  diferenčne enačbe/sistemi diferenčnih enačb,  eksplicitne rešitve, analiza stabilnosti fiksnih točk,  logistična enačba, programska orodja za primerjalno  analizo.Nekatera poglavja iz numerične analize).   * **Statistika** (Gaussova normalna porazdelitev; statistični vzorci in centralni limit izrek; formule izpeljane iz Gaussove porazdelitve (Studentova, hi-kvadrat,..); stopnje zaupanja in numerično računanje kritičnih konstant pri osnovnih statističnih porazdelitvah; osnovna struktura parametričnih statističnih testov; korelacijske matrike in multipla regresija, pri populaciji in vzorcih; testi za parametrično ocenjevanje korelacijskih in regresijskih koeficientov populacije na osnovi vzorčnih vrednosti; nelinearna regresija; računalniško modeliranje). | | | | | | | | | |  | | * **Qualitative theory of ordinary differential equations** (singular points of planar linear systems ODEs, main properties of solutions and trajectories of systems of ODEs, phase portraits of two-dimensional autonomous systems, stability of solutions of systems of ODEs and stability by the first approximation, bifurcations of singular points, bifurcations of periodic solutions, qualitative investigation of some technical models). * **Basics of Discrete Dynamical Systems** (recurrence   relations (linear recurrence with constant koefficients),  difference equations/systemd of difference equations,  closed form solutions, stability analysis for fixed points,  logistic model, Software for compartmental analysis).   * **Statistics** (Gaussian (normal) distibution; statistical   samples and central limit theorem; formulas derived from Gauss formula (Student, chi-square, …); confidence levels and numerical computations of critical constants for fundamental statistical distribution; basic structure of parametric statistical tests; correlation matrix and multiple regression, for population and samples; tests for estimation of correlation and regression coefficients; nonlinear regression; computer modeling). | | | | | | | | |
| **Temeljni literatura in viri / Readings:** | | | | | | | | | | | | | | | | | | | | |
| 1. D.K. Arowsmith, C.M. Place, Dynamical systems. Differential equations, maps an chaotic behaviour, Chapman and Hall Mathematics Series, Chapman & Hall, London 1992.  2. S. N. Chow, J. K. Hale, Methods of bifurcation theory, Grundlehren der mathematischen Wissenschaften, 251. Springer-Verlag, New York - Berlin 1982.  3. V. G. Romanovski, D.S. Shafer, The Center and Cyclicity Problems: A Computational Algebra Approach. Birkhäuser, Boston, 2009.  4**.** L. Perko, Differential Equations and Dynamical Systems: Texts in Applied Mathematics 7. New York: Springer-Verlag, 3rd edition, 2001.  5. P. Hartman, Ordinary Differential Equations, New York: Wiley, 1964.  6. I. Pardoe; Applied Regression Modeling, J. Wiley and Sons, 2012.  7. B. FERČEC, M. MENCINGER. *Algebraične metode v dinamičnih sistemih*. 1. izd. Maribor: Univerzitetna založba Univerze: Fakulteta za gradbeništvo, prometno inženirstvo in arhitekturo, 2018. | | | | | | | | | | | | | | | | | | | | |
| **Cilji in kompetence:** | | | | | | | | |  | | **Objectives and competences:** | | | | | | | | | |
| Cilji:  Proučiti metode kvalitativne teorije NDE, diskretne analize in statistike ter razumeti njihovo aplikativno vrednost v nekaterih tehničnih problemih.  Kompetence:  Sposobnost uporabe pridobljenih znanj pri tehničnih predmetih in pri raziskovalnem delu. | | | | | | | | |  | | Objectives:  To study the methods of the qualitative theory of ODE’s, discret analysis and statistics and to understand their applicative value in some technical problems.  Competences:  The ability to use the acquired knowledge in technical subjects and for the research. | | | | | | | | | |
| **Predvideni študijski rezultati:** | | | | | | | | | |  | **Intended learning outcomes:** | | | | | | | | | |
| Znanje in razumevanje  Po uspešno zaključenem predmetu naj bi bili študenti zmožni:   1. Razumeti osnovne načine kvalitativne in bifurkacijske analize diferencialnih in diferenčnih enačb. 2. Uporabljati metode študija lastnosti rešitev   diferencialnih in diferenčnih enačb.   1. Analizirati določene matematične modele, opisane z navadnimi diferencialnimi enačbami ali diferenčnimi enačbami. 2. Razumeti aplikativno vrednost statistike v problemih odločanja in znati uporabiti statistični test pri odločitvenih problemih. 3. Analizirati proces ter ga povzeti v obliki matematičnega modela. | | | | | | | | | |  | Knowledge and understanding  At the end of the course students are going to:   1. Understand main approaches to the qualitative and bifurcational analysis of differential and difference equations. 2. Use knowledege of methods of studying the properties of solutions of differential and difference equations. 3. Analyze a certain mathematical model described by ordinary differential equations or difference equations. 4. Understand the applicative value of statistics in   decision making problems and based on proper statistical test to be able to choose between the decisions related to sensitivity analysis.   1. Analyze and summarize the processes in sense of a mathematical model. | | | | | | | | | |
| **Metode poučevanja in učenja:** | | | | | | | | | |  | **Learning and teaching methods:** | | | | | | | | | |
| Klasična predavanja oz. konzultacije, uporaba prilagojenih računalniških programov za modeliranje. Individualizirano preiskovanje pri pripravi seminarske naloge. | | | | | | | | | |  | Classical lectures / tutorial consultations, the use of several software specialized for mathematical modeling. Individual reserch focused on project work. | | | | | | | | | |
| **Načini ocenjevanja:** | | | | | | | Delež (v %) /  Weight (in %) | | | | | | **Assessment:** | | | | | | | |
| Način (pisni izpit, ustno izpraševanje, naloge, projekt):   * Pisni izpit – problemi in teorija * Seminarska naloga | | | | | | | **60%**  **40%** | | | | | | Type (examination, oral, coursework, project):   * Written exam – problems and theory * Project work | | | | | | | |
| **Reference nosilca / Lecturer's references:** | | | | | | | | | | | | | | | | | | | | |
| FERČEC, Brigita, ŽULJ, Maja, GINÉ, Jaume. Blow-up method for linearizability of resonant differential systems. International journal of bifurcation and chaos in applied sciences and engineering. 2023, vol. 33, no. 08, str. 1-17. ISSN 1793-6551. https://www.worldscientific.com/doi/10.1142/S0218127423501006, DOI: 10.1142/S0218127423501006. [COBISS.SI-ID 159115267], [JCR, SNIP, WoS, Scopus] financer: ARRS, P1-0306, J1-2457, SI; Agencia Estatal de Investigación, PID2020- 113758GB-I00, ESP; AGAUR (Generalitat de Catalunya), 2021SGR 01618, ESP kategorija: 1A2 (Z, A1/2); uvrstitev: SCIE, Scopus, MBP (COMPENDEX, INSPEC, METADEX, MSN); tip dela je verificiral OSICN  FERČEC, Brigita, MENCINGER, Matej, PETEK, Tatjana, AYBAR, Orhan Ozgur, AYBAR, Ilknur Kusbeyzi. Qualitative Analysis of the Minimal Higgins Model of Glycolysis. Match : communications in mathematical and in computer chemistry. 2023, vol. 90, str. 563-580. ISSN 0340-6253. https://match.pmf.kg.ac.rs/issues/m90n3/m90n3\_563-580.html, DOI: 10.46793/match.90-3.563F. [COBISS.SI-ID 157794563], [JCR, SNIP, WoS, Scopus do 29. 9. 2023: št. citatov (TC): 1, čistih citatov (CI): 1, čistih citatov na avtorja (CIAu): 0.20] financer: ARRS, Program, P1-0306, SI; ARRS, Program, P1-0288, SI; ARRS, Projekt, BI-TR/19- 22-003, SI; Scientific and Technological Research Council of Turkey (TUBITAK) under project 119F017 kategorija: 1A2 (Z, A1/2); uvrstitev: SCIE, Scopus, MBP (MSN); tip dela je verificiral OSICN  FERČEC, Brigita, GINÉ, Jaume. Formal Weierstrass integrability for a Liénard differential system. Journal of mathematical analysis and applications. [Print ed.]. 2021, issue 1, art. 125016, 14 str. ISSN 0022-247X. DOI: 10.1016/j.jmaa.2021.125016. [COBISS.SI-ID 49998851], [JCR, SNIP, WoS do 19. 8. 2023: št. citatov (TC): 6, čistih citatov (CI): 6, čistih citatov na avtorja (CIAu): 3.00, Scopus do 13. 4. 2023: št. citatov (TC): 6, čistih citatov (CI): 6, čistih citatov na avtorja (CIAu): 3.00] kategorija: 1A1 (Z, A', A1/2); uvrstitev: SCIE, Scopus, MBP (INSPEC, MSN, PUBMED); tip dela je verificiral OSICN | | | | | | | | | | | | | | | | | | | | |

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| **UČNI NAČRT PREDMETA / COURSE SYLLABUS** | | | | | | | | | | | | | | | | | | | | |
| **Predmet:** | | | **NAPREDNE NUMERIČNE SIMULACIJE TOKOVNIH POJAVOV** | | | | | | | | | | | | | | | | | |
| **Course title:** | | | **ADVANCED NUMERICAL SIMULATIONS OF FLUID FLOWS** | | | | | | | | | | | | | | | | | |
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| **Študijski program in stopnja**  **Study programme and level** | | | | | **Študijska smer**  **Study field** | | | | | | | | | | | **Letnik**  **Academic year** | | **Semester**  **Semester** | | |
| **ENERGETIKA, 3. stopnja** | | | | | **-** | | | | | | | | | | | **1/2** | | **1/2/3** | | |
| **ENERGY TECHNOLOGY, 3. Degree** | | | | | **-** | | | | | | | | | | | **1/2** | | **1/2/3** | | |
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| **Vrsta predmeta / Course type** | | | | | | | | | | | | | | | Izbirni/Elective | | | | | |
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| **Univerzitetna koda predmeta / University course code:** | | | | | | | | | | | | | | | D | | | | | |
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| **Predavanja**  **Lectures** | **Seminar**  **Seminar** | | | **Vaje**  **Tutorial** | | | | **Klinične vaje**  **work** | | | | | | **Druge oblike študija** | | | **Samost. delo**  **Individ. work** | |  | **ECTS** |
| **30** | **-** | | | **-** | | | | **-** | | | | | | **-** | | | **150** | |  | **6** |
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| **Nosilec predmeta / Lecturer:** | | | | | **MATEJ FIKE** | | | | | | | | | | | | | | | |
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| **Jeziki /**  **Languages:** | | **Predavanja / Lectures:** | | | | **Slovenski/Slovene** | | | | | | | | | | | | | | |
| **Vaje / Tutorial:** | | | | **Slovenski/Slovene** | | | | | | | | | | | | | | |
| **Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:** | | | | | | | | | |  | | **Prerequisits:** | | | | | | | | |
| Zahtevano predhodno znanje iz področja matematike, fizike in računalniškega modeliranja. | | | | | | | | | |  | | General knowledge from the field of Mathematics, Physics and Computer modelling. | | | | | | | | |
| **Vsebina:** | | | | | | | | | |  | | **Content (Syllabus outline):** | | | | | | | | |
| * Namen numeričnih simulacij * Fizikalni opisi tokovnih pojavov: vodilne enačbe, robni in začetni pogoji. * Matematično modeliranje tokovnih pojavov * Metode numeričnega modeliranja in matematična formulacija. * Metoda končnih razlik: formulacija, diskretizacija. * Modeli turbulence. * Uporaba numeričnega modeliranja stacionarnih in časovno odvisnih tokovnih pojavov. * Možnosti numeričnega modeliranja dvofaznih tokovih pojavov. * Izdelava numeričnih mrež. | | | | | | | | | |  | | * The purpose of numerical simulations * Physical descriptions of fluid flow: leading equations, boundary and initial conditions. * Mathematical modeling of fluif flow. * Methods of numerical modeling and mathematical formulation. * Finite difference method, formulation, discretization, advantages, weaknesses * Turbulence models. * The use of numerical modeling of steady and transient fluid flow. * The possibilities of numerical modeling of two-phase fluid flows. * Numerical mesh generating. | | | | | | | | |
| **Temeljni literatura in viri / Readings:** | | | | | | | | | | | | | | | | | | | | |
| Anderson J.: Computational Fluid Dynamics, McGraw-Hill Education, 1995  Moukalled F., Mangani L., Darwish M.: The Finite Volume Method in Computational Fluid Dynamics: An Advanced Introduction with OpenFoam and Matlab, Springer, 2015 | | | | | | | | | | | | | | | | | | | | |
| **Cilji in kompetence:** | | | | | | | | |  | | **Objectives and competences:** | | | | | | | | | |
| Seznaniti študenta z osnovami numeričnih metod osnovnih ohranitvenih zakonov mehanike tekočin, posredovati pravilni pristop h generaciji mrež, pravilni numerični definiciji fizikalnega problema v računalniškem okolju ter uporabi računalniških simulacij . | | | | | | | | |  | | The course is intended to introduce students to the fundamentals of computational methods of basic conservation laws in fluid mechanics, to convey the right approach to mesh generation, computational modeling of physical problems, to provide practical experience with computer simulations . | | | | | | | | | |
| **Predvideni študijski rezultati:** | | | | | | | | | |  | **Intended learning outcomes:** | | | | | | | | | |
| Znanje in razumevanje:   * pravilne izbire ustreznega postopka * numeričnega modeliranja tokovnih pojavov * pravilna interpretacija numeričnih rezultatov ter uporaba v praksi.   Prenesljive/ključne spretnosti in drugi atributi:  • uspešno delo na energetskih razvojno  raziskovalnih projektih | | | | | | | | | |  | Knowledge and understanding:   * the correct choice of the appropriate   process of numerical modeling of energy  processes   * the correct interpretation of numerical results and application in practice   Transferable/Key Skills and other attributes:   * successful work on energy development research projects | | | | | | | | | |
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| **Metode poučevanja in učenja:** | | | | | | | | | |  | **Learning and teaching methods:** | | | | | | | | | |
| Predavanja  Računalniške vaje  Samostojno delo.  poučevanje in učenje poteka z didaktično uporabo IKT | | | | | | | | | |  | Lectures.  Computer exercises.  Individual work.  teaching and learning is done using didactic use of ICT | | | | | | | | | |
| **Načini ocenjevanja:** | | | | | | | Delež (v %) /  Weight (in %) | | | | | | **Assessment:** | | | | | | | |
| Ustni izpit  Projekt | | | | | | | **50%**  **50%** | | | | | | Oral examination  Project | | | | | | | |
| **Reference nosilca / Lecturer's references:** | | | | | | | | | | | | | | | | | | | | |
| FIKE, Matej, BOMBEK, Gorazd, HRIBERŠEK, Matjaž, HRIBERNIK, Aleš. Numerično raziskovanje vrtečega zastoja v aksialnem ventilatorju = Numerical investigation of rotating stall in an axial fan. V: HRIBERŠEK, Matjaž (ur.), RAVNIK, Jure (ur.). *Zbornik del*, Kuhljevi dnevi 2014, Maribor, 24.-25. september, 2014. Ljubljana: Slovensko društvo za mehaniko. 2014, str. 47-54, ilustr. <http://www.drustvozamehaniko.si/zbornik/ZbornikKD2014.pdf>. [COBISS.SI-ID [18123286](https://plus.si.cobiss.net/opac7/bib/18123286?lang=sl)]  FIKE, Matej, BOMBEK, Gorazd, HRIBERNIK, Aleš. Eksperimentalno in numerično raziskovanje nestacionarnega tokovnega polja okoli osamljenega krila = Experimental and numerical investigation of unsteady field around an isolated airfoil. V: EBERLINC, Matjaž (ur.), ŠIROK, Brane (ur.). *Zbornik del*, Kuhljevi dnevi, 22. september 2011, Mengeš. Ljubljana: SDM - Slovensko društvo za mehaniko. 2011, str. 33-40.  <http://www.drustvozamehaniko.si/zbornik/ZbornikKD2011.pdf>. [COBISS.SI-ID [15398422](https://plus.si.cobiss.net/opac7/bib/15398422?lang=sl)]  FIKE, Matej, BOMBEK, Gorazd, HRIBERNIK, Aleš. Numerical and experimental study of flow around airfoil. V: KUDLÁČEK, Jan (ur.), PEPELNJAK, Tomaž (ur.). *IN-TECH 2011 : proceedings*, International Conference on Innovative Technologies, IN-TECH 2011, 01. 09. 2011 to 03. 09. 2011, Bratislava, Slovakia. [S. l.: [J. Kudlaček]. 2011, str. 344-347. [COBISS.SI-ID [15304470](https://plus.si.cobiss.net/opac7/bib/15304470?lang=sl)]  FIKE, Matej, HREN, Gorazd, PREDIN, Andrej, PEZDEVŠEK, Marko. Primerjava numerične napovedi koeficienta moči in aksialne sile trilopatične vetrne turbine. V: GORENC ZORAN, Annmarie (ur.), ALJAŽ, Tomaž. *Relevant technologies in the era of sustainable development : professional monograph = Aktualne tehnologije v dobi trajnostnega razvoja : strokovna monografija*. Novo mesto: Fakulteta za industrijski inženiring: = Faculty of Industrial Engineering. 2016, str. 20-28, graf. prikazi. [COBISS.SI-ID [1024232796](https://plus.si.cobiss.net/opac7/bib/1024232796?lang=sl)]  FIKE, Matej, HREN, Gorazd, PREDIN, Andrej, PEZDEVŠEK, Marko. Primerjava numeričnih napovedi modelne vetrne turbine = Comparison of numerical predictions of a model wind turbine. V: GORENC ZORAN, Annmarie (ur.). *Tehnologija v dobi trajnostnega razvoja : zbornik povzetkov = Technology in the era of sustainable development : conference proceedings abstracts*. Novo mesto: Fakulteta za industrijski inženiring. 2016, str. 38. <http://rii.fini-unm.si/wp-content/uploads/2016/05/Zbornik-povzetkov-konference_FINAL-WEB.pdf>. [COBISS.SI-ID [1024228188](https://plus.si.cobiss.net/opac7/bib/1024228188?lang=sl)] | | | | | | | | | | | | | | | | | | | | |

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| **UČNI NAČRT PREDMETA / COURSE SYLLABUS** | | | | | | | | | | | | | | | | | | | | |
| **Predmet:** | | | **MODELIRANJE ELEKTRIČNIH NAPRAV** | | | | | | | | | | | | | | | | | |
| **Course title:** | | | **MODELLING OF ELECTRICAL DEVICES** | | | | | | | | | | | | | | | | | |
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| **Študijski program in stopnja**  **Study programme and level** | | | | | **Študijska smer**  **Study field** | | | | | | | | | | | **Letnik**  **Academic year** | | **Semester**  **Semester** | | |
| **ENERGETIKA, 3. stopnja** | | | | | **-** | | | | | | | | | | | **1/2** | | **1/2/3** | | |
| **ENERGY TECHNOLOGY, 3. Degree** | | | | | **-** | | | | | | | | | | | **1/2** | | **1/2/3** | | |
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| **Vrsta predmeta / Course type** | | | | | | | | | | | | | | | Izbirni/Elective | | | | | |
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| **Univerzitetna koda predmeta / University course code:** | | | | | | | | | | | | | | | D | | | | | |
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| **Predavanja**  **Lectures** | **Seminar**  **Seminar** | | | **Vaje**  **Tutorial** | | | | **Klinične vaje**  **work** | | | | | | **Druge oblike študija** | | | **Samost. delo**  **Individ. work** | |  | **ECTS** |
| **30** | **-** | | | **-** | | | | **-** | | | | | | **-** | | | **150** | |  | **6** |
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| **Nosilec predmeta / Lecturer:** | | | | | **MIRALEM HADŽISELIMOVIĆ** | | | | | | | | | | | | | | | |
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| **Jeziki /**  **Languages:** | | **Predavanja / Lectures:** | | | | **Slovenski/Slovene** | | | | | | | | | | | | | | |
| **Vaje / Tutorial:** | | | | **Slovenski/Slovene** | | | | | | | | | | | | | | |
| **Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:** | | | | | | | | | |  | | **Prerequisits:** | | | | | | | | |
| Predhodno znanje osnov elektrotehnike in osnov električnih strojev ter električnih naprav. | | | | | | | | | |  | | Preliminary knowledge of electrical engineering fundamentals and basics of electrical machines and devices. | | | | | | | | |
| **Vsebina:** | | | | | | | | | |  | | **Content (Syllabus outline):** | | | | | | | | |
| - Uvod v modeliranje električnih naprav, vrste analiz, vrste modelov, definiranje podsistemov (električni, mehanski, toplotni), povezovalno polje;  - Modeli s porazdeljenimi parametri (statične in tranzientne analize);  - Modeli s koncentriranimi parametri (nadomestna vezja, magnetno linearni – zapis diferencialnih enačb, magnetno nelinearni – zapis parcialnih diferencialnih enačb);  - Eksperimentalno določanje parametrov modela: merilne metode in merilni sistemi;  - Računsko določanje parametrov modela (analitični in numerični izračun parametrov);  - Modeliranje daljnovodov, dušilk, stikalnih naprav, elektromehanskih aktuatorjev, transformatorjev, asinhronskih strojev, sinhronskih strojev, enosmernih strojev. | | | | | | | | | |  | | - Introduction to the modelling of electrical devices, types of analysis, types of models, defining subsystems (electrical, mechanical, thermal), coupling field;  - Models with distributed parameters (static and transient analyzes);  - Models with lumped parameters (equivalent circuits, magnetic linear - a record of differential equations, nonlinear magnetic - a record of partial differential equations);  - Experimental determination of model parameters: measurement methods and measuring systems;  - Analytical and numerical determination of model parameters;  - Modelling of transmission lines, reactors, switching devices, electromechanical actuators, transformers, induction machines, synchronous machines, DC machines. | | | | | | | | |
| **Temeljni literatura in viri / Readings:** | | | | | | | | | | | | | | | | | | | | |
| P. C. Krause, O. Wasynczuk, and S. D. Sudhoff, Analysis of Electric Machinery, The Institute of Electrical and Electronics Engineers, New York, 1995.  M. Jadrić, B. Frančić, Dinamika električnih strojeva, Graphis, Zagreb, 1997.  M. M. Hossain, Heat and Mass Transfer – Modeling and Simulation, Published by InTech, Printed in Croatia, 2011.  A. Milella, D. D. Paola, G. Cicirelli, Mechatronic Systems, Simulation, Modelling and Control, Published by InTech, Printed in India, 2010.  G. Štumberger, B. Štumberger, T. Marčič, M. Hadžiselimović, D. Dolinar, Magnetically Nonlinear Dynamic Models of Synchronous Machines: Their Derivation, Parameters and Applications, Chapter 16 of book New Trends in Technologies: Devices, Computer, Communication and Industrial Systems, Publisher: Sciyo, 2010.  A. Belmiloudi, Heat Transfer – Mathematical Modelling, Numerical Methods and Information Technology, Published by InTech, Printed in India, 2011. | | | | | | | | | | | | | | | | | | | | |
| **Cilji in kompetence:** | | | | | | | | |  | | **Objectives and competences:** | | | | | | | | | |
| Študenti pridobijo poglobljena znanja s področja modeliranja električnih naprav v praksi. | | | | | | | | |  | | Students acquire knowledge in the field of electrical devices models and their practical use. | | | | | | | | | |
| **Predvideni študijski rezultati:** | | | | | | | | | |  | **Intended learning outcomes:** | | | | | | | | | |
| Znanje in razumevanje:  Poglobljeno razumevanje modeliranja električnih naprav in metod za določevanje parametrov, usposobljenost za samostojno modeliranje in izvedbo različnih simulacijskih izračunov z električnimi napravami.  Prenesljive/ključne spretnosti in drugi atributi:  Kombinirana uporaba različnih metod in programskih orodij za modeliranje električnih naprav. | | | | | | | | | |  | Knowledge and understanding:  In-depth understanding of electrical devices modelling and methods for parameter determination, skills for independent modelling and implementation of various simulations for electrical devices.  Transferable/Key skills and other attributes:  The combined use of different methods and software tools for electrical devices modelling. | | | | | | | | | |
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| **Metode poučevanja in učenja:** | | | | | | | | | |  | **Learning and teaching methods:** | | | | | | | | | |
| Predavanja.  Samostojno reševanje nalog.  Seminarska naloga  poučevanje in učenje poteka z didaktično uporabo IKT | | | | | | | | | |  | Lectures.  Individual solving of problems  Seminar work  teaching and learning is done using didactic use of ICT | | | | | | | | | |
| **Načini ocenjevanja:** | | | | | | | Delež (v %) /  Weight (in %) | | | | | | **Assessment:** | | | | | | | |
| pisni izpit  ustni izpit  seminarsko delo | | | | | | | **30%**  **30%**  **40%** | | | | | | written examination  oral examination  seminar work | | | | | | | |
| **Reference nosilca / Lecturer's references:** | | | | | | | | | | | | | | | | | | | | |
| **HADŽISELIMOVIĆ, Miralem**, SRPČIČ, Gregor, BRINOVAR, Iztok, PRAUNSEIS, Zdravko, SEME, Sebastijan, ŠTUMBERGER, Bojan. A novel concept of linear oscillatory synchronous generator designed for a stirlingengine. Energy, ISSN 1873-6785. [Online ed.], 7. maj 2019, [1-20] str., ilustr., doi: 10.1016/j.energy.2019.04.187. [COBISS.SI-ID 1024348508], [JCR, SNIP, WoS do 19. 7. 2019: št. citatov (TC): 0, čistih citatov (CI): 0, čistih citatov na avtorja (CIAu): 0, Scopus do 29. 5. 2019: št. citatov (TC): 0, čistih citatov (CI): 0, čistih citatov na avtorja (CIAu): 0]  kategorija: 1A1 (Z, A', A1/2); uvrstitev: SCI, Scopus, MBP; tip dela še ni verificiran  točke: 27.19, št. avtorjev: 6  SEME, Sebastijan, SREDENŠEK, Klemen, ŠTUMBERGER, Bojan, **HADŽISELIMOVIĆ, Miralem**. Analysis of the performance of photovoltaic systems in Slovenia. Solar energy, ISSN 0038-092X. [Print ed.], 2019, vol. 180, str. 550-558, ilustr., doi: 10.1016/j.solener.2019.01.062. [COBISS.SI-ID 1024334684], [JCR, SNIP, WoS do 10. 8. 2020: št. citatov (TC): 7, čistih citatov (CI): 7, čistih citatov na avtorja (CIAu): 1.75, Scopus do 10. 8. 2020: št. citatov (TC): 4, čistih citatov (CI): 4, čistih citatov na avtorja (CIAu): 1.00]  kategorija: 1A1 (Z, A', A1/2); uvrstitev: SCI, Scopus, MBP; tip dela je verificiral OSICT  točke: 25.26, št. avtorjev: 4  SEME, Sebastijan, SREDENŠEK, Klemen, PRAUNSEIS, Zdravko, ŠTUMBERGER, Bojan, **HADŽISELIMOVIĆ, Miralem**. Optimal price of electricity of solar power plants and small hydro power plants : technical and economical part of investments. Energy, ISSN 0360-5442, avg. 2018, vol. 157, str. 87-95, graf. prikazi, doi: 10.1016/j.energy.2018.05.121. [COBISS.SI-ID 1024307804], [JCR, SNIP, WoS do 10. 8. 2020: št. citatov (TC): 11, čistih citatov (CI): 10, čistih citatov na avtorja (CIAu): 2.00, Scopus do 10. 8. 2020: št. citatov (TC): 10, čistih citatov (CI): 9, čistih citatov na avtorja (CIAu): 1.80]  kategorija: 1A1 (Z, A', A1/2); uvrstitev: SCI, Scopus, MBP; tip dela je verificiral OSICT  točke: 32.63, št. avtorjev: 5 | | | | | | | | | | | | | | | | | | | | |

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| **UČNI NAČRT PREDMETA / COURSE SYLLABUS** | | | | | | | | | | | | | | | | | | | | |
| **Predmet:** | | | **NAČRTOVANJE ASINHRONSKIH STROJEV** | | | | | | | | | | | | | | | | | |
| **Course title:** | | | **DESIGN OF INDUCTION MACHINES** | | | | | | | | | | | | | | | | | |
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| **Študijski program in stopnja**  **Study programme and level** | | | | | **Študijska smer**  **Study field** | | | | | | | | | | | **Letnik**  **Academic year** | | **Semester**  **Semester** | | |
| **ENERGETIKA, 3. stopnja** | | | | | **-** | | | | | | | | | | | **1/2** | | **1/2/3** | | |
| **ENERGY TECHNOLOGY, 3. Degree** | | | | | **-** | | | | | | | | | | | **1/2** | | **1/2/3** | | |
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| **Vrsta predmeta / Course type** | | | | | | | | | | | | | | | Izbirni/Elective | | | | | |
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| **Univerzitetna koda predmeta / University course code:** | | | | | | | | | | | | | | | D | | | | | |
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| **Predavanja**  **Lectures** | **Seminar**  **Seminar** | | | **Vaje**  **Tutorial** | | | | **Klinične vaje**  **work** | | | | | | **Druge oblike študija** | | | **Samost. delo**  **Individ. work** | |  | **ECTS** |
| **30** | **-** | | | **-** | | | | **-** | | | | | | **-** | | | **150** | |  | **6** |
|  | | | | | | | | | | | | | | | | | | | | |
| **Nosilec predmeta / Lecturer:** | | | | | **MIRALEM HADŽISELIMOVIĆ** | | | | | | | | | | | | | | | |
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| **Jeziki /**  **Languages:** | | **Predavanja / Lectures:** | | | | **Slovenski/Slovene** | | | | | | | | | | | | | | |
| **Vaje / Tutorial:** | | | | **Slovenski/Slovene** | | | | | | | | | | | | | | |
| **Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:** | | | | | | | | | |  | | **Prerequisits:** | | | | | | | | |
| Predhodno znanje osnov elektrotehnike in osnov električnih strojev. | | | | | | | | | |  | | Preliminary knowledge of electrical engineering fundamentals and basics of electrical machines. | | | | | | | | |
| **Vsebina:** | | | | | | | | | |  | | **Content (Syllabus outline):** | | | | | | | | |
| - Uvod v asinhronske stroje (standardne geometrije in dimenzije, statorski in rotorski paketi, vrste ohišij, ležaji, priključna omarica, pregled konstrukcijskih materialov, vrsta pogona, … );  - Navitja asinhronskih strojev (načrtovanje,izračun navijalnih podatkov, izbira vodnikov);  - Analitični izračun elektromagnetnih karakteristik;  - Numerični izračun elektromagnetnih karakteristik;  - Numerični in analitični izračun toplotnega polja asinhronskega stroja;  - Posebnosti načrtovanja asinhronskih motorjev izvedenih v protieksplozijski zaščiti;  - Posebnosti načrtovanja asinhronskih motorjev za pogon električnih vozil;  - Posebnosti načrtovanja asinhronskih generatorjev. | | | | | | | | | |  | | - Introduction to induction machines (standard geometry and dimensions, stator and rotor packages, types of housing, bearings, terminal box, review of construction materials, duty cycle, ...);  - Windings in induction machines (design, calculation of winding data, conductor selection);  - Analytical calculation of the electromagnetic characteristics;  - Numerical calculation of electromagnetic characteristics;  - Numerical and analytical calculation of thermal field in induction machine;  - Special features of designing induction motors in explosion-proof protection;  - Special features of designing induction motors for electric vehicles;  - Special features of designing induction generators; | | | | | | | | |
| **Temeljni literatura in viri / Readings:** | | | | | | | | | | | | | | | | | | | | |
| I. Boldea, S. A. Nasar, The Induction Machine Handbook, CRC Press, 2002.  I. Zagradišnik , B. Slemnik: Električni rotacijski stroji, učbenik, Fakulteta za elektrotehniko, računalništvo in informatiko, 4. izdaja, Maribor, 2006.  R. Wolf: Uvod u teoriju električkih strojeva, Školska knjiga, Zagreb, 1975.  N. Srb: Elektromotori proračun, prematanje, popravak i mjerenje, Tehnička knjiga, Zagreb, 1987.  N. Srb: Ispitivanje i prematanje elektromotora, Dotisak, Zagreb, 2005. | | | | | | | | | | | | | | | | | | | | |
| **Cilji in kompetence:** | | | | | | | | |  | | **Objectives and competences:** | | | | | | | | | |
| Študenti pridobijo poglobljena znanja s področja načrtovanja asinhronskih strojev v praksi. | | | | | | | | |  | | Students acquire knowledge in the field of design induction machines in connection with practical problems. | | | | | | | | | |
| **Predvideni študijski rezultati:** | | | | | | | | | |  | **Intended learning outcomes:** | | | | | | | | | |
| Znanje in razumevanje:  Poglobljeno razumevanje teorije delovanja asinhronskih strojev, različnih metod izračunov, zmožnost izbire pravilnih materialov, usposobljenosti za samostojno razvijanje in reševanje najzahtevnejših konceptov pri načrtovanju asinhronskih strojev .  Prenesljive/ključne spretnosti in drugi atributi:  Kombinirana uporaba različnih metod in programskih orodij za načrtovanje in reševanje raziskovalnih problemov iz področja asinhronskih strojev. | | | | | | | | | |  | Knowledge and understanding:  In-depth understanding of the induction machines theory, different approaches and methods of calculations, ability to choose correct materials, competence for independent development and solving the most complex concepts in the design of induction machines.  Transferable/Key skills and other attributes:  The combined use of different methods and software tools for design and solving research problems in the field of induction machines. | | | | | | | | | |
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| **Metode poučevanja in učenja:** | | | | | | | | | |  | **Learning and teaching methods:** | | | | | | | | | |
| Predavanja.  Samostojno reševanje nalog.  Seminarska naloga  poučevanje in učenje poteka z didaktično uporabo IKT | | | | | | | | | |  | Lectures.  Individual solving of problems  Seminar work  teaching and learning is done using didactic use of ICT | | | | | | | | | |
| **Načini ocenjevanja:** | | | | | | | Delež (v %) /  Weight (in %) | | | | | | **Assessment:** | | | | | | | |
| pisni izpit  ustni izpit  seminarsko delo | | | | | | | **30%**  **30%**  **40%** | | | | | | written examination  oral examination  seminar work | | | | | | | |
| **Reference nosilca / Lecturer's references:** | | | | | | | | | | | | | | | | | | | | |
| 1. SEME, Sebastijan, SREDENŠEK, Klemen, PRAUNSEIS, Zdravko, ŠTUMBERGER, Bojan, HADŽISELIMOVIĆ, Miralem. Optimal price of electricity of solar power plants and small hydro power plants : technical and economical part of investments. Energy, ISSN 0360-5442. [Print ed.], avg. 2018, vol. 157, str. 87-95.  2. BAREŠIĆ, Dejan, HEDERIĆ, Željko, HADŽISELIMOVIĆ, Miralem. Modelling of an expert system for diagnosing the operational status of a diesel genset. Tehnički vjesnik : znanstveno-stručni časopis tehničkih fakulteta Sveučilišta u Osijeku, ISSN 1330-3651, 2018, vol. 25, suppl. 2, str. 437-443.  3. HADŽISELIMOVIĆ, Miralem, MLAKAR, Matej, ŠTUMBERGER, Bojan. Impact of pole pair number on the efficiency of an induction generator for a mini hydro power plant. Przeglęad Elektrotechniczny. Przeglęad Elektrotechniczny, ISSN 0033-2097, 2013, r. 89, nr. 2b, str. 17-20.  4. IGREC, Dalibor, ŠTUMBERGER, Bojan, CHOWDHURY, Amor, HADŽISELIMOVIĆ, Miralem. Impact of saturation modelling on the losses of electric drive controlled by QFT. Przeglęad Elektrotechniczny, ISSN 0033-2097, 2013, r. 89, nr. 2b, str. 92-95.  5. HADŽISELIMOVIĆ, Miralem, ZAGRADIŠNIK, Ivan, ŠTUMBERGER, Bojan. Induction machine : comparison of motor and generator characteristics. Przeglęad Elektrotechniczny, ISSN 0033-2097, 2013, r. 89, nr. 2b, str. 103-106.  6. HADŽISELIMOVIĆ, Miralem, MLAKAR, Matej, ŠTUMBERGER, Bojan. Impact of pole pair number on the efficiency of an induction generator for a mini hydro power plant. Przeglęad Elektrotechniczny, ISSN 0033-2097, 2013, r. 89, nr. 2b, str. 17-20.  7. HADŽISELIMOVIĆ, Miralem, ZAGRADIŠNIK, Ivan, ŠTUMBERGER, Bojan. Induction machine : comparison of motor and generator characteristics. Przeglęad Elektrotechniczny, ISSN 0033-2097, 2013, r. 89, nr. 2b, str. 103-106.  8. ŠTUMBERGER, Bojan, MARČIČ, Tine, HADŽISELIMOVIĆ, Miralem. Direct comparison of induction motor and line-start IPM synchronous motor characteristics for semi-hermetic compressor drives. IEEE transactions on industry applications, ISSN 1939-9367, 2012, vol. 48, no 6, str. 2310-2321.  9. BILUŠ, Ignacijo, HADŽISELIMOVIĆ, Miralem. The analysis of thermal losses in an induction motor. Przeglęad Elektrotechniczny, ISSN 0033-2097, 2011, vol. 87, iss. 3, str. 13-16.  10. HADŽISELIMOVIĆ, Miralem, MARČIČ, Tine, ŠTUMBERGER, Bojan, ZAGRADIŠNIK, Ivan. Winding type influence on efficiency of an induction motor. Przeglęad Elektrotechniczny, ISSN 0033-2097, 2011, vol. 87, iss. 3, str. 61-64.  11. HADŽISELIMOVIĆ, Miralem, ŠTUMBERGER, Bojan, MARČIČ, Tine, VIRTIČ, Peter, ŠTUMBERGER, Gorazd, HAMLER, Anton, ZAGRADIŠNIK, Ivan. The impact of a winding type on the operational characteristics of converter-fed induction motor. Przeglęad Elektrotechniczny, ISSN 0033-2097, 2008, vol. 84, no. 12, str. 170-173. | | | | | | | | | | | | | | | | | | | | |

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| **UČNI NAČRT PREDMETA / COURSE SYLLABUS** | | | | | | | | | | | | | | | | | | | | |
| **Predmet:** | | | **MODELIRANJE IN NUMERIČNE SIMULACIJE** | | | | | | | | | | | | | | | | | |
| **Course title:** | | | **MODELLING AND NUMERICAL SIMULATIONS** | | | | | | | | | | | | | | | | | |
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| **Študijski program in stopnja**  **Study programme and level** | | | | | **Študijska smer**  **Study field** | | | | | | | | | | | **Letnik**  **Academic year** | | **Semester**  **Semester** | | |
| **ENERGETIKA, 3. stopnja** | | | | | **-** | | | | | | | | | | | **1/2** | | **1/2/3** | | |
| **ENERGY TECHNOLOGY, 3. Degree** | | | | | **-** | | | | | | | | | | | **1/2** | | **1/2/3** | | |
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| **Vrsta predmeta / Course type** | | | | | | | | | | | | | | | Izbirni/Elective | | | | | |
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| **Univerzitetna koda predmeta / University course code:** | | | | | | | | | | | | | | | D | | | | | |
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| **Predavanja**  **Lectures** | **Seminar**  **Seminar** | | | **Vaje**  **Tutorial** | | | | **Klinične vaje**  **work** | | | | | | **Druge oblike študija** | | | **Samost. delo**  **Individ. work** | |  | **ECTS** |
| **30** | **-** | | | **-** | | | | **-** | | | | | | **-** | | | **150** | |  | **6** |
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| **Nosilec predmeta / Lecturer:** | | | | | **GORAZD HREN** | | | | | | | | | | | | | | | |
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| **Jeziki /**  **Languages:** | | **Predavanja / Lectures:** | | | | **Slovenski/Slovene** | | | | | | | | | | | | | | |
| **Vaje / Tutorial:** | | | | **Slovenski/Slovene** | | | | | | | | | | | | | | |
| **Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:** | | | | | | | | | |  | | **Prerequisits:** | | | | | | | | |
| Ni posebnih obveznosti. | | | | | | | | | |  | | No perquisites. | | | | | | | | |
| **Vsebina:** | | | | | | | | | |  | | **Content (Syllabus outline):** | | | | | | | | |
| Uvod, zgodovinski pregled in področja uporabe geometrijskega modeliranja. Klasične tehnike modeliranja 3D objektov, ploskovni modeli, objekti svobodnih oblik.  Parametrično modeliranje in tehnike za tvorbo in spreminjanje kompleksnih modelov, sklopov in kinematičnih simulacij.  Realnost, modeli, animacije in simulacije. Modeliranje inženirskih problemov. Pregled matematično-fizikalnih modelov trdnin in tekočin. Diferencialne formulacije – Metoda končnih razlik in integralske formulacije, Metoda končnih elementov in virtualno delo, Metoda končnih volumnov in prenosna enačba. Interpolacijske funkcije in vrste elementov - linijski, ravninski in prostorski problemi. Definicija robnih pogojev in konvergenčnih kriterijev.  Načrtovanje in izvedba računalniških simulacij. Vrednotenje ter predstavitev rezultatov. | | | | | | | | | |  | | Introduction, historical survey and applications of geometric modelling. Classical 3D modelling techniques, surface models, free-form objects.  Parametric and modern geometric techniques for model creation and modifications, assemblies and kinematical simulations.  Reality, models, animations and simulations. Modelling of engineering problems. Review of mathematical-physical models of solid and fluid continuum behaviour under different influences. Differential formulations: Finite difference method and Integral formulations, Finite element method and virtual work, Finite volume method for potential problems. Shape functions and types of elements. 1D, 2D and 3D problems. Definition of boundary conditions and convergence criteria.  Planning and execution of computer simulations. Evaluation and presentation of results. | | | | | | | | |
| **Temeljni literatura in viri / Readings:** | | | | | | | | | | | | | | | | | | | | |
| Ferziger, Perič: Computational methods for Fluid dynamics, Springer Verlag, 1997.  Mortenson: *Geometric Modeling*, 3rd Edition, Industrial Press, New York City, USA, 2006.  Zienkiewicz, Taylor, Zhu: The finite element method: Its Basis and Fundamentals, 6.ed., Elsevier 2005  Peiro, Sherwin: Finite Difference, Finite Element and Finite Volume Methods For Partial Differential Equations, Handbook of Materials Modeling, Volume I: Methods and Models, Springer, 2005. | | | | | | | | | | | | | | | | | | | | |
| **Cilji in kompetence:** | | | | | | | | |  | | **Objectives and competences:** | | | | | | | | | |
| Cilj predmeta je seznaniti študente s tehnikami kreiranja in predstavitve kompleksnih 3D geometrijskih modelov s sodobnimi računalniškimi orodji. Priprava numeričnih analiz: predprocesiranje, rešitev, prikaz in komentiranje rezultatov. | | | | | | | | |  | | The objective of this course is to acquaint students with techniques for complex 3D object creation and representation with modern computer tools. Preparation of numerical analyses: pre-processor, solver, post-processor, results validation. | | | | | | | | | |
| **Predvideni študijski rezultati:** | | | | | | | | | |  | **Intended learning outcomes:** | | | | | | | | | |
| * izbrati metodo predstavitve 3D objektov, * ilustrirati principe tehnologij za zajemanje 3D modelov in hitro izdelavo prototipov, * uporabiti sodobni geometrijski modelirni sistem, * razumevanje principov računalniškega reševanja inženirskih problemov, razlik med računskimi modeli in analizi numeričnih rezultatov; * praktična uporaba sodobnih računalniških sistemov za reševanje inženirskih problemov; | | | | | | | | | |  | * select appropriate 3D representation method * illustrate techniques 3D model acquisition and rapid prototyping technologies, * use a modern geometric modelling system, * understanding of principles of computational solutions of engineering problems, differences between computational models and analysis of numerical results; * practical use of modern computer systems for solution of engineering problems; | | | | | | | | | |
| **Metode poučevanja in učenja:** | | | | | | | | | |  | **Learning and teaching methods:** | | | | | | | | | |
| predavanja,  praktično delo v računalnici,  projektno delo.  poučevanje in učenje poteka z didaktično uporabo IKT | | | | | | | | | |  | lectures,  computertutorials,  projectwork.  teaching and learning is done using didactic use of ICT | | | | | | | | | |
| **Načini ocenjevanja:** | | | | | | | Delež (v %) /  Weight (in %) | | | | | | **Assessment:** | | | | | | | |
| Način (pisni izpit, ustno izpraševanje, naloge, projekt):   * ustni izpit, e-kviz * opravljeno projektno delo, * opravljene računalniške vaje. | | | | | | | **40%**  **50%**  **10%** | | | | | | Type (examination, oral, coursework, project):   * oral examination, e-quiz * completed project work, * completed tutorials. | | | | | | | |
| **Reference nosilca / Lecturer's references:** | | | | | | | | | | | | | | | | | | | | |
| HREN, Gorazd. Wind Turbine Blade Numerical Analysis with Two Software Packages, *Technical* *Gazette*, ISSN 1330-3651, 2018  HREN, Gorazd, KONOVŠEK, Damjan. Simulation of commissioning in warehouse = Simulacija komisioniranja v skladišču. *Journal of energy technology*, ISSN 1855-5748, 2016  HREN, Gorazd, PREDIN, Andrej, ŽAGAR, Ivan. Generic model of wind turbine blades = Generični model lopatic vetrne turbine. *Journal of energy technology*, ISSN 1855-5748, 2013  HREN, Gorazd, POTRČ, Iztok, AVSEC, Jurij. Integrated web-based framework for product mechanism simulation. *Advanced engineering*, ISSN 1846-5900, 2010  HREN, Gorazd. Web-based environment for mechanism simulation integrated with CAD system. *Engineering with computers*, ISSN 0177-0667, 2010 | | | | | | | | | | | | | | | | | | | | |

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| **UČNI NAČRT PREDMETA / COURSE SYLLABUS** | | | | | | | | | | | | | | | | | | | | |
| **Predmet:** | | | **VIRTUALNI INŽINERING** | | | | | | | | | | | | | | | | | |
| **Course title:** | | | **VIRTUAL ENGINEERING** | | | | | | | | | | | | | | | | | |
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| **Študijski program in stopnja**  **Study programme and level** | | | | | **Študijska smer**  **Study field** | | | | | | | | | | | **Letnik**  **Academic year** | | **Semester**  **Semester** | | |
| **ENERGETIKA, 3. stopnja** | | | | | **-** | | | | | | | | | | | **1/2** | | **1/2/3** | | |
| **ENERGY TECHNOLOGY, 3. Degree** | | | | | **-** | | | | | | | | | | | **1/2** | | **1/2/3** | | |
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| **Vrsta predmeta / Course type** | | | | | | | | | | | | | | | Izbirni/Elective | | | | | |
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| **Univerzitetna koda predmeta / University course code:** | | | | | | | | | | | | | | | D | | | | | |
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| **Predavanja**  **Lectures** | **Seminar**  **Seminar** | | | **Vaje**  **Tutorial** | | | | **Klinične vaje**  **work** | | | | | | **Druge oblike študija** | | | **Samost. delo**  **Individ. work** | |  | **ECTS** |
| **30** | **-** | | | **-** | | | | **-** | | | | | | **-** | | | **150** | |  | **6** |
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| **Nosilec predmeta / Lecturer:** | | | | | **GORAZD HREN** | | | | | | | | | | | | | | | |
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| **Jeziki /**  **Languages:** | | **Predavanja / Lectures:** | | | | **Slovenski/Slovene** | | | | | | | | | | | | | | |
| **Vaje / Tutorial:** | | | | **Slovenski/Slovene** | | | | | | | | | | | | | | |
| **Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:** | | | | | | | | | |  | | **Prerequisits:** | | | | | | | | |
| Ni posebnih obveznosti. | | | | | | | | | |  | | No perquisites. | | | | | | | | |
| **Vsebina:** | | | | | | | | | |  | | **Content (Syllabus outline):** | | | | | | | | |
| Namen in možnosti virtualnega inženiringa: modeliranje, obratni inženiring, navidezna resničnost in virtualni prototipi.  Navidezna in mešana resničnost: namen, vhod in izhod, procesiranje in vizualizacija.  Prenos CAD modelov v navidezno resničnost.  Metode in tehnike hitre izdelave prototipov, 3D tisk in njihove značilnosti. | | | | | | | | | |  | | Purpose and possibilities of virtual engineering: modelling, reverse engineering, virtual reality, and virtual prototyping.  Virtual and mixed reality: purpose, input and output, processing and visualisation.  Transferring of CAD objects into virtual environment.  Methods and techniques for rapid prototyping, 3D printing and characteristics. | | | | | | | | |
| **Temeljni literatura in viri / Readings:** | | | | | | | | | | | | | | | | | | | | |
| * [M. Mihelj](http://link.springer.com/search?facet-creator=%22Matja%C5%BE+Mihelj%22), [D.Novak](http://link.springer.com/search?facet-creator=%22Domen+Novak%22), [S. Beguš](http://link.springer.com/search?facet-creator=%22Samo+Begu%C5%A1%22): Virtual Reality Technology and Applications, Springer, 2014 * R.W.Messler: Reverse engineering : mechanisms, structures, systems, and materials, McGraw-Hill Education, 2014 * Alexandru C. Telea: Reverse Engineering – Recent Advances and Applications, InTech, 2012 * Mortenson: Geometric Modeling, 3rd Edition, Industrial Press, New York City, USA, 2006. * Noorani: Rapid Prototyping: Principles and Applications, Wiley, Hoboken, New Jersey, USA, 2005. | | | | | | | | | | | | | | | | | | | | |
| **Cilji in kompetence:** | | | | | | | | |  | | **Objectives and competences:** | | | | | | | | | |
| Integrirani razvoj izdelka ali procesa z uporabo metod virtualnega inženiringa. | | | | | | | | |  | | Integrated development of the product or process using methods of virtual engineering. | | | | | | | | | |
| **Predvideni študijski rezultati:** | | | | | | | | | |  | **Intended learning outcomes:** | | | | | | | | | |
| Znanje in razumevanje:  Metode modeliranja, prenosa CAD modelov v navidezno ali mešano okolje, hitrih simulacij in izdelave prototipa s tehnikami 3D tiska. | | | | | | | | | |  | Knowledge and understanding:  Methods of modelling, CAD models transferring into virtual or mixed reality and production of prototypes with 3D printing. | | | | | | | | | |
| **Metode poučevanja in učenja:** | | | | | | | | | |  | **Learning and teaching methods:** | | | | | | | | | |
| frontalna predavanja,  vaje-praktično delo na računalnici in laboratoriju  project.  poučevanje in učenje poteka z didaktično uporabo IKT | | | | | | | | | |  | frontal lectures,  tutorials-practical work in computer room and laboratory,  project.  teaching and learning is done using didactic use of ICT | | | | | | | | | |
| **Načini ocenjevanja:** | | | | | | | Delež (v %) /  Weight (in %) | | | | | | **Assessment:** | | | | | | | |
| Način (pisni izpit, ustno izpraševanje, naloge, projekt):   * domače naloge, * projekt, * teoretični del izpita (e-vprašalnik) | | | | | | | **20%**  **50%**  **30%** | | | | | | Type (examination, oral, coursework, project):   * homework, * course work report, * theoretical examination (e-kviz). | | | | | | | |
| **Reference nosilca / Lecturer's references:** | | | | | | | | | | | | | | | | | | | | |
| HREN, Gorazd, PEZDEVŠEK, Marko. Research in virtual engineering = Raziskave v virtualnem inženiringu. *Journal of energy technology*, 2018  HREN, Gorazd, PREDIN, Andrej. Visualisation of processes in warehouse on website with X3D. V: AYDIN, Ulviyye (ur.). *Maritime logistics : the new port projects of Turkey : proceedings*. Izmir: University: Logistics Association. 2015  HREN, Gorazd, PREDIN, Andrej, ŽAGAR, Ivan. Generic model of wind turbine blades = Generični model lopatic vetrne turbine. *Journal of energy technology*, 2013  HREN, Gorazd, JEZERNIK, Anton. A framework for collaborative product review. The international journal of advanced manufacturing technology, 2009  15. HREN, Gorazd, JEZERNIK, Anton, LUKŠIČ, Stanislav, PREDIN, Andrej. Integration framework to support cooperation in product development process. Strojniški vestnik, 2009  JEZERNIK, Anton, HREN, Gorazd. A solution to integrate computer-aided design (CAD) and virtual reality (VR) databases in design and manufacturing processes. *The international journal of advanced manufacturing technology*, 2003 | | | | | | | | | | | | | | | | | | | | |

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| **UČNI NAČRT PREDMETA / COURSE SYLLABUS** | | | | | | | | | | | | | | | | | | | | |
| **Predmet:** | | | **MODELIRANJE NELINEARNIH PROCESOV** | | | | | | | | | | | | | | | | | |
| **Course title:** | | | **MODELLING OF NONLINEAR PROCESSES** | | | | | | | | | | | | | | | | | |
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| **Študijski program in stopnja**  **Study programme and level** | | | | | **Študijska smer**  **Study field** | | | | | | | | | | | **Letnik**  **Academic year** | | **Semester**  **Semester** | | |
| **ENERGETIKA, 3. stopnja** | | | | | **-** | | | | | | | | | | | **1/2** | | **1/2/3** | | |
| **ENERGY TECHNOLOGY, 3. Degree** | | | | | **-** | | | | | | | | | | | **1/2** | | **1/2/3** | | |
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| **Vrsta predmeta / Course type** | | | | | | | | | | | | | | | Izbirni/Elective | | | | | |
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| **Univerzitetna koda predmeta / University course code:** | | | | | | | | | | | | | | | D | | | | | |
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| **Predavanja**  **Lectures** | **Seminar**  **Seminar** | | | **Vaje**  **Tutorial** | | | | **Klinične vaje**  **work** | | | | | | **Druge oblike študija** | | | **Samost. delo**  **Individ. work** | |  | **ECTS** |
| **30** | **-** | | | **-** | | | | **-** | | | | | | **-** | | | **150** | |  | **6** |
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| **Nosilec predmeta / Lecturer:** | | | | | **DALIBOR IGREC** | | | | | | | | | | | | | | | |
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| **Jeziki /**  **Languages:** | | **Predavanja / Lectures:** | | | | **Slovenski/Slovene** | | | | | | | | | | | | | | |
| **Vaje / Tutorial:** | | | | **Slovenski/Slovene** | | | | | | | | | | | | | | |
| **Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:** | | | | | | | | | |  | | **Prerequisits:** | | | | | | | | |
| Ni posebnih obveznosti | | | | | | | | | |  | | No prerequisits | | | | | | | | |
| **Vsebina:** | | | | | | | | | |  | | **Content (Syllabus outline):** | | | | | | | | |
| * Uvodni del: pomen modeliranja nelinearnih procesov, postopek modeliranja, dinamični in statični modeli. * Optimizacijske tehnike: linearna optimizacija in metoda najmanjših kvadratov, rekurzivna metoda najmanjših kvadratov, iskalni in gradientni algoritmi, nelinearna metoda najmanjših kvadratov, optimizacija in redukcija kompleksnih procesov. * Statični procesi: obdelava različnih tipov statičnih procesov, * Spremenljivi procesi: modeliranje linearnih dinamičnih procesov, časovne vrste, rekurzivni algoritmi, modeliranje s povratno vezavo, modeliranje nelinearnih dinamičnih procesov. * Pregled in obravnava izbranih primerov modeliranja nelinearnih procesov v energetiki. | | | | | | | | | |  | | * Introduction: importance of nonlinear process modelling, modelling procedure, dynamic and static models. * Optimization techniques: linear optimization and least squares method, recursive least squares method, search and gradient algorithms, nonlinear least squares method, complex processes optimization and reduction. * Static processes: handling different types of static processes. * Variable processes: modelling of linear dynamic processes, time series, recursive algorithms, feedback modelling, modelling of nonlinear dynamic processes. * Review and discussion of selected examples of modelling of nonlinear processes in the energy sector. | | | | | | | | |
| **Temeljni literatura in viri / Readings:** | | | | | | | | | | | | | | | | | | | | |
| * F. Abdullah, M. S. Alhajeri, P. D. Christofides: *Modeling and Control of Nonlinear Processes Using Sparse Identification: Using Dropout to Handle Noisy Data*, I&EC research, 2022 * R. Sakata, T. Oshima, S. Kawai, T. Nguyen-Van: *Equilibrium space and a pseudo linearization of nonlinear systems*, Scientific Reports, 2022 * M. S. Alhajeria, Z. Wua, D. Rincona, F. Albalawi, P. D. Christofides: *Machine-learning-based state estimation and predictive control of nonlinear processes*, Elsevier B.V., 2021 * F. Abdullaha, P. D. Christofides: *Real-time adaptive sparse-identification-based predictive control of nonlinear processes*, Elsevier Ltd., 2023 * M. V. B. Santana: *Exact Solutions of Nonlinear Second-Order Autonomous Ordinary Differential Equations: Application to Mechanical Systems*, Dynamics, 2023 * B. Yi, I. R. Manchester: *On the Equivalence of Contraction and Koopman Approaches for Nonlinear Stability and Control*, 60th IEEE Conference on Decision and Control (CDC), 2021 | | | | | | | | | | | | | | | | | | | | |
| **Cilji in kompetence:** | | | | | | | | |  | | **Objectives and competences:** | | | | | | | | | |
| Cilj predmeta je podati študentom poglobljeno znanje o modeliranju nelinearnih procesov. | | | | | | | | |  | | Students gain in-depth knowledge of nonlinear process modelling. | | | | | | | | | |
| **Predvideni študijski rezultati:** | | | | | | | | | |  | **Intended learning outcomes:** | | | | | | | | | |
| Znanje in razumevanje:  Po zaključku predmeta bo študent sposoben:   * samostojno izvesti modeliranje nelinearnega procesa, * načrtati algoritme za nelinearno modeliranje procesov v programskih in simulacijskih orodjih, * predstaviti osnovne načine metod modeliranja nelinearnih procesov v industrijskih aplikacijah, * razumeti razlike med metodami modeliranja nelinearnih procesov, * raziskovalne rezultate pri modeliranju uporabiti v praksi in le-te predstaviti v znanstveni publikaciji. | | | | | | | | | |  | Knowledge and understanding:  On completion of this course the student will be able to:   * independently perform modelling of nonlinear process, * design algorithms for nonlinear modelling of processes in software and simulation tools, * to present the basic methods of modelling of nonlinear processes in industrial applications, * understand the differences between the methods of modelling nonlinear processes, * to apply research results of modelling in practice and present them in a scientific publication. | | | | | | | | | |
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| **Metode poučevanja in učenja:** | | | | | | | | | |  | **Learning and teaching methods:** | | | | | | | | | |
| Predavanja,  seminarska naloga,  domače naloge  poučevanje in učenje poteka z didaktično uporabo IKT | | | | | | | | | |  | Lectures,  seminar work,  homework’s  teaching and learning is done using didactic use of ICT | | | | | | | | | |
| **Načini ocenjevanja:** | | | | | | | Delež (v %) /  Weight (in %) | | | | | | **Assessment:** | | | | | | | |
| * Pisni izpit, * ustni izpit, * seminarska naloga. | | | | | | | **40 %**  **40 %**  **20 %** | | | | | | * Written examination, * oral examination, * seminar work. | | | | | | | |
| **Reference nosilca / Lecturer's references:** | | | | | | | | | | | | | | | | | | | | |
| CHOWDHURY, Amor, URBANIJA, Miloš, GOŠTE, Luka, **IGREC, Dalibor**. Smart unattended home delivery box : EP 3 799 554 B1. München: European Patent Application, 2023. 20 str., ilustr. [COBISS.SI-ID 1024321116]  patentna družina: Prijavitelj Margento R&D d.o.o.; EP 3 799 554 B1, 2023-07-12  kategorija: 2E (Z, A1/2)  točke: 50, št. avtorjev: 4  **IGREC, Dalibor**, CHOWDHURY, Amor, ŠTUMBERGER, Bojan, SARJAŠ, Andrej. *Robust tracking system design for a synchronous reluctance motor - SynRM based on a new modified bat optimization algorithm*. Applied soft computing, ISSN 1568-4946. [Print ed.], aug. **2018**, vol. 69, str. 568-584, doi: 10.1016/j.asoc.2018.05.002. [COBISS.SI-ID 1024306524], [JCR, SNIP, WoS do 3. 8. 2018: št. citatov (TC): 0, čistih citatov (CI): 0, čistih citatov na avtorja (CIAu): 0, Scopus do 30. 6. 2018: št. citatov (TC): 0, čistih citatov (CI): 0, čistih citatov na avtorja (CIAu): 0]  **kategorija: 1A1** (Z, A', A1/2); uvrstitev: SCI, Scopus, MBP; tip dela je verificiral OSICT  točke: 31.84, št. avtorjev: 4  CHOWDHURY, Amor, **IGREC, Dalibor**. *Smart optical tag* : EP3059697 (B1), **2018**-05-16. Munich: European Patent Office, 2018. 6 str., ilustr. [COBISS.SI-ID 1024306012]  patentna družina: Prijavitelj Margento R&D d.o.o.; EP3059697 (A1), 2016-08-24; SI24935 (A), 2016-08-31; SI20150000036, 2015-02-19  kategorija: 2E (Z, A'', A', A1/2); tip dela je verificiral OSICT  točke: 100, št. avtorjev: 2  CHOWDHURY, Amor, BLAZINŠEK, Iztok, IGREC, Dalibor. Encryption coding module = Verschlüsselungscodierungsmodul = Module de codage de cryptage : European patent specification EP 3139564 (B1), 2019-01-16. München: Europäisches Patentamt, 2019. 17 str., ilustr. [COBISS.SI-ID 1024334940]  patentna družina: EP3139564 (A1), 2017-03-08; EP 20150184095, 2015-09-07  kategorija: 2E (Z, A'', A', A1/2); tip dela je verificiral OSICT  točke: 66.67, št. avtorjev: 3 | | | | | | | | | | | | | | | | | | | | |

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| **UČNI NAČRT PREDMETA / COURSE SYLLABUS** | | | | | | | | | | | | | | | | | | | | |
| **Predmet:** | | | **MODELIRANJE IN REŠEVANJE ČASOVNO ODVISNIH ELEKTROMAGNETNIH POJAVOV** | | | | | | | | | | | | | | | | | |
| **Course title:** | | | **MODELLING AND SOLVING OF THE TIME DEPENDANT ELECTROMAGNETIC PHENOMENA** | | | | | | | | | | | | | | | | | |
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| **Študijski program in stopnja**  **Study programme and level** | | | | | **Študijska smer**  **Study field** | | | | | | | | | | | **Letnik**  **Academic year** | | **Semester**  **Semester** | | |
| **ENERGETIKA, 3. stopnja** | | | | | **-** | | | | | | | | | | | **1/2** | | **1/2/3** | | |
| **ENERGY TECHNOLOGY, 3. Degree** | | | | | **-** | | | | | | | | | | | **1/2** | | **1/2/3** | | |
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| **Vrsta predmeta / Course type** | | | | | | | | | | | | | | | Izbirni/Elective | | | | | |
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| **Univerzitetna koda predmeta / University course code:** | | | | | | | | | | | | | | | D | | | | | |
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| **Predavanja**  **Lectures** | **Seminar**  **Seminar** | | | **Vaje**  **Tutorial** | | | | **Klinične vaje**  **work** | | | | | | **Druge oblike študija** | | | **Samost. delo**  **Individ. work** | |  | **ECTS** |
| **30** | **-** | | | **-** | | | | **-** | | | | | | **-** | | | **150** | |  | **6** |
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| **Nosilec predmeta / Lecturer:** | | | | | **MARKO JESENIK** | | | | | | | | | | | | | | | |
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| **Jeziki /**  **Languages:** | | **Predavanja / Lectures:** | | | | **Slovenski/Slovene** | | | | | | | | | | | | | | |
| **Vaje / Tutorial:** | | | | **Slovenski/Slovene** | | | | | | | | | | | | | | |
| **Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:** | | | | | | | | | |  | | **Prerequisits:** | | | | | | | | |
| Visokošolsko znanje osnov elektortehnike in teoretske elektrotehnike | | | | | | | | | |  | | High school knowledge of electrical engineering and theoretical electrical engineering | | | | | | | | |
| **Vsebina:** | | | | | | | | | |  | | **Content (Syllabus outline):** | | | | | | | | |
| * Uvod: opis elektromagnetnih pojavov s poudarkom na časovno odvisnih pojavih. * Teoretične osnove za numerično modeliranje in reševanje elektromagnetnih pojavov ter delitev časovno odvisnih pojavov v harmonične in tranzientne. * Numerični pristop: numerično reševanje harmoničnih in tranzientnih problemov, definiranje robnih pogojev, začentih vrednosti in časovnega koraka. * Opisi materialov za potrebe numričnega modeliranja časovno odvisnih elektromagnetnih pojavov: opisi materialov, katerih karakteristike se spreminjajo v odvisnosti od velikosti in smeri elektromagnetnega polja. * Primeri numerično modeliranih časovno odvisnih elektromagnetnih pojavov: modeliranje kožnega pojava, modeliranje vrtinčnih tokov in karakteristični problemi pri posameznih modelih in izračunih.   Primeri modeliranja magnetnih prehodnih pojavov v elektromagnetnih napravah: primer elektromotorja, primer elektromagnetne naprave itd. | | | | | | | | | |  | | * Introduction: description of the electromagnetic phenomena with emphasis on the time dependant phenomena. * Theoretical basis for the numerical modelling and solving of the electromagnetic phenomena and partition of the time dependant phenomena into the harmonic and transient. * Numerical approach: numerical solving of the harmonic and transient problems, defining of the boundary conditions, initial values and defining of the time step. * Description of the materials used for the numerical modelling of the time dependant electromagnetic phenomena: descriptions of the materials, which characteristics are changing depending on the amplitude and direction of the electromagnetic field. * Numerically modelled time dependant electromagnetic phenomena examples: skin effect modelling, eddy currents modelling and characteristic problems by single modelling and calculations.   Examples of the magnetic transient phenomena modelling in the electromagnetic devices: electric motor example, electromagnetic device example, etc. | | | | | | | | |
| **Temeljni literatura in viri / Readings:** | | | | | | | | | | | | | | | | | | | | |
| * Gouri Dhatt and Gilbert Touzot: *The Finite Element Method Displayed*, John Wiley & Sons, New York, 1985. * P. P. Silvester, R. L. Ferrari: *Finite Elements for Electrical Engineers, Second Edition,* Cambridge University Press, Cambridge, 1990. * A. Krawczyk, J. A. Tegopoulos: *Numerical Modelling of Eddy Currents,* Clarendon Press, Oxford, 1993. | | | | | | | | | | | | | | | | | | | | |
| **Cilji in kompetence:** | | | | | | | | |  | | **Objectives and competences:** | | | | | | | | | |
| Cilj predmeta so:  - seznaniti študenta s principi modeliranja elektromagnetnih pojavov s poudarkom na časovno odvisnih problemih,  - pojasniti teoretične osnove za numerično modeliranja,  - predstaviti numerični pristop,  - seznaniti študenta z opisi materialov za potrebe numeričnega modeliranja,  - pojasniti primere modeliranja časovno odvisnih elektromagnetih problemov | | | | | | | | |  | | The objective of this course are:  - description of the electromagnetic phenomena with emphasis on the time dependant phenomena  - description of the theoretical basis for the numerical modelling  - description of numerical approach  - description of materials for the needs of numerical modeling  - explaination of examples of modeling time-dependent electromagnetic problems | | | | | | | | | |
| **Predvideni študijski rezultati:** | | | | | | | | | |  | **Intended learning outcomes:** | | | | | | | | | |
| Znanje in razumevanje:  Po zaključku tega predmeta bo študent sposoben   * uporabiti znanje in razumevanje principov modeliranja in reševanje elektromagnetnih pojavov, * analizirati in rešiti enostavne aplikacije s področja časovno odvisnih elektromagnetnih pojavov. | | | | | | | | | |  | Knowledge and understanding:  On completion of this course the student will be able to   * use knowledge and understanding of modelling principles and solving of electromagnetic phenomena, * analyze and solving applications of time dependant electromagnetic phenomena. | | | | | | | | | |
| Prenosljive/ključne spretnosti in drugi atributi:   * *Spretnosti komuniciranja:* ustni zagovor izpita, pisno izražanje na pisnem izpitu. * *Uporaba informacijske tehnologije:* uporaba programskih orodij za numerično modeliranje časovno odvisnih elektromagnetnih pojavov. * *Reševanje problemov:* modeliranje časovno odvisnega elektromagnetnega pojava | | | | | | | | | |  | Transferable/Key skills and other attributes:   * *Communication skills:* oral examination defence, manner of expression at written examination. * *Use of information technology:* use of numerical time dependant electromagnetic phenomena modelling software tools. * *Problem solving:* design of the time dependant electromagnetic phenomena. | | | | | | | | | |
| **Metode poučevanja in učenja:** | | | | | | | | | |  | **Learning and teaching methods:** | | | | | | | | | |
| predavanja,  laboratorijske vaje  poučevanje in učenje poteka z didaktično uporabo IKT | | | | | | | | | |  | lectures,  lab work  teaching and learning is done using didactic use of ICT | | | | | | | | | |
| **Načini ocenjevanja:** | | | | | | | Delež (v %) /  Weight (in %) | | | | | | **Assessment:** | | | | | | | |
| Način (pisni izpit, ustno izpraševanje, naloge, projekt):  projekt  ustno izpraševanje | | | | | | | **50%**  **50%** | | | | | | Type (examination, oral, coursework, project):  project  oral examination | | | | | | | |
| **Reference nosilca / Lecturer's references:** | | | | | | | | | | | | | | | | | | | | |
| TRBUŠIĆ, Mislav, HAMLER, Anton, GORIČAN, Viktor, **JESENIK, Marko**. Contactless determination of a permanent magnet%s stable position within ferrofluid. Mathematics, ISSN 2227-7390, 2022, vol. 10, no. 14, 12 str., doi: 10.3390/math10142499. [COBISS.SI-ID 118958595], [JCR, SNIP, WoS do 25. 8. 2022: št. citatov (TC): 0, čistih citatov (CI): 0, čistih citatov na avtorja (CIAu): 0, Scopus do 8. 9. 2022: št. citatov (TC): 0, čistih citatov (CI): 0, čistih citatov na avtorja (CIAu): 0] [tip COBISS: 1.01 Izvirni znanstveni članek] [uvrstitev revije v MBP (2021): SCIE, Scopus, DOAJ, METADEX, PUBMED]  [Z/3.2 Izvirni znanstveni članek (SCIE ali SSCI) - 1. četrtina] kategorija: 1A1 (Z, A', A1/2); uvrstitev: SCI, Scopus, MBP; tip dela je verificiral OSICT  točke: 31.84, št. avtorjev: 4  **JESENIK, Marko**, HAMLER, Anton, TRLEP, Mladen. Analyzing of a soil model using the finite element method for simulation of soil resistivity measurement. IEEE transactions on magnetics, ISSN 0018-9464, July 2021, vol. 57, iss. 7, str. 1-4, doi: 10.1109/TMAG.2021.3075580. [COBISS.SI-ID 68941059], [JCR, SNIP, WoS do 10. 7. 2021: št. citatov (TC): 0, čistih citatov (CI): 0, čistih citatov na avtorja (CIAu): 0, Scopus do 18. 8. 2021: št. citatov (TC): 0, čistih citatov (CI): 0, čistih citatov na avtorja (CIAu): 0] [tip COBISS: 1.01 Izvirni znanstveni članek] [uvrstitev revije v MBP (2021): SCIE, Scopus, COMPENDEX, INSPEC, METADEX, PUBMED]  [Z/3.4 Izvirni znanstveni članek (SCIE ali SSCI) - 3. četrtina] kategorija: 1A1 (Z, A', A1/2); uvrstitev: SCI, Scopus,ve MBP; tip dela je verificiral OSICT  točke: 34.76, št. avtorjev: 4  **JESENIK, Marko**, MERNIK, Marjan, ČREPINŠEK, Matej, RAVBER, Miha, TRLEP, Mladen. Searching for soil models' parameters using metaheuristics. Applied soft computing, ISSN 1568-4946. [Print ed.], 2018, vol. 69, str. 131-148, doi: 10.1016/j.asoc.2018.04.045. [COBISS.SI-ID 21391894], [JCR, SNIP, WoS do 30. 6. 2022: št. citatov (TC): 6, čistih citatov (CI): 3, čistih citatov na avtorja (CIAu): 0.60, Scopus do 17. 7. 2022: št. citatov (TC): 8, čistih citatov (CI): 4, čistih citatov na avtorja (CIAu): 0.80] [tip COBISS: 1.01 Izvirni znanstveni članek] [uvrstitev revije v MBP (2018): SCIE, Scopus, COMPENDEX, INSPEC, PUBMED] [Z/3.2 Izvirni znanstveni članek (SCIE ali SSCI) - 1. četrtina] kategorija: 1A1 (Z, A', A1/2); uvrstitev: SCI, Scopus, MBP; tip dela je verificiral OSICT | | | | | | | | | | | | | | | | | | | | |

**UNIVERZA V MARIBORU FAKULTETA ZA ENERGETIKO**

**Vloga za akreditacijo doktorskega študijskega programa ENERGETIKA - 3. stopnja**

**UČNI NAČRTI – IZBIRNE UČNE ENOTE**

**September 2023**

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| **UČNI NAČRT PREDMETA / COURSE SYLLABUS** | | | | | | | | | | | | | | | | | | | | |
| **Predmet:** | | | **VERJETNOSTNE ANALIZE VARNOSTI, ZANESLJIVOSTI IN TVEGANJ** | | | | | | | | | | | | | | | | | |
| **Course title:** | | | **PROBABILISTIC ANALYSIS OF SAFETY, RELIABILITY AND RISK** | | | | | | | | | | | | | | | | | |
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| **Študijski program in stopnja**  **Study programme and level** | | | | | **Študijska smer**  **Study field** | | | | | | | | | | | **Letnik**  **Academic year** | | **Semester**  **Semester** | | |
| **ENERGETIKA, 3. stopnja** | | | | | **-** | | | | | | | | | | | **1/2** | | **1/2/3** | | |
| **ENERGY TECHNOLOGY, 3. Degree** | | | | | **-** | | | | | | | | | | | **1/2** | | **1/2/3** | | |
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| **Vrsta predmeta / Course type** | | | | | | | | | | | | | | | Izbirni/Elective | | | | | |
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| **Univerzitetna koda predmeta / University course code:** | | | | | | | | | | | | | | | D | | | | | |
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| **Predavanja**  **Lectures** | **Seminar**  **Seminar** | | | **Vaje**  **Tutorial** | | | | **Klinične vaje**  **work** | | | | | | **Druge oblike študija** | | | **Samost. delo**  **Individ. work** | |  | **ECTS** |
| **30** | **-** | | | **-** | | | | **-** | | | | | | **-** | | | **150** | |  | **6** |
|  | | | | | | | | | | | | | | | | | | | | |
| **Nosilec predmeta / Lecturer:** | | | | | **IVAN KODELI** | | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | | | | | | |
| **Jeziki /**  **Languages:** | | **Predavanja / Lectures:** | | | | **Slovenski/Slovene** | | | | | | | | | | | | | | |
| **Vaje / Tutorial:** | | | | **Slovenski/Slovene** | | | | | | | | | | | | | | |
| **Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:** | | | | | | | | | |  | | **Prerequisits:** | | | | | | | | |
| Pogoj za vključitev v delo je vpis v letnik študija.  Opravljene vaje/izdelki so pogoj za pristop k izpitu. | | | | | | | | | |  | | Matriculation, enrolment in the current study year.  Performed course works are prerequisite for accession to exam. | | | | | | | | |
| **Vsebina:** | | | | | | | | | |  | | **Content (Syllabus outline):** | | | | | | | | |
| Definiranje zanesljivosti, razpoložljivosti, pogostosti odpovedi, tveganj, varnosti.  Verjetnostni račun, teorije množic in Boolove algebra.  Negotovosti in propagacija negotovosti. Perturbacijske metode, občutljivostne in negotovostne analize v nuklearni znanosti in tehnologiji.  Metode za ocenjevanje varnosti in zanesljivosti – teorija in primeri: drevo odpovedi, drevo dogodkov, analiza načinov in učinkov odpovedi.  Baze podatkov in verjetnostni modeli.  Merila zanesljivosti sistemov in varnosti objektov in naprav.  Odpovedi s skupnim vzrokom – metode in primeri.  Analiza zanesljivosti človeka: diagnoza, akcije. Upoštevanje medsebojne odvisnosti aktivnosti.  Optimizacija vzdrževanja z verjetnostnimi varnostnimi analizami (optimizacijske metode in povezava z verjetnostnimi varnostnimi analizami).  Uporaba verjetnostnih varnostnih analiz za ocenjevanje ranljivosti objektov.  Primer negotovosti v analizah fisijskih in fuzijskih reaktorjev zaradi negotovosti v nuklearnih podatkih. | | | | | | | | | |  | | Definitions of reliability, availability, failure rate, risk, safety.  Probability theory, set theory and Boolean algebra.  Uncertainty and uncertainty propagation. Perturbation methods, sensitivity and uncertainty analysis in nuclear science and technology.  Methods for assessment of safety and reliability – theory and examples: fault tree, event tree, failure modes and effects analysis.  Data base and probabilistic models.  System reliability measures and measures of safety of facilities.  Common cause failues – methods and examples.  Human reliability analysis: diagnosis, actions. Consideration of mutual dependency of related activities.  Maintenance optimization with probabilistic safety assessment (integration of probabilistic safety assessment and optimisation methods).  Applications of probabilistic safety assessment for vulnerability analysis.  Example of uncertainties in fission and fusion reactor analysis due to nuclear data uncertainties. | | | | | | | | |
| **Temeljni literatura in viri / Readings:** | | | | | | | | | | | | | | | | | | | | |
| H. Kumamoto, E. J. Henley, Probabilistic Risk Assessment and Management for Engineers and Scientists, IEEE Press, 1996.  U. S. Nuclear Regulatory Commission: Fault Tree Handbook; NUREG-0492, 1981.  Čepin, Marko. Analysis of truncation limit in probabilistic safety assessment. Reliab. eng. syst. saf., 2005, vol. 87, str. 395-403.  W. Vesely, J. Dugan, J. Fragola, J. Minarick, J. Railsback, Fault Tree Handbook with Aerospace Applications, National Aeronautics and Space Administration, NASA, 2002.  D. L. Smith, Probability, Statistics, and data Uncertainties in Nuclear Science and Technology, OECD/NEA 1991 | | | | | | | | | | | | | | | | | | | | |
| **Cilji in kompetence:** | | | | | | | | |  | | **Objectives and competences:** | | | | | | | | | |
| Prepoznati informacije o verjetnostnih varnostnih analizah.  Pridobiti in poglobiti znanje o pomenu zanesljivosti sistemov za varno delovanje jedrskih objektov. | | | | | | | | |  | | To recognise information about probabilistic safety assessment.  To obtain knowledge about importance of systems reliability for safe operation of nuclear facilities. | | | | | | | | | |
| **Predvideni študijski rezultati:** | | | | | | | | | |  | **Intended learning outcomes:** | | | | | | | | | |
| Sposobnost razumevanja zakonov in pravil povezanih z jedrsko varnostjo. Sposobnost obvladanja standardnih metod, postopkov in procesov.  Zavezanost profesionalni etiki.  Uporaba standardnih metod, postopkov in procesov v praksi.  Lastno razumevanje teorije in izkušenj v praksi, kritično ovrednotenje skladnosti med teoretičnimi načeli in praktičnim ravnanjem.  Spretnosti uporabe domače in tuje literature in drugih virov, zbiranja in interpretiranja podatkov, identifikacija in reševanje problemov, kritična analiza, sinteza, pisanje člankov, skupinsko delo. | | | | | | | | | |  | Capability of understanding definitions and rules connected with nuclear safety. Capability of understanding the standard methods, procedures and processes.  Commitment to professional ethics.  Application of standard methods, procedures and processes.  Understanding the theory and experience in practice, critical evaluation of harmony between theoretical principles and practical applications.  Skilfulness of use of domestic and foreign literature and of other sources of information, of collection and interpretation of data, of identifying problems and solving them, of critical analysis, of synthesis, of writing articles and of teamwork. | | | | | | | | | |
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| **Metode poučevanja in učenja:** | | | | | | | | | |  | **Learning and teaching methods:** | | | | | | | | | |
| Predavanja, kjer študent spozna teoretične vsebine, raziskovalni seminarji, projektno delo, individualne naloge, vodeni individualni študij.  poučevanje in učenje poteka z didaktično uporabo IKT | | | | | | | | | |  | Lectures, where student recognises theoretical contents, research seminars, project work, individual assignments, tutorial studies.  teaching and learning is done using didactic use of ICT | | | | | | | | | |
| **Načini ocenjevanja:** | | | | | | | Delež (v %) /  Weight (in %) | | | | | | **Assessment:** | | | | | | | |
| Način (pisni izpit, ustno izpraševanje, naloge, projekt):  pisni izpit  ustni izpit  seminarska naloga | | | | | | | **40%**  **40%**  **20%** | | | | | | Type (examination, oral, coursework, project):  written examination  oral examination  coursework | | | | | | | |
| **Reference nosilca / Lecturer's references:** | | | | | | | | | | | | | | | | | | | | |
| **KODELI, Ivan** Aleksander, ANGELONE, M. FNG copper benchmark evaluation for the SINBAD database. Fusion engineering and design. [Print ed.]. [in press] 2019. ISSN 0920-3796. DOI: /10.1016/j.fusengdes.2018.12.053. [COBISS.SI-ID 32023591], [JCR, SNIP, WoS do 16. 1. 2019: št. citatov (TC): 0, čistih citatov (CI): 0, Scopus do 26. 10. 2019: št. citatov (TC): 0, čistih citatov (CI): 0] kategorija: 1A1 (Z, A', A1/2); uvrstitev: SCI,  **KODELI, Ivan** Aleksander, PLEVNIK, Lucijan. Nuclear data adjustment exercise combining information from shielding, critical and kinetics benchmark experiments ASPIS-Iron 88, Popsy and SNEAK-7A/7B. Progress in Nuclear Energy. [Print ed.]. 2018, vol. 106, str. 215-230. ISSN 0149-1970. DOI: 10.1016/j.pnucene.2018.03.007. [COBISS.SI-ID 31288359], [JCR, SNIP, WoS do 3. 12. 2019: št. citatov (TC): 2, čistih citatov (CI): 0, Scopus do 3. 12. 2019: št. citatov (TC): 2, čistih citatov (CI): 0] kategorija: 1A1 (Z, A', A1/2); uvrstitev: SCI,  **KODELI, Ivan** Aleksander. Beta-effective sensitivity and uncertainty analysis of MYRRHA reactor for possible use in nuclear data validation and improvement. Annals of Nuclear Energy. [Print ed.]. 2018, vol. 113, str. 425-435. ISSN 0306-4549. DOI: 10.1016/j.anucene.2017.11.039. [COBISS.SI-ID 31089447], [JCR, SNIP, WoS do 3. 12. 2019: št. citatov (TC): 2, čistih citatov (CI): 2, Scopus do 3. 12. 2019: št. citatov (TC): 2, čistih citatov (CI): 2] kategorija: 1A2 (Z, A1/2); uvrstitev: SCI, | | | | | | | | | | | | | | | | | | | | |

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| **UČNI NAČRT PREDMETA / COURSE SYLLABUS** | | | | | | | | | | | | | | | | | | | | |
| **Predmet:** | | | **SREDICA JEDRSKEGA REAKTORJA** | | | | | | | | | | | | | | | | | |
| **Course title:** | | | **NUCLEAR REACTOR CORE** | | | | | | | | | | | | | | | | | |
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| **Študijski program in stopnja**  **Study programme and level** | | | | | **Študijska smer**  **Study field** | | | | | | | | | | | **Letnik**  **Academic year** | | **Semester**  **Semester** | | |
| **ENERGETIKA, 3. stopnja** | | | | | **-** | | | | | | | | | | | **1/2** | | **1/2/3** | | |
| **ENERGY TECHNOLOGY, 3. Degree** | | | | | **-** | | | | | | | | | | | **1/2** | | **1/2/3** | | |
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| **Vrsta predmeta / Course type** | | | | | | | | | | | | | | | Izbirni/Elective | | | | | |
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| **Univerzitetna koda predmeta / University course code:** | | | | | | | | | | | | | | | D | | | | | |
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| **Predavanja**  **Lectures** | **Seminar**  **Seminar** | | | **Vaje**  **Tutorial** | | | | **Klinične vaje**  **work** | | | | | | **Druge oblike študija** | | | **Samost. delo**  **Individ. work** | |  | **ECTS** |
| **30** | **-** | | | **-** | | | | **-** | | | | | | **-** | | | **150** | |  | **6** |
|  | | | | | | | | | | | | | | | | | | | | |
| **Nosilec predmeta / Lecturer:** | | | | | **MARJAN KROMAR** | | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | | | | | | |
| **Jeziki /**  **Languages:** | | **Predavanja / Lectures:** | | | | **Slovenski/Slovene** | | | | | | | | | | | | | | |
| **Vaje / Tutorial:** | | | | **Slovenski/Slovene** | | | | | | | | | | | | | | |
| **Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:** | | | | | | | | | |  | | **Prerequisits:** | | | | | | | | |
| Ni posebnih obveznosti. | | | | | | | | | |  | | No prerequisites. | | | | | | | | |
| **Vsebina:** | | | | | | | | | |  | | **Content (Syllabus outline):** | | | | | | | | |
| * Jedrsko gorivo in zgradba sredice reaktorja * Tipi reaktorjev glede na gorivo, hladilo, moderator * Gorivni cikel, upravljanje z gorivom in stroški goriva * Obratovalni parametri sredice * Elementi projektiranja sredice reaktorja * Preveritev projektnih vrednosti sredice z meritvami | | | | | | | | | |  | | * Nuclear fuels and the structure of reactor core * Reactor types with respect to fuel, coolant, moderator * Fuel cycle, fuel management and fuel costs * Operational parameters of the nuclear reactor core * Elements of nuclear core design * Verification of design parameters by measurements | | | | | | | | |
| **Temeljni literatura in viri / Readings:** | | | | | | | | | | | | | | | | | | | | |
| Osnovni/Basic:   * John C. Lee, Nuclear Reactor: Physics and Engineering, Wiley (2020) * P. Mohanakrishnan, Om Pal Singh, K. Umasankari, Physics of Nuclear Reactors, Academic Press (2021) * C. Demazière, Modelling of Nuclear Reactor Multi-physics: From Local Balance Equations to Macroscopic Models in Neutronics and Thermal-Hydraulics, Academic Press (2019) * T. Hensley, Nuclear Reactor Physics, NY Research Press (2019)   Dodatni/Additional:   * Relevantna specifična znanstvena literatura/Relevant specific publications in scientific journals | | | | | | | | | | | | | | | | | | | | |
| **Cilji in kompetence:** | | | | | | | | |  | | **Objectives and competences:** | | | | | | | | | |
| Cilji:   * Temeljni cilj predmeta je usposobiti študenta za samostojno raziskovalno in razvojno delo na področju reaktorske fizike sredice, ki je primerljiva in konkurenčna s trenutnimi vrhunskimi raziskavami v najrazvitejših delih sveta. * Študent se seznani z najnovejšimi dognanji na tem področju in pridobljeno teoretično znanje zna uporabiti pri reševanju problemov. Poudarek je na izpopolnjevanju na področju študentovega raziskovalnega dela.   Kompetence:   * Študent z reševanjem problemov in kritičnim mišljenjem razvija naravoslovno-znanstveno kompetenco iz področja reaktorske fizike sredice in tehnike. | | | | | | | | |  | | Objectives:   * The main objective of the course is to qualify the student to conduct independent research and development in the field of reactor core physics at a level comparable to and competitive with current top-quality research pursued in the most advanced parts of the world. * The student acquires a state-of-the-art knowledge in selected topic and can use theoretical knowledge for problem solving. The course topics are focused on the student's research area.   Competences:   * Student develops, through problem-solving and critical thinking, natural science competence in the field of reactor core physics and reactor engineering. | | | | | | | | | |
| **Predvideni študijski rezultati:** | | | | | | | | | |  | **Intended learning outcomes:** | | | | | | | | | |
| Znanje in razumevanje:   * Razumevanje principov delovanja reaktorjev in fizikalnih lastnosti, po katerih se različni tipi reaktorjev med seboj razlikujejo. * Pridobitev poglobljenih znanj za učinkovito upravljanje z gorivom in obratovanje jedrske elektrarne.   Prenesljive/ključne spretnosti in drugi atributi:   * Poglobljeno razumevanje trenutnega raziskovalnega stanja na različnih področjih omogoča povezovanje teoretičnih razlag in eksperimentalnih metod. * Študent razvija veščine in spretnosti v uporabi znanja na svojem konkretnem strokovnem delovnem področju. | | | | | | | | | |  | Knowledge and understanding:   * Understanding of the principles of operation and physical properties that distinguish different reactor types. * Knowledge for efficient fuel management and power reactor operation.   Transferable/Key Skills and other attributes:   * Deepened knowledge of contemporary scientific state-of-the-art in various fields enables interconnection of theoretical and experimental methods. * Student developes skills and expertise in the use of knowledge in a specific technical working area. | | | | | | | | | |
| **Metode poučevanja in učenja:** | | | | | | | | | |  | **Learning and teaching methods:** | | | | | | | | | |
| * predavanja * konzultacije | | | | | | | | | |  | * lectures * consultation | | | | | | | | | |
| **Načini ocenjevanja:** | | | | | | | Delež (v %) /  Weight (in %) | | | | | | **Assessment:** | | | | | | | |
| * pisni izpit * ustni izpit/razgovor | | | | | | | **50 %**  **50 %** | | | | | | * written examination * oral examination/discussion | | | | | | | |
| **Reference nosilca / Lecturer's references:** | | | | | | | | | | | | | | | | | | | | |
| ĆALIĆ, Dušan, KROMAR, Marjan. Spent fuel characterization analysis using various nuclear data libraries. Nuclear Engineering and Technology. 2022, vol. 54, issue 9, str. 3260-3271. ISSN 1738-5733. DOI: 10.1016/j.net.2022.04.009. [COBISS.SI-ID 105496067]  GORIČANEC, Tanja, ŠTANCAR, Žiga, KOTNIK, Domen, SNOJ, Luka, KROMAR, Marjan. Applicability of the Krško nuclear power plant core Monte Carlo model for the determination of the neutron source term. Nuclear Engineering and Technology. 2021, vol. 53, iss. 11, str. 3528-3542. ISSN 1738-5733. DOI: 10.1016/j.net.2021.05.022. [COBISS.SI-ID 76991491]  **KROMAR, Marjan**, SLAVIČ, Slavko, ŽEFRAN, Bojan. The nuclear design and core management of the Krško NPP : Cycle 32. Izdaja 0. Ljubljana: Inštitut Jožef Stefan, 2021. 94 str. IJS delovno poročilo, 13497. [COBISS.SI-ID 80002819] Vrednost projekta 281.190,25 EUR | | | | | | | | | | | | | | | | | | | | |

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| **UČNI NAČRT PREDMETA / COURSE SYLLABUS** | | | | | | | | | | | | | | | | | | | | |
| **Predmet:** | | | **NAPREDNI REAKTORSKI SISTEMI** | | | | | | | | | | | | | | | | | |
| **Course title:** | | | **ADVANCED REACTOR SYSTEMS** | | | | | | | | | | | | | | | | | |
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| **Študijski program in stopnja**  **Study programme and level** | | | | | **Študijska smer**  **Study field** | | | | | | | | | | | **Letnik**  **Academic year** | | **Semester**  **Semester** | | |
| **ENERGETIKA, 3. stopnja** | | | | | **-** | | | | | | | | | | | **1/2** | | **1/2/3** | | |
| **ENERGY TECHNOLOGY, 3. Degree** | | | | | **-** | | | | | | | | | | | **1/2** | | **1/2/3** | | |
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| **Vrsta predmeta / Course type** | | | | | | | | | | | | | | | Izbirni/Elective | | | | | |
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| **Univerzitetna koda predmeta / University course code:** | | | | | | | | | | | | | | | D | | | | | |
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| **Predavanja**  **Lectures** | **Seminar**  **Seminar** | | | **Vaje**  **Tutorial** | | | | **Klinične vaje**  **work** | | | | | | **Druge oblike študija** | | | **Samost. delo**  **Individ. work** | |  | **ECTS** |
| **30** | **-** | | | **-** | | | | **-** | | | | | | **-** | | | **150** | |  | **6** |
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| **Nosilec predmeta / Lecturer:** | | | | | **IGOR LENGAR** | | | | | | | | | | | | | | | |
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| **Jeziki /**  **Languages:** | | **Predavanja / Lectures:** | | | | **Slovenski/Slovene** | | | | | | | | | | | | | | |
| **Vaje / Tutorial:** | | | | **Slovenski/Slovene** | | | | | | | | | | | | | | |
| **Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:** | | | | | | | | | |  | | **Prerequisits:** | | | | | | | | |
| Ni posebnih obveznosti. | | | | | | | | | |  | | No prerequisites. | | | | | | | | |
| **Vsebina:** | | | | | | | | | |  | | **Content (Syllabus outline):** | | | | | | | | |
| * Pregled razvoja jedrske tehnologije od kritičnosti prvega reaktorja do razvoja sodobnih tlačnovodnih reaktorjev * Fizikalni opis pomanjkljivosti obstoječih sistemov * Hitri natrijev reaktor * Zelo visoko temperaturni reaktor * Reaktor na staljeno sol * Reaktor na tekoče gorivo * Hitri svinčev reaktor * Oplodni reaktorji * Kroglični reaktor * Kogeneracija z visokotemperaturnimi reaktorji * Hibridni sistemi * Fuzijski reaktorji | | | | | | | | | |  | | * Review of the development of nuclear technology from the criticality of the first reactor to the development of modern pressurized reactors * Description of the deficiencies of existing systems * Sodium-Cooled Fast Reactor * Very high temperature reactor * Molten Salt Reactor * Circulating-fuel reactor * Lead-cooled fast reactor * Breeder reactor * Pebble bed reactor * Cogeneration by high temperature reactors * Hybrid systems * Fusion reactors | | | | | | | | |
| **Temeljni literatura in viri / Readings:** | | | | | | | | | | | | | | | | | | | | |
| Bell-Glasstone, Nuclear reactor theory,Van Nostrand, 1970  Advanced Nuclear Fuel Cycles and Radioactive Waste Management, NEA No.5990, OECD NEA ND, Pariz, 2006.  J.R. Lamarsh, A. J. Baratta, Introduction to nuclear engineering, third edition, Prentice Hall, 2001, ISBN 0-201-82498-2  R. A. Knief: Nuclear Energy Technology, McGraw – Hill.  Emelia Clarke, Advanced Reactors: Review of U.S. Efforts in the Development of Nuclear and Fusion Energy, ISBN-13: 978-1634632638  John Grossenbacher, Carl E. Behrens, Energy: Nuclear: Advanced Reactor Concepts and Fuel technologies, ISBN-13: 978-1587331862 | | | | | | | | | | | | | | | | | | | | |
| **Cilji in kompetence:** | | | | | | | | |  | | **Objectives and competences:** | | | | | | | | | |
| * Razumevanje prednosti in slabosti obstoječih jedrskih reaktorjev * Razumevanje prednosti hitrih reaktorskih sistemov pred termičnimi * Poglobljeno znanje o gorivnem ciklu z vključenimi hitrimi reaktorji * Poglobljeno razumevanje prednosti posameznih tipov naprednih reaktorjev * Razumevanje fizikalnih osnov hitrih in visokotemperaturnih reaktorskih sistemov * Poglobljeno znanje o možnostih ko-generacije pri obstoječih in zelo visoko temperaturnih reaktorjih | | | | | | | | |  | | * Understanding the strengths and weaknesses of existing nuclear reactors * Understanding the advantages of fast reactor systems with respect to thermal reactors * Knowledge of the fuel cycle with inclusion of fast reactors * Understanding advantages of individual types of advanced reactors * Understanding the physics fundamentals of fast and high temperature reactor systems * Knowledge on the possibilities of co-generation in existing and very high temperature reactors | | | | | | | | | |
| **Predvideni študijski rezultati:** | | | | | | | | | |  | **Intended learning outcomes:** | | | | | | | | | |
| * Poglobljeno znanje teorije jedrskih reaktorjev * Poglobljeno znanje o jedrskem gorivnem ciklu * Splošno znanje reaktorske fizike * Poglobljeno znanje o obstoječi jedrski tehnologiji ob primerjavi z rešitvami pri naprednih reaktorskih sistemih. * Poglobljeno znanje o slabostih obstoječih jedrskih reaktorjev * Ločevanje med hitrimi, termičnimi in visoko temperaturnimi reaktorskimi sistemi * Poglobljeno znanje o možnih rešitvah za izboljšanje obstoječih reaktorjev * Znanje za raziskovalno delo v reaktorski fiziki in tehnologiji. * Poznavanje temeljev pridobivanje energije s fuzijo | | | | | | | | | |  | * In-depth knowledge of the theory of nuclear reactors * In-depth knowledge of the nuclear fuel cycle * General knowledge of reactor physics * In-depth knowledge of existing nuclear technology compared to solutions, pursued by advanced reactor systems. * In-depth knowledge of the weaknesses of existing nuclear reactors * Separation between fast, thermal and high temperature reactor systems * In-depth knowledge of possible solutions for improving existing reactors * Knowledge for research work in reactor physics and technology. * Knowledge of the fundamentals of obtaining energy by fusion | | | | | | | | | |
| **Metode poučevanja in učenja:** | | | | | | | | | |  | **Learning and teaching methods:** | | | | | | | | | |
| Predavanja  vaje  domače naloge  konzultacije  poučevanje in učenje poteka z didaktično uporabo IKT | | | | | | | | | |  | lectures  exercises  homework  consultation  teaching and learning is done using didactic use of ICT | | | | | | | | | |
| **Načini ocenjevanja:** | | | | | | | Delež (v %) /  Weight (in %) | | | | | | **Assessment:** | | | | | | | |
| Pisni izpit  Ustno izpraševanje | | | | | | | **50%**  **50%** | | | | | | written examination  oral examination | | | | | | | |
| **Reference nosilca / Lecturer's references:** | | | | | | | | | | | | | | | | | | | | |
| **LENGAR, Igor**, KOTNIK, Domen, KOS, Bor, CUFAR, Aljaž, BACHMANN, Christian, SNOJ, Luka. Shutdown dose rate calculations with modified DEMO single sector model. Fusion engineering and design, ISSN 0920-3796. [Print ed.], 2021, vol. 171, art. 112569, 8 str., doi: 10.1016/j.fusengdes.2021.112569. [COBISS.SI-ID 63948035], [JCR, SNIP, Scopus do 21. 5. 2021: št. citatov (TC): 0, cistih citatov (CI): 0, cistih citatov na avtorja (CIAu): 0] [tip COBISS: 1.01 Izvirni znanstveni clanek] [uvrstitev revije v MBP (2020): SCIE, Scopus, COMPENDEX, INSPEC] ŠTD = 12 ; ŠTK = 2; št. avtorjev: 6; [Z/3.2 Izvirni znanstveni clanek (SCIE ali SSCI) - 1. cetrtina]  **LENGAR, Igor**, ŽOHAR, Andrej, BATISTONI, P., POPOVICHEV, Sergei, CONROY, S., ČUFAR, Aljaž, DRENIK, Aleksander, KODELI, Ivan Aleksander, KOS, Bor, SNOJ, Luka, et al., JET Contributors. Characterization of JET neutron field in irradiation locations for DD, DT and TT plasmas. Fusion engineering and design, ISSN 0920-3796. [Print ed.], 2019, vol. 146, part B, str. 1967-1970, doi: 10.1016/j.fusengdes.2019.03.078. [COBISS.SI-ID 32604711], [JCR, SNIP, WoS do 25. 10. 2019: št. citatov (TC): 0, čistih citatov (CI): 0, čistih citatov na avtorja (CIAu): 0, Scopus do 3. 9. 2019: št. citatov (TC): 0, čistih citatov (CI): 0, čistih citatov na avtorja (CIAu): 0]  kategorija: 1A1 (Z, A', A1/2); uvrstitev: SCI, Scopus, MBP; tip dela je verificiral OSICN  točke: 3.36, št. avtorjev: 957  **LENGAR, Igor**, ČUFAR, Aljaž, RADULOVIĆ, Vladimir, BATISTONI, P., POPOVICHEV, Sergei, PACKER, Lee, GHANI, Z., KODELI, Ivan Aleksander, CONROY, S., SNOJ, Luka, DRENIK, Aleksander, KOS, Bor, et al., JET Contributors. Activation material selection for multiple foil activation detectors in JET TT campaign. Fusion engineering and design, ISSN 0920-3796. [Print ed.], 2018, vol. 136, str. 988-992, doi: 10.1016/j.fusengdes.2018.04.052. [COBISS.SI-ID 31570471], [JCR, SNIP, WoS do 28. 12. 2018: št. citatov (TC): 0, čistih citatov (CI): 0, čistih citatov na avtorja (CIAu): 0, Scopus do 3. 9. 2019: št. citatov (TC): 1, čistih citatov (CI): 0, čistih citatov na avtorja (CIAu): 0]  kategorija: 1A1 (Z, A', A1/2); uvrstitev: SCI, Scopus, MBP; tip dela je verificiral OSICN  točke: 3.24, št. avtorjev: 1223 | | | | | | | | | | | | | | | | | | | | |

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| **UČNI NAČRT PREDMETA / COURSE SYLLABUS** | | | | | | | | | | | | | | | | | | | | |
| **Predmet:** | | | **ENERGETSKI SISTEMI Z MOTORJI Z NOTRANJIM ZGOREVANJEM** | | | | | | | | | | | | | | | | | |
| **Course title:** | | | **INTERNAL COMBUSTION ENGINE POWER PLANT** | | | | | | | | | | | | | | | | | |
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| **Študijski program in stopnja**  **Study programme and level** | | | | | **Študijska smer**  **Study field** | | | | | | | | | | | **Letnik**  **Academic year** | | **Semester**  **Semester** | | |
| **ENERGETIKA, 3. stopnja** | | | | | **-** | | | | | | | | | | | **1/2** | | **1/2/3** | | |
| **ENERGY TECHNOLOGY, 3. Degree** | | | | | **-** | | | | | | | | | | | **1/2** | | **1/2/3** | | |
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| **Vrsta predmeta / Course type** | | | | | | | | | | | | | | | Izbirni/Elective | | | | | |
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| **Univerzitetna koda predmeta / University course code:** | | | | | | | | | | | | | | | D | | | | | |
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| **Predavanja**  **Lectures** | **Seminar**  **Seminar** | | | **Vaje**  **Tutorial** | | | | **Klinične vaje**  **work** | | | | | | **Druge oblike študija** | | | **Samost. delo**  **Individ. work** | |  | **ECTS** |
| **30** | **-** | | | **-** | | | | **-** | | | | | | **-** | | | **150** | |  | **6** |
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| **Nosilec predmeta / Lecturer:** | | | | | **MILAN MARČIČ** | | | | | | | | | | | | | | | |
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| **Jeziki /**  **Languages:** | | **Predavanja / Lectures:** | | | | **Slovenski/Slovene** | | | | | | | | | | | | | | |
| **Vaje / Tutorial:** | | | | **Slovenski/Slovene** | | | | | | | | | | | | | | |
| **Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:** | | | | | | | | | |  | | **Prerequisits:** | | | | | | | | |
| Zahtevano predhodno znanje iz področja matematike, mehanike, fizike in termodinamike. | | | | | | | | | |  | | General knowledge from the field of Mathematics, Mechanics, Physics and Thermodynamics | | | | | | | | |
| **Vsebina:** | | | | | | | | | |  | | **Content (Syllabus outline):** | | | | | | | | |
| Vsebina predmeta obsega sledeča poglavja:  1. Stacionarni Otto motorji  2. Stacionarni plinski motorji  3. Stacionarni dizelski motorji  4. Priprava zmesi plinskih motorjev  5. Vžigalni sistemi plinskih motorjev  6. Regulacija stacionarnih plinskih motorjev  7. Konstrukcijske izvedbe plinskih motorjev  8. Vgradnja stacionarnih motorjev  9. Regulacija stacionarnih Otto motorjev  10. Regulacija stacionarnih dizelskih motorjev  11. Katalitična obdelava izpušnih plinov stacionarnih motorjev. | | | | | | | | | |  | | Content of the Subject:  1. Stationary Spark Ignition Engine  2. Stationary Gas Engine  3. Stationary Diesel Engine  4. Mixture Valves for Gas Engines  5. Ignition System of Gas Engines  6. Control of Stationary Gas Engines  7. Design of Stationary Gas Engines  8. Assembly of Stationary Engines  9. Control of Stationary Spark Ignition Engines  10. Control of Stationary Diesel Engines  11. Aftertreatment of Exhaust Gases | | | | | | | | |
| **Temeljni literatura in viri / Readings:** | | | | | | | | | | | | | | | | | | | | |
| C.F. Taylor, The Internal-Combustion Engine in Theory and Practice, 1985, M.I.T. Press  W. G. Vicenti, C. H. Kruger Jr., Introduction to Physical Gas Dynamics, John Wiley and Sons, 1965  Max Bohner, Rolf Gscheidle,….., Motorno vozilo, ISBN 86-365-0206-3.  Milan Marčič, Jurij Avsec, Hladilna tehnika, Fakulteta za strojništvo, Univerza v Mariboru, 2003.  Faye McQuiston, Jerald Parker, Jefrey Spitler, Heating, Ventilating and Air-Conditioning, John Wiley&Sons 2000. | | | | | | | | | | | | | | | | | | | | |
| **Cilji in kompetence:** | | | | | | | | |  | | **Objectives and competences:** | | | | | | | | | |
| Študent si pridobi poglobljeno znanje o motorjih z notranjim izgorevanjem. Samostojno razvijanje novega znanja in reševanje najzahtevnejših problemov s preizkušanjem in izboljševanjem znanih in odkrivanjem novih rešitev | | | | | | | | |  | | Improved Knowledge of Advanced Gas Engines, Diesel Engines and Spark Ignition Engines. Enable students to independently develop new knowledge and solve complex problems, testing and improving new methods. | | | | | | | | | |
| **Predvideni študijski rezultati:** | | | | | | | | | |  | **Intended learning outcomes:** | | | | | | | | | |
| Znanje in razumevanje: | | | | | | | | | |  | Knowledge and understanding: | | | | | | | | | |
| Poglobljeno razumevanje teoretskih in metodoloških konceptov ter usposobljenost za samostojno razvijanje novega znanja in reševanje najzahtevnejših problemov na področju Otto, Diesel in plinskih motorjev. | | | | | | | | | |  | In-depth understanding of theoretical and methodological concepts and the ability to independently develop new knowledge and solving the most challenging problems from the field of internal combustion engines. | | | | | | | | | |
| **Metode poučevanja in učenja:** | | | | | | | | | |  | **Learning and teaching methods:** | | | | | | | | | |
| Avditorna predavanja,  Praktično delo pri avditornih vajah  Reševanje domačih nalog,  poučevanje in učenje poteka z didaktično uporabo IKT | | | | | | | | | |  | Lectures,  Practical work at tutorials,  Homeworks  teaching and learning is done using didactic use of ICT | | | | | | | | | |
| **Načini ocenjevanja:** | | | | | | | Delež (v %) /  Weight (in %) | | | | | | **Assessment:** | | | | | | | |
| Način (pisni izpit, ustno izpraševanje, naloge, projekt):  ustni izpit  seminar | | | | | | | **50%**  **50%** | | | | | | Type (examination, oral, coursework, project):  oral examination  coursework | | | | | | | |
| **Reference nosilca / Lecturer's references:** | | | | | | | | | | | | | | | | | | | | |
| MARČIČ, Simon, MARČIČ, Milan, WENSING, Michael, VOGEL, Thomas, PRAUNSEIS, Zdravko. A simplified model for a diesel spray. *Fuel*, ISSN 1873-7153, 2018, vol. 222, str. 485-495, doi: [10.1016/j.fuel.2018.02.152](https://doi.org/10.1016/j.fuel.2018.02.152). [COBISS.SI-ID [1024304988](https://plus.si.cobiss.net/opac7/bib/1024304988?lang=sl)]  STRUŠNIK, Dušan, MARČIČ, Milan, GOLOB, Marjan, HRIBERNIK, Aleš, ŽIVIĆ, Marija, AVSEC, Jurij. Energy efficiency analysis of steam ejector and electric vacuum pump for a turbine condenser air extraction system based on supervised machine learning modelling. *Applied energy*, ISSN 0306-2619, jul. 2016, vol. 173, str. 386-405, graf. prikazi, doi: [10.1016/j.apenergy.2016.04.047](https://doi.org/10.1016/j.apenergy.2016.04.047). [COBISS.SI-ID [1024226652](https://plus.si.cobiss.net/opac7/bib/1024226652?lang=sl)]  GERŠAK, Jelka, MARČIČ, Milan. The effect of clothing on thermoregulatory responses of human body in a hot environment. *Journal of fiber bioengineering and informatics*, ISSN 1940-8676, March 2017, vol. 10, iss. 1, str. 1-12, doi: [10.3993/jfbim00252](https://doi.org/10.3993/jfbim00252). [COBISS.SI-ID [20431382](https://plus.si.cobiss.net/opac7/bib/20431382?lang=sl)] | | | | | | | | | | | | | | | | | | | | |

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| **UČNI NAČRT PREDMETA / COURSE SYLLABUS** | | | | | | | | | | | | | | | | | | | | |
| **Predmet:** | | | **PLINSKO/PARNI TURBINSKI SISTEMI** | | | | | | | | | | | | | | | | | |
| **Course title:** | | | **GAS/STEAM TURBINE SYSTEMS** | | | | | | | | | | | | | | | | | |
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| **Študijski program in stopnja**  **Study programme and level** | | | | | **Študijska smer**  **Study field** | | | | | | | | | | | **Letnik**  **Academic year** | | **Semester**  **Semester** | | |
| **ENERGETIKA, 3. stopnja** | | | | | **-** | | | | | | | | | | | **1/2** | | **1/2/3** | | |
| **ENERGY TECHNOLOGY, 3. Degree** | | | | | **-** | | | | | | | | | | | **1/2** | | **1/2/3** | | |
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| **Vrsta predmeta / Course type** | | | | | | | | | | | | | | | Izbirni/Elective | | | | | |
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| **Univerzitetna koda predmeta / University course code:** | | | | | | | | | | | | | | | D | | | | | |
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| **Predavanja**  **Lectures** | **Seminar**  **Seminar** | | | **Vaje**  **Tutorial** | | | | **Klinične vaje**  **work** | | | | | | **Druge oblike študija** | | | **Samost. delo**  **Individ. work** | |  | **ECTS** |
| **30** | **-** | | | **-** | | | | **-** | | | | | | **-** | | | **150** | |  | **6** |
|  | | | | | | | | | | | | | | | | | | | | |
| **Nosilec predmeta / Lecturer:** | | | | | **MILAN MARČIČ** | | | | | | | | | | | | | | | |
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| **Jeziki /**  **Languages:** | | **Predavanja / Lectures:** | | | | **Slovenski/Slovene** | | | | | | | | | | | | | | |
| **Vaje / Tutorial:** | | | | **Slovenski/Slovene** | | | | | | | | | | | | | | |
| **Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:** | | | | | | | | | |  | | **Prerequisits:** | | | | | | | | |
| Zahtevano predhodno znanje iz področja hidroenergetskh ali termoenergetskh sistemov | | | | | | | | | |  | | General knowledge from the field of Hydroenergetic or Thermoenergetic systems | | | | | | | | |
| **Vsebina:** | | | | | | | | | |  | | **Content (Syllabus outline):** | | | | | | | | |
| - Termodinamika  - Plinski in parni tok,  - Plinska in parna turbina v *p-V* in *h-S* diagramu,  - Parni proces  - Obratovalne karakteristike  - Vrste parnih turbin in parno-turbinskih sistemov,  - Regenerativno gretje  - Toplotni izmenjevalci,  - Termodinamični procesi v plinski turbini,  - Krožni procesi (Carnot, Joule, Ericson, … ),  - Hlajenje (notranje in zunanje),  - Letalski potisniki,  - Poraba goriva in zgorevalni proces,  - Tipi plinskih turbin, | | | | | | | | | |  | | - Thermodynamics  - Gas and steam flow,  - Gas and steam turbine in *p-V* and *h-S* diagram,  - Steam process,  - Operating characteristic,  - Ttypes of steam turbines and steam turbine systems,  - Regenerative heating,  - Heat exchangers,  - Thermodynamic process in gas turbine,  - Circular process (Carnot, Joule, Ericson, … ),  - Cooling process (inside and external),  - Air gas turbines,  - Gas consumption and burn process,  - Types of gas turbines, | | | | | | | | |
| **Temeljni literatura in viri / Readings:** | | | | | | | | | | | | | | | | | | | | |
| **H. Sigloch:** Strömungsmaschinen – Grundlagen und Anwendungen, 2. Aflage, Carl Hanser Verlag München Wien, 1993  **H. P. Bloch, C. Soares:** Process Plant Machinery, Butterworth-Heinemann, 1998  **R. J. Goldstein:** Heat Transfer in Gas Turbine Systems, The New York Academy of Sciences, New York, 2001  **B. Černigoj:** Plinske turbine v teoriji in praksi, FS-UL, 1983  **J. Miler:** Parne I plinske turbine, Zagreb, Tehnička knjiga 1965 | | | | | | | | | | | | | | | | | | | | |
| **Cilji in kompetence:** | | | | | | | | |  | | **Objectives and competences:** | | | | | | | | | |
| Namen predmeta je seznanitev študenta s sodobnim in naprednimi tipi plinskih in parnih turbin in sistemov. | | | | | | | | |  | | Objective of this course is to introduce a student with contemporary and advanced gas and steam turbines and its systems. | | | | | | | | | |
| **Predvideni študijski rezultati:** | | | | | | | | | |  | **Intended learning outcomes:** | | | | | | | | | |
| Znanje in razumevanje:  Poglobljeno razumevanje principov obratovanja plinskih in parnih turbin ter sistemov. Sinteza znanj za raziskave na področju razvoja plinskih in parnih turbin in sistemov. | | | | | | | | | |  | Knowledge and understanding:  In depth understanding of operating principles of gas and steam turbines and its systems. Knowledge synthesis for research and development of gas and steam turbines and its systems | | | | | | | | | |
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| **Metode poučevanja in učenja:** | | | | | | | | | |  | **Learning and teaching methods:** | | | | | | | | | |
| Frontalna predavanja,  Praktično delo pri laboratorijskih vajah,  Seminarska naloga (projektno delo);  poučevanje in učenje poteka z didaktično uporabo IKT | | | | | | | | | |  | Frontal lectures,  Practical work at laboratory work  Seminar (project) work  teaching and learning is done using didactic use of ICT | | | | | | | | | |
| **Načini ocenjevanja:** | | | | | | | Delež (v %) /  Weight (in %) | | | | | | **Assessment:** | | | | | | | |
| Način (pisni izpit, ustno izpraševanje, naloge, projekt):  pisni izpit  ustni izpit  projektno delo | | | | | | | **40%**  **40%**  **20%** | | | | | | Type (examination, oral, coursework, project):  written examination  oral examination  project work | | | | | | | |
| **Reference nosilca / Lecturer's references:** | | | | | | | | | | | | | | | | | | | | |
| MARČIČ, Simon, MARČIČ, Milan, WENSING, Michael, VOGEL, Thomas, PRAUNSEIS, Zdravko. A simplified model for a diesel spray. *Fuel*, ISSN 1873-7153, 2018, vol. 222, str. 485-495, doi: [10.1016/j.fuel.2018.02.152](https://doi.org/10.1016/j.fuel.2018.02.152). [COBISS.SI-ID [1024304988](https://plus.si.cobiss.net/opac7/bib/1024304988?lang=sl)]  STRUŠNIK, Dušan, MARČIČ, Milan, GOLOB, Marjan, HRIBERNIK, Aleš, ŽIVIĆ, Marija, AVSEC, Jurij. Energy efficiency analysis of steam ejector and electric vacuum pump for a turbine condenser air extraction system based on supervised machine learning modelling. *Applied energy*, ISSN 0306-2619, jul. 2016, vol. 173, str. 386-405, graf. prikazi, doi: [10.1016/j.apenergy.2016.04.047](https://doi.org/10.1016/j.apenergy.2016.04.047). [COBISS.SI-ID [1024226652](https://plus.si.cobiss.net/opac7/bib/1024226652?lang=sl)]  GERŠAK, Jelka, MARČIČ, Milan. The effect of clothing on thermoregulatory responses of human body in a hot environment. *Journal of fiber bioengineering and informatics*, ISSN 1940-8676, March 2017, vol. 10, iss. 1, str. 1-12, doi: [10.3993/jfbim00252](https://doi.org/10.3993/jfbim00252). [COBISS.SI-ID [20431382](https://plus.si.cobiss.net/opac7/bib/20431382?lang=sl)] | | | | | | | | | | | | | | | | | | | | |

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| **UČNI NAČRT PREDMETA / COURSE SYLLABUS** | | | | | | | | | | | | | | | | | | | | |
| **Predmet:** | | | **MEHANIKA LOMA ENERGETSKIH KOMPONENT** | | | | | | | | | | | | | | | | | |
| **Course title:** | | | **FRACTURE MECHANICS OF ENERGY COMPONENTS** | | | | | | | | | | | | | | | | | |
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| **Študijski program in stopnja**  **Study programme and level** | | | | | **Študijska smer**  **Study field** | | | | | | | | | | | **Letnik**  **Academic year** | | **Semester**  **Semester** | | |
| **ENERGETIKA, 3. stopnja** | | | | | **-** | | | | | | | | | | | **1/2** | | **1/2/3** | | |
| **ENERGY TECHNOLOGY, 3. Degree** | | | | | **-** | | | | | | | | | | | **1/2** | | **1/2/3** | | |
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| **Vrsta predmeta / Course type** | | | | | | | | | | | | | | | Izbirni/Elective | | | | | |
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| **Univerzitetna koda predmeta / University course code:** | | | | | | | | | | | | | | | D | | | | | |
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| **Predavanja**  **Lectures** | **Seminar**  **Seminar** | | | **Vaje**  **Tutorial** | | | | **Klinične vaje**  **work** | | | | | | **Druge oblike študija** | | | **Samost. delo**  **Individ. work** | |  | **ECTS** |
| **30** | **-** | | | **-** | | | | **-** | | | | | | **-** | | | **150** | |  | **6** |
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| **Nosilec predmeta / Lecturer:** | | | | | **ZDRAVKO PRAUNSEIS** | | | | | | | | | | | | | | | |
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| **Jeziki /**  **Languages:** | | **Predavanja / Lectures:** | | | | **Slovenski/Slovene** | | | | | | | | | | | | | | |
| **Vaje / Tutorial:** | | | | **Slovenski/Slovene** | | | | | | | | | | | | | | |
| **Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:** | | | | | | | | | |  | | **Prerequisits:** | | | | | | | | |
| Zahtevano predhodno znanje iz področja hidroenergetskih ali termoenergetskh sistemov. | | | | | | | | | |  | | General knowledge from the field of Hydroenergetic or Thermoenergetic systems. | | | | | | | | |
| **Vsebina:** | | | | | | | | | |  | | **Content (Syllabus outline):** | | | | | | | | |
| Vsebina predmeta obsega sledeča poglavja:  1.Praktična uporaba mehanike loma v hidroenergetskih in termoenergetskih sistemih.  2.Koncepti mehanike loma energetskih komponent.  3.Odpornostne krivulje energetskih materialov in spojev.  4. Trdnostna neenakost heterogenih energetskih komponent.  5. Kvantitativne metode mehanike loma (FAD model, ETM model).  6. Določitev življenske dobe energetskih komponent z razpoko (SINTAP postopek).  7. J-integral in gonilna sila razvoja razpoke.  8. Odpornost energetskih materialov proti rasti razpoke.  9. Statistična analiza v duktilno-krhkem prehodnem področju.  10. Analiza odpornosti energetskih komponent pri pogojih geometrijskega omejevanja. | | | | | | | | | |  | | Content of the Subject:  .1.Practical application of fracture mechanics in Hydroenergetic and Thermoenergetic systems.  2. Fracture mechanics concepts of energy components.  3. Resistance curves of energy materials and joints.  4. Strenght Mis-Matching of heterogeneous energy components  5. Quantity methods of fracture mechanics (FAD model, ETM model).  6. Life service determination of energy components with crack (SINTAP procedure).  7. J- integral and crack driving force.  8. Crack growth resistance of energy materials.  9. Statistical analysis of ductile-brittle transition region.  10. Resistance analysis of energy components at constraint conditions. | | | | | | | | |
| **Temeljni literatura in viri / Readings:** | | | | | | | | | | | | | | | | | | | | |
| H.L. Ewalds: Fracture Mechanics, VSSD, Delft, 1993.  Z. Praunseis: The Influence of strenght undermatched weld metal containing heterogeneous regions on fracture properties of HSLA steel weld joint, doctoral thesis, 1998.  Z. Praunseis; J. Avsec: Gradniki v energetiki, Univerzitetni učbenik, Fakulteta za energetiko, Krško, 2012.  SINTAP: Structural integrity assessment procedure for European industry. Final procedure, British Steel, 1999.  Y. Murakami: Stress Anylysis of Cracks Handbook, Pergamon, Oxford, UK, 1987.  T.L. Anderson: Fracture mechanics of energy materials, CRC Press, USA, 1994 | | | | | | | | | | | | | | | | | | | | |
| **Cilji in kompetence:** | | | | | | | | |  | | **Objectives and competences:** | | | | | | | | | |
| Pridobiti poglobljena znanja o konstruiranju hidroenergetskih in termoenergetskih sistemov na življensko dobo na osnovi uporabe mehanike loma. Znanja bodo prispevala k snovanju sistemov konstruiranja energetskih sistemov nove generacije. | | | | | | | | |  | | The main objective is to acquire appropriate skills about construction of Hydroenergetic and Thermoenergetic systems on the live service with application of fracture mechanics concepts.  This knowledge can initiate construction of energy systems of new generation. | | | | | | | | | |
| **Predvideni študijski rezultati:** | | | | | | | | | |  | **Intended learning outcomes:** | | | | | | | | | |
| Usposobljenost za vodenje konstrukcijskih oddelkov v energetskih  sistemih in znanstveno raziskovalnih projektov s širokega strokovnega  oz. znanstvenega področja. | | | | | | | | | |  | Knowledge and Understanding:  To give students competence to conduct the most complex construction work in energy systems and scientific research projects with broad expertise etc.. scientific areas . | | | | | | | | | |
| Prenesljive/ključne spretnosti in drugi atributi:  Pridobljena znanja morajo vzpodbuditi lastno kreativnost udeležencev v smislu razvoja novih metod konstruiranja v energetskih sistemih. | | | | | | | | | |  | Transferable/Key Skills and other attributes:  Acquired knowledge will actuate participants own creativeness to develope a new methods of construction in energy systems. | | | | | | | | | |
| **Metode poučevanja in učenja:** | | | | | | | | | |  | **Learning and teaching methods:** | | | | | | | | | |
| Avditorna predavanja,  Praktično delo pri avditornih vajah  Reševanje domačih nalog,  poučevanje in učenje poteka z didaktično uporabo IKT | | | | | | | | | |  | Lectures,  Practical work at tutorials,  Homeworks  teaching and learning is done using didactic use of ICT | | | | | | | | | |
| **Načini ocenjevanja:** | | | | | | | Delež (v %) /  Weight (in %) | | | | | | **Assessment:** | | | | | | | |
| Način (pisni izpit, ustno izpraševanje, naloge, projekt):  ustni izpit  seminar | | | | | | | **50%**  **50%** | | | | | | Type (examination, oral, coursework, project):  oral examination  coursework | | | | | | | |
| **Reference nosilca / Lecturer's references:** | | | | | | | | | | | | | | | | | | | | |
| Praunseis, Zdravko. Fracture mechanics procedure for determination of mechanical properties of steels and joints = Lomno mehanska procedura za določitev mehanskih lastnosti jekel in spojev. V: Gorenc Zoran, Annmarie (ur.). *Technology in the era of sustainable development : scientific monograph = Tehnologije v dobi trajnostnega razvoja : znanstvena monografija*. Novo mesto: Fakulteta za industrijski inženiring: = Faculty of Industrial Engineering. 2016, str. 37-46, graf. prikazi. [COBISS.SI-ID [1024231772](https://plus.si.cobiss.net/opac7/bib/1024231772?lang=sl)]  Praunseis, Zdravko. Determination of the titanium corrosion resistance by nitrogenion implantation for applications in electrical engineering. *Przeglęad Elektrotechniczny*, ISSN 0033-2097, 2017, nr. 67, str. 41-45, graf. prikazi, doi: [10.15199/48.2017.06.11](https://doi.org/10.15199/48.2017.06.11). [COBISS.SI-ID [1024274268](https://plus.si.cobiss.net/opac7/bib/1024274268?lang=sl)], [[SNIP](https://plus.si.cobiss.net/opac7/snip?c=sc=0033-2097+and+PY=2017&r1=true&lang=sl), [Scopus](http://www.scopus.com/inward/record.url?partnerID=2dRBettD&eid=2-s2.0-85020434811) do 6. 7. 2017: št. citatov (TC): 0, čistih citatov (CI): 0].  Praunseis, Zdravko. Fracture evaluation of energy components with local brittle zones = Vrednotenje loma v energetskih komponentah z lokalnimi krhkimi področji. *Journal of energy technology*, ISSN 1855-5748. [Tiskana izd.], feb. 2013, vol. 6, iss. 1, str. 51-60, ilustr. <http://www.fe.um.si/en/jet.html>. [COBISS.SI-ID [1024133212](https://plus.si.cobiss.net/opac7/bib/1024133212?lang=sl)]  Praunseis, Zdravko, Softić, Seudin. Device for the manufacturing of ovens by resistance seam welding = Naprava za izdelovanje pečic z uporovnim kolutnim varjenjem. *Journal of energy technology*, ISSN 1855-5748. [Tiskana izd.], dec. 2016, vol. 9, iss. 4, str. 21-34, ilustr. [COBISS.SI-ID [1024256860](https://plus.si.cobiss.net/opac7/bib/1024256860?lang=sl)]  Praunseis, Zdravko, Virtič, Peter. Evaluation of mechanical properties of soft magnetic materials for axial flux permanent magnet synchronous machines. *Przeglęad Elektrotechniczny*, ISSN 0033-2097, 2013, r. 89, nr. 2b, str. 35-37. <http://www.red.pe.org.pl/articles/2013/2b/10.pdf>. [COBISS.SI-ID [1024122460](https://plus.si.cobiss.net/opac7/bib/1024122460?lang=sl)], [[SNIP](https://plus.si.cobiss.net/opac7/snip?c=sc=0033-2097+and+PY=2013&r1=true&lang=sl), [Scopus](http://www.scopus.com/inward/record.url?partnerID=2dRBettD&eid=2-s2.0-84875345084) do 17. 5. 2013: št. citatov (TC): 0, čistih citatov (CI): 0] | | | | | | | | | | | | | | | | | | | | |

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| **UČNI NAČRT PREDMETA / COURSE SYLLABUS** | | | | | | | | | | | | | | | | | | | | |
| **Predmet:** | | | **AERO- IN HIDRO- ENERGETSKI SISTEMI** | | | | | | | | | | | | | | | | | |
| **Course title:** | | | **AERO- AND HYDRO- ENERGETIC SYSTEMS** | | | | | | | | | | | | | | | | | |
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| **Študijski program in stopnja**  **Study programme and level** | | | | | **Študijska smer**  **Study field** | | | | | | | | | | | **Letnik**  **Academic year** | | **Semester**  **Semester** | | |
| **ENERGETIKA, 3. stopnja** | | | | | **-** | | | | | | | | | | | **1/2** | | **1/2/3** | | |
| **ENERGY TECHNOLOGY, 3. Degree** | | | | | **-** | | | | | | | | | | | **1/2** | | **1/2/3** | | |
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| **Vrsta predmeta / Course type** | | | | | | | | | | | | | | | Izbirni/Elective | | | | | |
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| **Univerzitetna koda predmeta / University course code:** | | | | | | | | | | | | | | | D | | | | | |
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| **Predavanja**  **Lectures** | **Seminar**  **Seminar** | | | **Vaje**  **Tutorial** | | | | **Klinične vaje**  **work** | | | | | | **Druge oblike študija** | | | **Samost. delo**  **Individ. work** | |  | **ECTS** |
| **30** | **-** | | | **-** | | | | **-** | | | | | | **-** | | | **150** | |  | **6** |
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| **Nosilec predmeta / Lecturer:** | | | | | **ANDREJ PREDIN** | | | | | | | | | | | | | | | |
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| **Jeziki /**  **Languages:** | | **Predavanja / Lectures:** | | | | **Slovenski/Slovene** | | | | | | | | | | | | | | |
| **Vaje / Tutorial:** | | | | **Slovenski/Slovene** | | | | | | | | | | | | | | |
| **Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:** | | | | | | | | | |  | | **Prerequisits:** | | | | | | | | |
| Predhodno znanje iz področja hidroenergetskih sistemov , vodnih strojev in naprav | | | | | | | | | |  | | General knowledge from the field of Hydroenergetic systems, Advanced water machines and apparatus | | | | | | | | |
| **Vsebina:** | | | | | | | | | |  | | **Content (Syllabus outline):** | | | | | | | | |
| - Vodilne enačbe hidromehanike  - Vodilne enačbe mehanike tekočin,  - Vodilne enačbe termodinamike toka,  - Klasični, napredni in alternativni aero- in hidro- energetski procesi,  - Hidroenergetski sistemi (vrste in principi delovanja klasičnih, naprednih in alternativnih sistemov),  - Vetrni energetski sistemi (vrste in principi delovanja klasičnih, naprednih in alternativnih sistemov),  - Trenutno znani alternativni aero- in hidro- energetski procesi;  - Smernice k razvoju novih alternativnih aero- in hidro- energetskih procesov; | | | | | | | | | |  | | - Governing Hydromechanics equations,  - Governing fluid mechanic equations,  - Governing thermodynamics and fluid flow equations,  - Classic, advanced and alternative aero- and hydro- energy process,  - Hydroenergetic systems (types and principles of classic, advanced and alternative hydroenergetic systems),  - Wind energetic systems (types and principles of classic, advanced and alternative hydroenergetic systems),  - Temporary known alternative aero- and hydro- energetic process,  - Directions to new alternative aero- and hydro- energetic process; | | | | | | | | |
| **Temeljni literatura in viri / Readings:** | | | | | | | | | | | | | | | | | | | | |
| **M. E. Hazen:** Alternative Energy, An Introduction to Alternative & Renewable Energy Sources, Howard W. Sams & Company, 1996  **T. Wright:** Fluid Machinery, Performance, Analysis and Design, CRC Press LLC, 1999  **H. Sigloch:** Strömungsmaschinen – Grundlagen und Anwendungen, 2. Aflage, Carl Hanser Verlag München Wien, 1993  **H. P. Bloch, C. Soares:** Process Plant Machinery, Butterworth-Heinemann, 1998 | | | | | | | | | | | | | | | | | | | | |
| **Cilji in kompetence:** | | | | | | | | |  | | **Objectives and competences:** | | | | | | | | | |
| Namen predmeta je seznanitev študenta z naprednimi in alternativnimi tipi aero- in hidro- energetskih sistemov, | | | | | | | | |  | | Objective of this course is to introduce a student with advanced and alternative aero- and hydro- energetic systems. | | | | | | | | | |
| **Predvideni študijski rezultati:** | | | | | | | | | |  | **Intended learning outcomes:** | | | | | | | | | |
| Znanje in razumevanje:  Poglobljeno razumevanje principov obratovanja sodobnih, naprednih in alternativnih tipov vetrnih energetskih sistemov  Poglobljeno razumevanje principov obratovanja naprednih in alternativnih tipov hidro- energetskih sistemov  Sinteza znanj za raziskave na področju razvoja aero- in hidro- energetskih sistemov. | | | | | | | | | |  | Knowledge and understanding:  In depth understanding of operating principles of contemporary, advanced and alternative types of wind turbine energetic systems,  In depth understanding of operating principles of advanced and alternative types of hydro- energetic systems.  Knowledge synthesis for research and development of aero- and hydro- energetic systems. | | | | | | | | | |
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| **Metode poučevanja in učenja:** | | | | | | | | | |  | **Learning and teaching methods:** | | | | | | | | | |
| Frontalna predavanja,  Praktično delo pri laboratorijskih vajah,  Seminarska naloga (projektno delo);  poučevanje in učenje poteka z didaktično uporabo IKT | | | | | | | | | |  | Frontal lectures,  Practical work at laboratory work  Seminar (project) work  teaching and learning is done using didactic use of ICT | | | | | | | | | |
| **Načini ocenjevanja:** | | | | | | | Delež (v %) /  Weight (in %) | | | | | | **Assessment:** | | | | | | | |
| Način (pisni izpit, ustno izpraševanje, naloge, projekt):  pisni izpit  ustni izpit  projektno delo | | | | | | | **40%**  **40%**  **20%** | | | | | | Type (examination, oral, coursework, project):  written examination  oral examination  project work | | | | | | | |
| **Reference nosilca / Lecturer's references:** | | | | | | | | | | | | | | | | | | | | |
| **41.** LEŽAIĆ, Dario, MIHALIĆ, Tihomir, PREDIN, Andrej. Charging a car in motion wirelessly = Brezžično polnjenje avtomobilov v vožnji. *Journal of energy technology*, ISSN 1855-5748. [Tiskana izd.], sep. 2018, vol. 11, iss. 2, str. 61-66, ilustr. [COBISS.SI-ID [1024327772](https://plus.si.cobiss.net/opac7/bib/1024327772?lang=sl)]  **42.** HREN, Gorazd, PREDIN, Andrej. Evaluation of warehouse with virtual technologies. V: SINUANY-STERN, Zilla (ur.), COHEN, Yuval (ur.). *ICIL 2018 : conference proceedings*, 14th International Conference on Industrial Logistics, 15-17 May 2018, Beer-Sheva, Israel. Beer-Sheva: Ben-Gurion University. 2018, str. 87-93. [COBISS.SI-ID [1024319836](https://plus.si.cobiss.net/opac7/bib/1024319836?lang=sl)]  **38.** PREDIN, Andrej, HREN, Gorazd. Small kinetic water turbines review, possible locations and economoc efficiency in Slovenia. V: KROPE, Jurij (ur.), et al. *Renewable energy sources : (conference proceedings)*. Maribor: University of Maribor Press: Faculty of Chemistry and Chemical Engineering. 2017, str. 277-290. <http://press.um.si/index.php/ump/catalog/view/252/214/437-1>. [COBISS.SI-ID [1024295772](https://plus.si.cobiss.net/opac7/bib/1024295772?lang=sl)]  **39.** HREN, Gorazd, PREDIN, Andrej. Virtual warehouse simulation in Industry 4.0 scenarios. V: ZRNIĆ, Nenad Đ. (ur.), KARTNIG, Georg (ur.), BOŠNJAK, Srđan (ur.). *MHCL 2017*, MHCL 2017, 4th-6th October, 2017, Belgrade. Belgrade: Faculty of Mechanical Engineering. 2017, str. 219-244, ilustr. [COBISS.SI-ID [1024298332](https://plus.si.cobiss.net/opac7/bib/1024298332?lang=sl)]  GRGURIĆ, Gordan, MIHALIĆ, Tihomir, PREDIN, Andrej. Design of a train articulation system = Načrtovanje in izračun priklopnikov vagonov. *Journal of energy technology*, ISSN 1855-5748. [Tiskana izd.], apr. 2016, vol. 9, iss. 1, str. 29-38, ilustr. [COBISS.SI-ID [1024238428](https://plus.si.cobiss.net/opac7/bib/1024238428?lang=sl)]  HREN, Gorazd, PREDIN, Andrej. Visualisation of processes in warehouse on website with X3D. V: AYDIN, Ulviyye (ur.). *Maritime logistics : the new port projects of Turkey : proceedings*. Izmir: University: Logistics Association. 2015, str. 215-222. [COBISS.SI-ID [86071553](https://plus.si.cobiss.net/opac7/bib/86071553?lang=sl)]  MIHALIĆ, Tihomir, GUZOVIĆ, Zvonimir, PREDIN, Andrej. CFD flow analysis in the centrifugal vortex pump. *International journal of numerical methods for heat & fluid flow*, ISSN 0961-5539, 2014, vol. 24, no. 3, str. 545-562. <http://www.emeraldinsight.com/journals.htm?issn=0961-5539&volume=24&issue=3&articleid=17109922&show=abstract>, doi: [10.1108/HFF-05-2012-0124](https://doi.org/10.1108/HFF-05-2012-0124). [COBISS.SI-ID [1024162140](https://plus.si.cobiss.net/opac7/bib/1024162140?lang=sl)]  PREDIN, Andrej, HREN, Gorazd. Majhne kinetične vodne turbine, mogoče postavitve in ekonomska učinkovitost. V: VOLFAND, Jože (ur.), CIRMAN, Andreja, ŠIJANEC-ZAVRL, Marjana. *URE, energetika in okolje = Energy efficiency, energy and environment*, (Zbirka Zelena Slovenija). Celje: Fit media. 2013, str. 143-149. [COBISS.SI-ID [76815873](https://plus.si.cobiss.net/opac7/bib/76815873?lang=sl)]  PREDIN, Andrej. Mikro elektrarna - pot k zadostitvi električnih potreb naših domov = Micro-power plants - meeting the electrical needs of our homes. *Journal of energy technology*, ISSN 1855-5748. [Tiskana izd.], feb. 2013, vol. 6, iss. 1, str. 8-10. <http://www.fe.um.si/en/jet.html>. [COBISS.SI-ID [1024132188](https://plus.si.cobiss.net/opac7/bib/1024132188?lang=sl)]  MIHALIĆ, Tihomir, GUZOVIĆ, Zvonimir, PREDIN, Andrej. Performances and flow analysis in the centrifugal vortex pump. *Journal of fluids engineering : Transactions of the ASME*, ISSN 0098-2202, Jan. 2013, vol. 133, iss. 1, str. 011107-1-011107-7, doi: [10.1115/1.4023198](https://doi.org/10.1115/1.4023198). [COBISS.SI-ID [1024124252](https://plus.si.cobiss.net/opac7/bib/1024124252?lang=sl)] | | | | | | | | | | | | | | | | | | | | |

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| **UČNI NAČRT PREDMETA / COURSE SYLLABUS** | | | | | | | | | | | | | | | | | | | | |
| **Predmet:** | | | **NAPREDNI VODNI STROJI IN NAPRAVE** | | | | | | | | | | | | | | | | | |
| **Course title:** | | | **ADVANCED WATER MACHINES AND APPARATUS** | | | | | | | | | | | | | | | | | |
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| **Študijski program in stopnja**  **Study programme and level** | | | | | **Študijska smer**  **Study field** | | | | | | | | | | | **Letnik**  **Academic year** | | **Semester**  **Semester** | | |
| **ENERGETIKA, 3. stopnja** | | | | | **-** | | | | | | | | | | | **1/2** | | **1/2/3** | | |
| **ENERGY TECHNOLOGY, 3. Degree** | | | | | **-** | | | | | | | | | | | **1/2** | | **1/2/3** | | |
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| **Vrsta predmeta / Course type** | | | | | | | | | | | | | | | Izbirni/Elective | | | | | |
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| **Univerzitetna koda predmeta / University course code:** | | | | | | | | | | | | | | | D | | | | | |
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| **Predavanja**  **Lectures** | **Seminar**  **Seminar** | | | **Vaje**  **Tutorial** | | | | **Klinične vaje**  **work** | | | | | | **Druge oblike študija** | | | **Samost. delo**  **Individ. work** | |  | **ECTS** |
| **30** | **-** | | | **-** | | | | **-** | | | | | | **-** | | | **150** | |  | **6** |
|  | | | | | | | | | | | | | | | | | | | | |
| **Nosilec predmeta / Lecturer:** | | | | | **ANDREJ PREDIN** | | | | | | | | | | | | | | | |
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| **Jeziki /**  **Languages:** | | **Predavanja / Lectures:** | | | | **Slovenski/Slovene** | | | | | | | | | | | | | | |
| **Vaje / Tutorial:** | | | | **Slovenski/Slovene** | | | | | | | | | | | | | | |
| **Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:** | | | | | | | | | |  | | **Prerequisits:** | | | | | | | | |
| Zahtevano predhodno znanje iz področja hidroenergetskih sistemov | | | | | | | | | |  | | General knowledge from the field of Hydroenergetic systems | | | | | | | | |
| **Vsebina:** | | | | | | | | | |  | | **Content (Syllabus outline):** | | | | | | | | |
| -Pregled sodobnih in alternativnih vodnih strojev:  - Francisova turbina (navadna izvedba, vertikalna in horizontalna izvedba, črpalka-turbina (reverzibilna) izvedba)  - Kaplanova turbina: - navadna izvedba (vertikalna in horizontalna), - tandemska izvedba, - posebne izvedbe  - Peltonova turbina (eno in več-šobna izvedba, horizontalna in vertikalna izvedba, specialne izvedbe – izvedba s strojnico pod tlakom, Turgo izvedba, …)  - S izvedba Kaplanove turbine  - Cevne izvedbe Kaplanove turbine,  - Večstopenjske in dvotokovne izvedbe,  - Bibavične izvedbe turbin,  - Vodne »vetrnice«  - Pregled sodobnih in alternativnih naprav (sistemov):  - Izvedbe turbin, ki koristijo hidravlični udar,  - Izvedbe turbin, ki koristijo energijo morskih valov,  - Sistem osmotske elektrarne (koriščenje slanega in sladkega vodnega vira)  - Drugi alternativni principi koriščenja vodne energije | | | | | | | | | |  | | -Overview of the contemporary, advanced and alternative water machines:  - Francis turbine (regular type, vertical and horizontal type, pump-turbine (reversible) type),  - Kaplan turbine – regular type, -vertical and horizontal type, - tandem type, - special types,  - Pelton type (one and more-jets types, special types – type with pressurized machine chamber, Turgo type, …)  - S type of Kaplan turbine,  - Bulb types of Kaplan turbine,  - More stage and two flow types,  - Tide turbine types,  - Watermill types  - Overview of contemporary and alternative apparatus (systems):  - Turbine types that use water hammer pressure rise,  - Turbine types that use sea waves energy,  - Osmosis plant types (use of salt and regular water sources)  - Others alternative principles fro water energy use; | | | | | | | | |
| **Temeljni literatura in viri / Readings:** | | | | | | | | | | | | | | | | | | | | |
| **J. Raabe:** Hydraulische Maschinen und Anlagen, Teil 1, Grundlagen der hydraulischen Strömungsmaschinen, Teil 2, Wasser Turbinen, Teil 3, Pumpen, Teil 4, Wasserkraftanlagen, VDI-Verlag, GmbH Düsseldorf, 1968  **D. Stephenson:** Water resources management, CRC Press, 2003  **J. Twidell, T. Weir:** Renewable Energy Resources, Second edition, Taylor & Francis Group, London and New York, 2005  **T. Wright:** Fluid Machinery: Performance, Analysis and Design, CRC Press 1999 | | | | | | | | | | | | | | | | | | | | |
| **Cilji in kompetence:** | | | | | | | | |  | | **Objectives and competences:** | | | | | | | | | |
| Namen predmeta je seznanitev študenta s sodobnim, naprednimi in alternativnimi tipi vodnih strojev in naprav. | | | | | | | | |  | | Objective of this course is to introduce a student with contemporary, advanced and alternative water machines and apparatus types. | | | | | | | | | |
| **Predvideni študijski rezultati:** | | | | | | | | | |  | **Intended learning outcomes:** | | | | | | | | | |
| Znanje in razumevanje:  Poglobljeno razumevanje principov obratovanja vodnih strojev in naprav  Sinteza znanj za raziskave na področju razvoja vodnih strojev in naprav | | | | | | | | | |  | Knowledge and understanding:  In depth understanding of operating principles of water machines and apparatus  Knowledge synthesis for research and development of water machines and apparatus. | | | | | | | | | |
| **Metode poučevanja in učenja:** | | | | | | | | | |  | **Learning and teaching methods:** | | | | | | | | | |
| Frontalna predavanja,  Praktično delo pri laboratorijskih vajah,  Seminarska naloga (projektno delo);  poučevanje in učenje poteka z didaktično uporabo IKT | | | | | | | | | |  | Frontal lectures,  Practical work at laboratory work  Seminar (project) work  teaching and learning is done using didactic use of ICT | | | | | | | | | |
| **Načini ocenjevanja:** | | | | | | | Delež (v %) /  Weight (in %) | | | | | | **Assessment:** | | | | | | | |
| Način (pisni izpit, ustno izpraševanje, naloge, projekt):  pisni izpit  ustni izpit  projektno delo | | | | | | | **40%**  **40%**  **20%** | | | | | | Type (examination, oral, coursework, project):  written examination  oral examination  project work | | | | | | | |
| **Reference nosilca / Lecturer's references:** | | | | | | | | | | | | | | | | | | | | |
| **41.** LEŽAIĆ, Dario, MIHALIĆ, Tihomir, PREDIN, Andrej. Charging a car in motion wirelessly = Brezžično polnjenje avtomobilov v vožnji. *Journal of energy technology*, ISSN 1855-5748. [Tiskana izd.], sep. 2018, vol. 11, iss. 2, str. 61-66, ilustr. [COBISS.SI-ID [1024327772](https://plus.si.cobiss.net/opac7/bib/1024327772?lang=sl)]  **42.** HREN, Gorazd, PREDIN, Andrej. Evaluation of warehouse with virtual technologies. V: SINUANY-STERN, Zilla (ur.), COHEN, Yuval (ur.). *ICIL 2018 : conference proceedings*, 14th International Conference on Industrial Logistics, 15-17 May 2018, Beer-Sheva, Israel. Beer-Sheva: Ben-Gurion University. 2018, str. 87-93. [COBISS.SI-ID [1024319836](https://plus.si.cobiss.net/opac7/bib/1024319836?lang=sl)]  **38.** PREDIN, Andrej, HREN, Gorazd. Small kinetic water turbines review, possible locations and economoc efficiency in Slovenia. V: KROPE, Jurij (ur.), et al. *Renewable energy sources : (conference proceedings)*. Maribor: University of Maribor Press: Faculty of Chemistry and Chemical Engineering. 2017, str. 277-290. <http://press.um.si/index.php/ump/catalog/view/252/214/437-1>. [COBISS.SI-ID [1024295772](https://plus.si.cobiss.net/opac7/bib/1024295772?lang=sl)]  **39.** HREN, Gorazd, PREDIN, Andrej. Virtual warehouse simulation in Industry 4.0 scenarios. V: ZRNIĆ, Nenad Đ. (ur.), KARTNIG, Georg (ur.), BOŠNJAK, Srđan (ur.). *MHCL 2017*, MHCL 2017, 4th-6th October, 2017, Belgrade. Belgrade: Faculty of Mechanical Engineering. 2017, str. 219-244, ilustr. [COBISS.SI-ID [1024298332](https://plus.si.cobiss.net/opac7/bib/1024298332?lang=sl)]  GRGURIĆ, Gordan, MIHALIĆ, Tihomir, PREDIN, Andrej. Design of a train articulation system = Načrtovanje in izračun priklopnikov vagonov. *Journal of energy technology*, ISSN 1855-5748. [Tiskana izd.], apr. 2016, vol. 9, iss. 1, str. 29-38, ilustr. [COBISS.SI-ID [1024238428](https://plus.si.cobiss.net/opac7/bib/1024238428?lang=sl)]  HREN, Gorazd, PREDIN, Andrej. Visualisation of processes in warehouse on website with X3D. V: AYDIN, Ulviyye (ur.). *Maritime logistics : the new port projects of Turkey : proceedings*. Izmir: University: Logistics Association. 2015, str. 215-222. [COBISS.SI-ID [86071553](https://plus.si.cobiss.net/opac7/bib/86071553?lang=sl)]  MIHALIĆ, Tihomir, GUZOVIĆ, Zvonimir, PREDIN, Andrej. CFD flow analysis in the centrifugal vortex pump. *International journal of numerical methods for heat & fluid flow*, ISSN 0961-5539, 2014, vol. 24, no. 3, str. 545-562. <http://www.emeraldinsight.com/journals.htm?issn=0961-5539&volume=24&issue=3&articleid=17109922&show=abstract>, doi: [10.1108/HFF-05-2012-0124](https://doi.org/10.1108/HFF-05-2012-0124). [COBISS.SI-ID [1024162140](https://plus.si.cobiss.net/opac7/bib/1024162140?lang=sl)]  PREDIN, Andrej, HREN, Gorazd. Majhne kinetične vodne turbine, mogoče postavitve in ekonomska učinkovitost. V: VOLFAND, Jože (ur.), CIRMAN, Andreja, ŠIJANEC-ZAVRL, Marjana. *URE, energetika in okolje = Energy efficiency, energy and environment*, (Zbirka Zelena Slovenija). Celje: Fit media. 2013, str. 143-149. [COBISS.SI-ID [76815873](https://plus.si.cobiss.net/opac7/bib/76815873?lang=sl)]  PREDIN, Andrej. Mikro elektrarna - pot k zadostitvi električnih potreb naših domov = Micro-power plants - meeting the electrical needs of our homes. *Journal of energy technology*, ISSN 1855-5748. [Tiskana izd.], feb. 2013, vol. 6, iss. 1, str. 8-10. <http://www.fe.um.si/en/jet.html>. [COBISS.SI-ID [1024132188](https://plus.si.cobiss.net/opac7/bib/1024132188?lang=sl)]  MIHALIĆ, Tihomir, GUZOVIĆ, Zvonimir, PREDIN, Andrej. Performances and flow analysis in the centrifugal vortex pump. *Journal of fluids engineering : Transactions of the ASME*, ISSN 0098-2202, Jan. 2013, vol. 133, iss. 1, str. 011107-1-011107-7, doi: [10.1115/1.4023198](https://doi.org/10.1115/1.4023198). [COBISS.SI-ID [1024124252](https://plus.si.cobiss.net/opac7/bib/1024124252?lang=sl)] | | | | | | | | | | | | | | | | | | | | |

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| **UČNI NAČRT PREDMETA / COURSE SYLLABUS** | | | | | | | | | | | | | | | | | | | | |
| **Predmet:** | | | **FOTONAPETOSTNI SLEDILNI SISTEMI** | | | | | | | | | | | | | | | | | |
| **Course title:** | | | **PHOTOVOLTAIC TRACKING SYSTEMS** | | | | | | | | | | | | | | | | | |
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| **Študijski program in stopnja**  **Study programme and level** | | | | | **Študijska smer**  **Study field** | | | | | | | | | | | **Letnik**  **Academic year** | | **Semester**  **Semester** | | |
| **ENERGETIKA, 3. stopnja** | | | | | **-** | | | | | | | | | | | **1/2** | | **1/2/3** | | |
| **ENERGY TECHNOLOGY, 3. Degree** | | | | | **-** | | | | | | | | | | | **1/2** | | **1/2/3** | | |
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| **Vrsta predmeta / Course type** | | | | | | | | | | | | | | | Izbirni/Elective | | | | | |
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| **Univerzitetna koda predmeta / University course code:** | | | | | | | | | | | | | | | D | | | | | |
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| **Predavanja**  **Lectures** | **Seminar**  **Seminar** | | | **Vaje**  **Tutorial** | | | | **Klinične vaje**  **work** | | | | | | **Druge oblike študija** | | | **Samost. delo**  **Individ. work** | |  | **ECTS** |
| **30** | **-** | | | **-** | | | | **-** | | | | | | **-** | | | **150** | |  | **6** |
|  | | | | | | | | | | | | | | | | | | | | |
| **Nosilec predmeta / Lecturer:** | | | | | **SEBASTIJAN SEME** | | | | | | | | | | | | | | | |
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| **Jeziki /**  **Languages:** | | **Predavanja / Lectures:** | | | | **Slovenski/Slovene** | | | | | | | | | | | | | | |
| **Vaje / Tutorial:** | | | | **Slovenski/Slovene** | | | | | | | | | | | | | | |
| **Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:** | | | | | | | | | |  | | **Prerequisits:** | | | | | | | | |
| Ni posebnih obveznosti. | | | | | | | | | |  | | No prerequisites. | | | | | | | | |
| **Vsebina:** | | | | | | | | | |  | | **Content (Syllabus outline):** | | | | | | | | |
| Moč in energija sončnega sevanja. Statistični in deterministični modeli za računanje gostote moči sončnega sevanja.  Gradniki fotonapetostnih sistemov, vse od fotonapetostnih modulov, razsmernikov do prenapetostne zaščite in priključevanja na omrežje.  Zasnova in razvoj različnih tipov sledilnih fotonapetostnih sistemov. Konstrukcijska zasnova in določanje vrste in velikosti sledilnih sistemov. Trdnostna kontrola in globalni izračun konstrukcije.  Pogonski sklopi za premikanje fotonapetostnih sledilnih sistemov. Načini vodenja in napajanja električnih pogonskih sklopov. Nove metode iskanja optimalnega vodenja pogonskih sklopov sledilnih sistemov za dosego maksimalnega izplena proizvodnje električne energije.  Določitev in ovrednotenje električnih izgub pogonskih sklopov sledilnih sistemov. | | | | | | | | | |  | | Power and energy of solar radiation. Statistical and deterministic models to calculate the solar radiation.  Elements of photovoltaic systems, including photovoltaic modules, converters, overvoltage protection and connection to the grid.  Planning and developing the various types of photovoltaic tracking systems. Construction and determining the type and size of the tracking systems. Strength control and global calculation of construction.  Electric power drive for moving the photovoltaic tracking systems. Methods for controlling and supplying the electric power drive. The new methods for determining such trajectories of the photovoltaic modules that change the position of the photovoltaic modules in such a way that the production of the electric energy in the given time interval of the observation reaches its maximum.  Determination and evaluation of electric drive losses of the photovoltaic tracking systems. | | | | | | | | |
| **Temeljni literatura in viri / Readings:** | | | | | | | | | | | | | | | | | | | | |
| Goswami, D. Yogi, ”Principles of Solar Engineering,” 2023.  C. Sun, Physics of Solar Energy. Arcler Press, 2019. [eBook].  Dickinson, E. W, ”Solar Energy Technology Handbook,” 2018.  V. Quaschning, Understanding Renewable Energy Systems. Routledge, 2016. doi:  D. Lenardič, Fotonapetostni sistemi: priročnik: gradniki, načrtovanje, namestitev in vzdrževanje, 2., Razširjena in dopolnjena izd. Ljubljana: Agencija Poti, 2012, p. XVIII, 674.  Dodatna literatura / Additional literature  P. Mavsar, “Fizični, geografski, tehnični in ekonomski potencial za optimalno konfiguracijo fotonapetostnih sistemov s pomočjo digitalnih posnetkov območja: doktorska disertacija,” [P. Mavsar], Krško, 2021. [Online]. Available: <https://dk.um.si/IzpisGradiva.php?id=78352>.  N. Lukač, “Algoritem za celostno vrednotenje fotovoltaičnega in vetrnega potenciala večjih geografskih območij: doktorska disertacija,” [N. Lukač], Maribor, 2016. [Online]. Available: https://dk.um.si/IzpisGradiva.php?id=58766.  P. Sukič, “Fotonapetostne elektrarne kot vodeni aktivni členi razdeljevalnih omrežij: doktorska disertacija,” [P. Sukič], Maribor, 2018. [Online]. Available: <https://dk.um.si/IzpisGradiva.php?id=69636>. | | | | | | | | | | | | | | | | | | | | |
| **Cilji in kompetence:** | | | | | | | | |  | | **Objectives and competences:** | | | | | | | | | |
| Po opravljenih predavanjih in samostojnem delu ter izpolnjenih obveznostih bo študent:  Cilji:  Cilji predmeta so, da bo študent sposoben samostojno načrtovati sledilne fotonapetostne sistemi, da bo pri tem razumel delovanje pogonskih sklopov in načinov vodenja sledilnih sistemov. Usposobiti študenta za samostojno obravnavo sončnih modulov, razsmernikov, postavitve fotonapetostnih sistemov. Usposobiti študenta za izračun velikosti fotonapetostnega sistema glede na podane pogoje.  Kompetence:  Razviti sposobnosti, da bo študent samostojno in kreativno reševal inženirske probleme. | | | | | | | | |  | | After completing lectures and independent work and fulfilling obligations, the student will:  Objectives:  The objectives of the course are that the student will be able to independently design tracking photovoltaic systems, in order to understand the operation of drive units and ways of managing tracking systems. To train the student to independently deal with solar modules, inverters, and the installation of photovoltaic systems. Train the student to calculate the size of the photovoltaic system according to the given conditions.  Competences:  To develop the skills for the student to independently and creatively solve engineering problems. | | | | | | | | | |
| **Predvideni študijski rezultati:** | | | | | | | | | |  | **Intended learning outcomes:** | | | | | | | | | |
| Znanje in razumevanje:  Razumevanje pojavov v fotovoltaiki, sledilnih sistemov, vodenja in načrtovanja pogonskih sklopov.  Prenesljive/ključne spretnosti in drugi atributi:  Reševanje problemov, ki so povezani s fotonapetostnimi sledilnimi sistemi in konstruiranje tovrstnih naprav za uporabo v praksi. | | | | | | | | | |  | Knowledge and Understanding:  Understanding of phenomena and devices related to the photovoltaic systems, tracking systems and controlling the electric drive.  Transferable/Key Skills and other attributes:  Solving problems related to the photovoltaic tracking systems and construction modelling. | | | | | | | | | |
| **Metode poučevanja in učenja:** | | | | | | | | | |  | **Learning and teaching methods:** | | | | | | | | | |
| Predavanja/konzultacije  projekt,  samostojno delo,  poučevanje in učenje poteka z didaktično uporabo IKT, | | | | | | | | | |  | Lectures/consultations,  Project,  Individual work,  Teaching and learning is done using didactic use of ICT, | | | | | | | | | |
| **Načini ocenjevanja:** | | | | | | | Delež (v %) /  Weight (in %) | | | | | | **Assessment:** | | | | | | | |
| Način (pisni izpit, ustno izpraševanje, naloge, projekt):  ustno izpraševanje,  projekti | | | | | | | **50%**  **50%** | | | | | | Type (examination, oral, coursework, project):  oral,  project | | | | | | | |
| **Reference nosilca / Lecturer's references:** | | | | | | | | | | | | | | | | | | | | |
| SREDENŠEK, Klemen, ŠTUMBERGER, Bojan, HADŽISELIMOVIĆ, Miralem, MAVSAR, Primož, SEME, Sebastijan. Physical, geographical, technical, and economic potential for theoptimal configuration of photovoltaic systems using a digital surfacemodel and optimization method. Energy. [Online ed.]. 2021, vol. 242, art. 122971, str. 1-13, ilustr. ISSN 1873-6785. DOI: 10.1016/j.energy.2021.122971. [COBISS.SI-ID 91870723], [JCR, SNIP, WoS do 28. 5. 2023: št. citatov (TC): 2, čistih citatov (CI): 2, čistih citatov na avtorja (CIAu): 0,40, Scopus do 27. 5. 2023: št. citatov (TC): 2, čistih citatov (CI): 2, čistih citatov na avtorja (CIAu): 0,40]  kategorija: 1A1 (Z, A'', A', A1/2); uvrstitev: SCIE, Scopus, MBP (ASFA, CAB, COMPENDEX, GEOREF, INSPEC, PUBMED); tip dela je verificiral OSICT  točke: 31.6, št. avtorjev: 5  DEŽELAK, Klemen, BRACINÍK, Peter, SREDENŠEK, Klemen, **SEME, Sebastijan**. Proportional-integral controllers performance of a grid-connected solar PV system with particle swarm optimization and Ziegler-Nichols tuning method. Energies. 2021, vol. 14, issue 9, str. 1-15. ISSN 1996-1073. DOI: 10.3390/en14092516. [COBISS.SI-ID 61414659], [JCR, SNIP, WoS do 26. 10. 2022: št. citatov (TC): 7, čistih citatov (CI): 6, čistih citatov na avtorja (CIAu): 1,50, Scopus do 9. 8. 2022: št. citatov (TC): 7, čistih citatov (CI): 6, čistih citatov na avtorja (CIAu): 1,50] kategorija: 1A3 (Z); uvrstitev: SCIE, Scopus, MBP (INSPEC, COMPENDEX, METADEX, CAB, PUBMED, DOAJ); tip dela je verificiral OSICT točke: 16.06, št. avtorjev: 4  KORZENIEWSKA, Ewa, TOMCZYK, Mariusz, PIETRZAK, Łukasz, HADŽISELIMOVIĆ, Miralem, ŠTUMBERGER, Bojan, SREDENŠEK, Klemen, SEME, Sebastijan. Efficiency of laser-shaped photovoltaic cells. Energies. 2020, art. 4747, no. 18, str. 1-13. ISSN 1996-1073. DOI: 10.3390/en13184747. [COBISS.SI-ID 28404483], [JCR, SNIP, WoS do 23. 4. 2023: št. citatov (TC): 6, čistih citatov (CI): 6, čistih citatov na avtorja (CIAu): 0,86, Scopus do 7. 4. 2023: št. citatov (TC): 8, čistih citatov (CI): 8, čistih citatov na avtorja (CIAu): 1,14]  kategorija: 1A3 (Z); uvrstitev: SCIE, Scopus, MBP (CAB, COMPENDEX, DOAJ, INSPEC, METADEX, PUBMED); tip dela je verificiral OSICT  točke: 9.88, št. avtorjev: 7 | | | | | | | | | | | | | | | | | | | | |

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| **UČNI NAČRT PREDMETA / COURSE SYLLABUS** | | | | | | | | | | | | | | | | | | | | |
| **Predmet:** | | | **IZBRANA POGLAVJA IZ FOTONAPETOSTNIH SISTEMOV** | | | | | | | | | | | | | | | | | |
| **Course title:** | | | **SELECTED TOPICS FROM THE PHOTOVOLTAIC SYSTEMS** | | | | | | | | | | | | | | | | | |
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| **Študijski program in stopnja**  **Study programme and level** | | | | | **Študijska smer**  **Study field** | | | | | | | | | | | **Letnik**  **Academic year** | | **Semester**  **Semester** | | |
| **ENERGETIKA, 3. stopnja** | | | | | **-** | | | | | | | | | | | **1/2** | | **1/2/3** | | |
| **ENERGY TECHNOLOGY, 3. Degree** | | | | | **-** | | | | | | | | | | | **1/2** | | **1/2/3** | | |
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| **Vrsta predmeta / Course type** | | | | | | | | | | | | | | | Izbirni/Elective | | | | | |
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| **Univerzitetna koda predmeta / University course code:** | | | | | | | | | | | | | | | D | | | | | |
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| **Predavanja**  **Lectures** | **Seminar**  **Seminar** | | | **Vaje**  **Tutorial** | | | | **Klinične vaje**  **work** | | | | | | **Druge oblike študija** | | | **Samost. delo**  **Individ. work** | |  | **ECTS** |
| **30** | **-** | | | **-** | | | | **-** | | | | | | **-** | | | **150** | |  | **6** |
|  | | | | | | | | | | | | | | | | | | | | |
| **Nosilec predmeta / Lecturer:** | | | | | **SEBASTIJAN SEME, BARUKČIĆ MARINKO** | | | | | | | | | | | | | | | |
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| **Jeziki /**  **Languages:** | | **Predavanja / Lectures:** | | | | **Slovenski/Slovene** | | | | | | | | | | | | | | |
| **Vaje / Tutorial:** | | | | **Slovenski/Slovene** | | | | | | | | | | | | | | |
| **Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:** | | | | | | | | | |  | | **Prerequisits:** | | | | | | | | |
| Ni posebnih obveznosti. | | | | | | | | | |  | | No prerequisites. | | | | | | | | |
| **Vsebina:** | | | | | | | | | |  | | **Content (Syllabus outline):** | | | | | | | | |
| Princip pretvarjanja sončne energije v električno energijo.  Elementi fotonapetostnih sistemov. Delovanje fotonapetostnih sistemov (fotonapetostni moduli), fotonapetostnih razsmernikov (DC/DC in DC/AC) in sistemov za shranjevanje električne energije.  Vrste in uporaba fotonapetostnih modulov.  Zasnova otočnih in omrežnih fotonapetostnih sistemov z otočnimi (off-grid) in omrežnimi razsmerniki.  Načrtovanje fiksnih in sledilnih fotonapetostnih sistemov. Podrobnejši pregled in ocena potenciala sončno sevanje. Načrtovanje nosilne konstrukcije in prenapetostne zaščite naprav. Ekonomska analiza upravičenosti izgradnje tovrstnih sistemov.  Zaščita pred udari strele in vzdrževanje fotonapetostnih sistemov.  Sistemi za shranjevanje energija in izvedbe (baterije in pretočni akumulatorji). | | | | | | | | | |  | | Principle of solar energy conversion into electric energy.  Elements of photovoltaic systems. Operation of photovoltaic systems (photovoltaic modules), photovoltaic converters (DC/DC and DC/AC) and electric energy storage systems.  Types and application of photovoltaic modules.  Development of off-grid and grid connection photovoltaic systems by off-grid and grid converters.  Planning and developing the fixed and tracking photovoltaic systems. Detailed review and evaluation of solar radiation potential. Development of photovoltaic system construction and overvoltage protection of electrical devices. Economic analysis for investment.  Lightning protection and maintenance of photovoltaic systems.  Energy storage principles and realisations (batteries and flow batteries). | | | | | | | | |
| **Temeljni literatura in viri / Readings:** | | | | | | | | | | | | | | | | | | | | |
| Goswami, D. Yogi, ”Principles of Solar Engineering,” 2023.  Mulmudi Hemant Kumar, “Potential Use of Solar Energy and Emerging Technologies in Micro Irrigation,” 2020.  Maurice Hébert, “Maximum Power Point Tracking: Background, Implementation and Classification,” 2020.  C. Sun, Physics of Solar Energy. Arcler Press, 2019. [eBook].  Dickinson, E. W, ”Solar Energy Technology Handbook,” 2018.  V. Quaschning, Understanding Renewable Energy Systems. Routledge, 2016. doi:  D. Lenardič, Fotonapetostni sistemi: priročnik: gradniki, načrtovanje, namestitev in vzdrževanje, 2., Razširjena in dopolnjena izd. Ljubljana: Agencija Poti, 2012, p. XVIII, 674.  Dodatna literatura / Additional literature  P. Mavsar, “Fizični, geografski, tehnični in ekonomski potencial za optimalno konfiguracijo fotonapetostnih sistemov s pomočjo digitalnih posnetkov območja: doktorska disertacija,” [P. Mavsar], Krško, 2021. [Online]. Available: <https://dk.um.si/IzpisGradiva.php?id=78352>.  N. Lukač, “Algoritem za celostno vrednotenje fotovoltaičnega in vetrnega potenciala večjih geografskih območij: doktorska disertacija,” [N. Lukač], Maribor, 2016. [Online]. Available: https://dk.um.si/IzpisGradiva.php?id=58766.  P. Sukič, “Fotonapetostne elektrarne kot vodeni aktivni členi razdeljevalnih omrežij: doktorska disertacija,” [P. Sukič], Maribor, 2018. [Online]. Available: <https://dk.um.si/IzpisGradiva.php?id=69636>. | | | | | | | | | | | | | | | | | | | | |
| **Cilji in kompetence:** | | | | | | | | |  | | **Objectives and competences:** | | | | | | | | | |
| Študent pridobi poglobljena znanja s področja gradnikov fotonapetostnih sistemov in pripadajočih sodobnih tehnologij. | | | | | | | | |  | | Student gets deeper insight into photovoltaic systems and modern advanced technologies. | | | | | | | | | |
| **Predvideni študijski rezultati:** | | | | | | | | | |  | **Intended learning outcomes:** | | | | | | | | | |
| Znanje in razumevanje:  Razumevanje pojavov v fotovoltaiki in naprav povezanih s fotonapetostnimi sistemi in njihovo vključevanje v elektroenergetsko omrežje.  Prenesljive/ključne spretnosti in drugi atributi:  Reševanje problemov, ki so povezani s fotonapetostnimi sistemi in razsmerniškimi vezji za priključevanje tovrstnih naprav na omrežje. | | | | | | | | | |  | Knowledge and Understanding:  Understanding of phenomena and devices related to the photovoltaic systems and their integration into the electric grid.  Transferable/Key Skills and other attributes:  Solving problems related to the photovoltaic systems and converters. | | | | | | | | | |
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| **Metode poučevanja in učenja:** | | | | | | | | | |  | **Learning and teaching methods:** | | | | | | | | | |
| Predavanja/konzultacije/mentorirano projektno delo,  projekt,  samostojno delo,  poučevanje in učenje poteka z didaktično uporabo IKT. | | | | | | | | | |  | Lectures/consultations/supervised project work,  Project,  Individual work,  Teaching and learning is done using didactic use of ICT. | | | | | | | | | |
| **Načini ocenjevanja:** | | | | | | | Delež (v %) /  Weight (in %) | | | | | | **Assessment:** | | | | | | | |
| Način (pisni izpit, ustno izpraševanje, naloge, projekt):  ustno izpraševanje,  projekti | | | | | | | **50%**  **50%** | | | | | | Type (examination, oral, coursework, project):  oral,  project | | | | | | | |
| **Reference nosilca / Lecturer's references:** | | | | | | | | | | | | | | | | | | | | |
| MAVSAR, Primož, SREDENŠEK, Klemen, ŠTUMBERGER, Bojan, HADŽISELIMOVIĆ, Miralem, **SEME, Sebastijan.** Simplified method for analyzing the availability of rooftop photovoltaic potential. Energies, ISSN 1996-1073, 2019, vol. 12, no. 22, str. 1-17, doi: 10.3390/en12224233. [COBISS.SI-ID 1024364636], [JCR, SNIP]  kategorija: 1A3 (Z); uvrstitev: SCI, Scopus, MBP; tip dela je verificiral OSICT  točke: 15.44, št. avtorjev: 5  **SEME, Sebastijan**, SREDENŠEK, Klemen, ŠTUMBERGER, Bojan, HADŽISELIMOVIĆ, Miralem. Analysis of the performance of photovoltaic systems in Slovenia. Solar energy, ISSN 0038-092X. [Print ed.], 2019, vol. 180, str. 550-558, ilustr., doi: 10.1016/j.solener.2019.01.062. [COBISS.SI-ID 1024334684], [JCR, SNIP, WoS do 13. 10. 2019: št. citatov (TC): 4, čistih citatov (CI): 4, čistih citatov na avtorja (CIAu): 1.00, Scopus do 29. 11. 2019: št. citatov (TC): 4, čistih citatov (CI): 4, čistih citatov na avtorja (CIAu): 1.00]  kategorija: 1A1 (Z, A', A1/2); uvrstitev: SCI, Scopus, MBP; tip dela je verificiral OSICT  točke: 25.26, št. avtorjev: 4  BARUKČIĆ, Marinko, HEDERIĆ, Željko, HADŽISELIMOVIĆ, Miralem, **SEME, Sebastijan**. A simple stochastic method for modelling the uncertainty of photovoltaic power production based on measured data. Energy, ISSN 1873-6785. [Online ed.], 2018, [31] str., doi: 10.1016/j.energy.2018.09.134. [COBISS.SI-ID 1024322140], [JCR, SNIP, WoS do 11. 8. 2019: št. citatov (TC): 1, čistih citatov (CI): 1, čistih citatov na avtorja (CIAu): 0.25, Scopus do 29. 11. 2019: št. citatov (TC): 2, čistih citatov (CI): 2, čistih citatov na avtorja (CIAu): 0.50]  kategorija: 1A1 (Z, A', A1/2); uvrstitev: SCI, Scopus, MBP; tip dela še ni verificiran  točke: 40.79, št. avtorjev: 4  **Barukčić, M**.; Varga, T.; Jerković Štil, V.; Benšić, T. Co-Simulation and Data-Driven Based Procedure for Estimation of Nodal Voltage Phasors in Power Distribution Networks Using a Limited Number of Measured Data. Electronics 2021, 10, 522. <https://doi.org/10.3390/electronics10040522>  Varga, T.; Benšić, T.; Jerković Štil, V.; **Barukčić, M**. Continuous Control Set Predictive Current Control for Induction Machine. Appl. Sci. 2021, 11, 6230. <https://doi.org/10.3390/app11136230>  **Barukčić, Marinko**; Varga, Toni; Benšić, Tin; Jerković Štil, Vedrana Jerković Optimal Allocation of Renewable Energy Sources and Battery Storage Systems Considering Energy Management System Optimization Based on Fuzzy Inference // Energies, 15 (2022), 19; 6884, 17 doi:10.3390/en15196884 | | | | | | | | | | | | | | | | | | | | |

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| **UČNI NAČRT PREDMETA / COURSE SYLLABUS** | | | | | | | | | | | | | | | | | | | | |
| **Predmet:** | | | **RADIO-EKOLOGIJA** | | | | | | | | | | | | | | | | | |
| **Course title:** | | | **RADIO-ECOLOGY** | | | | | | | | | | | | | | | | | |
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| **Študijski program in stopnja**  **Study programme and level** | | | | | **Študijska smer**  **Study field** | | | | | | | | | | | **Letnik**  **Academic year** | | **Semester**  **Semester** | | |
| **ENERGETIKA, 3. stopnja** | | | | | **-** | | | | | | | | | | | **1/2** | | **1/2/3** | | |
| **ENERGY TECHNOLOGY, 3. Degree** | | | | | **-** | | | | | | | | | | | **1/2** | | **1/2/3** | | |
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| **Vrsta predmeta / Course type** | | | | | | | | | | | | | | | Izbirni/Elective | | | | | |
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| **Univerzitetna koda predmeta / University course code:** | | | | | | | | | | | | | | | D | | | | | |
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| **Predavanja**  **Lectures** | **Seminar**  **Seminar** | | | **Vaje**  **Tutorial** | | | | **Klinične vaje**  **work** | | | | | | **Druge oblike študija** | | | **Samost. delo**  **Individ. work** | |  | **ECTS** |
| **30** | **-** | | | **-** | | | | **-** | | | | | | **-** | | | **150** | |  | **6** |
|  | | | | | | | | | | | | | | | | | | | | |
| **Nosilec predmeta / Lecturer:** | | | | | **BORUT SMODIŠ** | | | | | | | | | | | | | | | |
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| **Jeziki /**  **Languages:** | | **Predavanja / Lectures:** | | | | **Slovenski/Slovene** | | | | | | | | | | | | | | |
| **Vaje / Tutorial:** | | | | **Slovenski/Slovene** | | | | | | | | | | | | | | |
| **Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:** | | | | | | | | | |  | | **Prerequisits:** | | | | | | | | |
| Ni posebnih obveznosti. | | | | | | | | | |  | | No prerequisites. | | | | | | | | |
| **Vsebina:** | | | | | | | | | |  | | **Content (Syllabus outline):** | | | | | | | | |
| Viri ionizirajočih sevanj v okolju: naravna in umetna radioaktivnost;  Okoljska radioaktivnost v kontekstu zakonodaje: biološki učinki ionizirajočih sevanj, radiotoksičnost in meje letnega vnosa;  Disperzija in transport radionuklidov v kopenskem in vodnem okolju: kemija radionuklidov, mobilnost radionuklidov in njihove interakcije z biološko ter geološko okolico;  Ocene radioloških vplivov izpustov radionuklidov v okolje: modeliranje porazdelitve in transporta radionuklidov, ocena radiološke izpostavljenosti;  Ravnanje z radioaktivnimi snovmi v primeru izpustov v okolje: viri umetnih radionuklidov kot posledica jedrske industrije; nadzorovani izpusti;  Nenadzorovani izpusti radionuklidov v okolje in ukrepi za zmanjšanje škodljivih vplivov. | | | | | | | | | |  | | Sources of ionising radiation in the environment: natural radioactivity, manmade radioactivity;  Environmental radioactivity within legal context: biological effects of ionising radiation, radiotoxicity and annual limits of intake;  Dispersion and transfer of radionuclides in the terrestrial and aquatic environments: chemistry of radionuclides, their mobility and interactions with bio geosphere;  Assessing the radiological impact of releases of radionuclides to the environment: modelling radionuclide distribution and transport, estimating radiation exposure;  Management of radioactive releases to the environment: sources of artificial radionuclides from the nuclear industry, routine releases;  Accidental releases and countermeasures. | | | | | | | | |
| **Temeljni literatura in viri / Readings:** | | | | | | | | | | | | | | | | | | | | |
| R. J. Pentreath. Radioecology: Sources and Consequences of Ionising Radiation in the Environment. Cambridge University Press (2021), 300 str., ISBN-13: 978-1107096028  Approaches for modelling of radioecological data to identify key radionuclides and associated parameter values for human and wildlife exposure assessments, IAEA-TECDOC-1950, International Atomic Energy Agency (2021), ISBN 978-92-0-106021-1  Radiation protection of wildlife: modelling the exposure and effects, IAEA-TECDOC-1986 (2021), International Atomic Energy Agency,ISBN 978-92-0-138121-7 | | | | | | | | | | | | | | | | | | | | |
| **Cilji in kompetence:** | | | | | | | | |  | | **Objectives and competences:** | | | | | | | | | |
| Cilj predmeta je pojasniti študentu vplive ionizirajočih sevanj na ekosisteme.  Cilj se navezuje na kompetence:  Obvladovanje raziskovalnih metod, postopkov in procesov ter razvoj kritične in samokritične presoje;  Uporaba teoretskih in eksperimentalnih metod pri razreševanju problemov, povezanih z vplivi ionizirajočih sevanj na ekosisteme. | | | | | | | | |  | | The objective of the course is to explain a student the effects of ionising radiation on ecosystems.  This objective is related to competences:  Command of research methods, procedures and processes, and well-formed skills for critical judgment;  Ability to apply theoretical and experimental methods in solving problems related to the effects of ionising radiation on ecosystems. | | | | | | | | | |
| **Predvideni študijski rezultati:** | | | | | | | | | |  | **Intended learning outcomes:** | | | | | | | | | |
| Znanje in razumevanje:  Pridobitev potrebnih znanj in poglobitev razumevanja o obnašanju radioaktivnih snovi v okolju;  Pridobitev znanja o ravnanju z radioaktivnimi snovmi v primeru nenadzorovanih izpustov v okolje ali v primeru jedrskih nesreč;  Poglobitev obvladovanja raziskovalnih metod, postopkov in procesov, razvoj kritične presoje in sposobnost uporabe znanja v praksi;  Vpeljava v uporabo metod in tehnik, primernih za konkretne podiplomske projekte. | | | | | | | | | |  | Knowledge and understanding:  Acquirement of knowledge on and deepen understanding of the environmental behaviour of radioactive substances in the environment;  Acquirement of knowledge on management of radioactive substances in case of uncontrolled releases into the environment or nuclear accidents;  Mastered research methods, procedures and processes, and developed skills for critical judgement, and critical thinking in practical work;  Practical implementation of methods and techniques applicable to perform concrete postgraduate projects. | | | | | | | | | |
| **Metode poučevanja in učenja:** | | | | | | | | | |  | **Learning and teaching methods:** | | | | | | | | | |
| Predavanja;  Seminarji;  Praktično delo.  poučevanje in učenje poteka z didaktično uporabo IKT | | | | | | | | | |  | Lectures;  Seminars;  Practical work.  teaching and learning is done using didactic use of ICT | | | | | | | | | |
| **Načini ocenjevanja:** | | | | | | | Delež (v %) /  Weight (in %) | | | | | | **Assessment:** | | | | | | | |
| Način (pisni izpit, ustno izpraševanje, naloge, projekt):  pisni izpit  ustni izpit  seminarska naloga | | | | | | | **30%**  **30%**  **40%** | | | | | | Type (examination, oral, coursework, project):  written examination  oral examination  coursework | | | | | | | |
| **Reference nosilca / Lecturer's references:** | | | | | | | | | | | | | | | | | | | | |
| **SMODIŠ, Borut.** Thirty years of ko-NAA at JSI, Ljubljana : implementation, progress, achievements. Journal of radioanalytical and nuclear chemistry, ISSN 0236-5731, 2018, vol. 315, no. 3, str. 685-688, doi: 10.1007/s10967-017-5633-z. [COBISS.SI-ID 30912807], [JCR, SNIP, WoS do 16. 3. 2018: št. citatov (TC): 0, čistih citatov (CI): 0, čistih citatov na avtorja (CIAu): 0, Scopus do 10. 8. 2020: št. citatov (TC): 1, čistih citatov (CI): 0, čistih citatov na avtorja (CIAu): 0]; kategorija: 1A3 (Z); uvrstitev: SCI, Scopus, MBP; tip dela je verificiral OSICN  **SMODIŠ, Borut,** PESSOA BARRADAS, Nuno, RIDIKAS, Danas, BODE, Peter, LANDSBERGER, Sheldon. An E-learning tool as living book for knowledge preservation in neutron activation analysis. Journal of radioanalytical and nuclear chemistry, ISSN 0236-5731, [in press] 2020, 7 str., doi: 10.1007/s10967-020-07129-1. [COBISS.SI-ID 33302311], [JCR, SNIP, WoS do 24. 4. 2020: št. citatov (TC): 0, čistih citatov (CI): 0, čistih citatov na avtorja (CIAu): 0, Scopus do 1. 5. 2020: št. citatov (TC): 0, čistih citatov (CI): 0, čistih citatov na avtorja (CIAu): 0]; kategorija: 1A3 (Z); uvrstitev: SCI, Scopus, MBP; tip dela še ni verificiran  **SMODIŠ, Borut**, BENEDIK, Ljudmila, JAĆIMOVIĆ, Radojko. Analytical radiochemistry of neutron activated samples in practice. Journal of radioanalytical and nuclear chemistry, ISSN 0236-5731, 2018, vol. 318, no. 3, str. 1641-1647, doi: 10.1007/s10967-018-6275-5. [COBISS.SI-ID 31828263], [JCR, SNIP, WoS do 10. 5. 2020: št. citatov (TC): 1, čistih citatov (CI): 1, čistih citatov na avtorja (CIAu): 0.33, Scopus do 29. 3. 2020: št. citatov (TC): 1, čistih citatov (CI): 1, čistih citatov na avtorja (CIAu): 0.33]; kategorija: 1A3 (Z); uvrstitev: SCI, Scopus, MBP; tip dela je verificiral OSICN | | | | | | | | | | | | | | | | | | | | |

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| **UČNI NAČRT PREDMETA / COURSE SYLLABUS** | | | | | | | | | | | | | | | | | | | | |
| **Predmet:** | | | **IZBRANA POGLAVJA IZ ELEKTRIČNIH STROJEV** | | | | | | | | | | | | | | | | | |
| **Course title:** | | | **ELECTRIC MACHINES-SELECTED TOPICS** | | | | | | | | | | | | | | | | | |
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| **Študijski program in stopnja**  **Study programme and level** | | | | | **Študijska smer**  **Study field** | | | | | | | | | | | **Letnik**  **Academic year** | | **Semester**  **Semester** | | |
| **ENERGETIKA, 3. stopnja** | | | | | **-** | | | | | | | | | | | **1/2** | | **1/2/3** | | |
| **ENERGY TECHNOLOGY, 3. Degree** | | | | | **-** | | | | | | | | | | | **1/2** | | **1/2/3** | | |
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| **Vrsta predmeta / Course type** | | | | | | | | | | | | | | | Izbirni/Elective | | | | | |
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| **Univerzitetna koda predmeta / University course code:** | | | | | | | | | | | | | | | D | | | | | |
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| **Predavanja**  **Lectures** | **Seminar**  **Seminar** | | | **Vaje**  **Tutorial** | | | | **Klinične vaje**  **work** | | | | | | **Druge oblike študija** | | | **Samost. delo**  **Individ. work** | |  | **ECTS** |
| **30** | **-** | | | **-** | | | | **-** | | | | | | **-** | | | **150** | |  | **6** |
|  | | | | | | | | | | | | | | | | | | | | |
| **Nosilec predmeta / Lecturer:** | | | | | **BOJAN ŠTUMBERGER** | | | | | | | | | | | | | | | |
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| **Jeziki /**  **Languages:** | | **Predavanja / Lectures:** | | | | **Slovenski/Slovene** | | | | | | | | | | | | | | |
| **Vaje / Tutorial:** | | | | **Slovenski/Slovene** | | | | | | | | | | | | | | |
| **Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:** | | | | | | | | | |  | | **Prerequisits:** | | | | | | | | |
| Zahtevano predhodno znanje iz področja matematike, elektrotehnike in električnih strojev | | | | | | | | | |  | | General knowledge from the field of Mathematics, Electric machines and Electrical engineering | | | | | | | | |
| **Vsebina:** | | | | | | | | | |  | | **Content (Syllabus outline):** | | | | | | | | |
| Uvod: magnetni krogi električnih strojev, navitja električnih strojev z vrtilnim magnetnim poljem.  Analitični in numerični izračun magnetnega kroga električnih strojev.  Transformator: vklopni tok, prehodni pojav v kratkem stiku.  Asinhronski stroj: vpliv višjih harmonskih komponent na karakteristiko vrtilnega momenta, harmoniki nasičenja, asinhronski generator na lastnem omrežju.  Sinhronski stroj: sinhronski generator na lastnem omrežju, švedski diagram, V-krivulje.  Izračun reaktanc standardnih električnih strojev.  Sinhronski stroji s trajnimi magneti: oblike, način delovanja (BLAC in BLDC način delovanja).  Preklopno reluktančni stroji: način delovanja, izvedljivost-izbira kombinacije števila faz in števila polov.  Motorji in generatorji z dvojnim napajanjem brez drsnih obročev: asinhronski stroj, sinhronski stroj, preklopno reluktančni stroj.  Teorija dodatnih izgub, ležajni tokovi, hrup in vibracije.  Teorija prenosa toplote v električnih strojih. | | | | | | | | | |  | | Introduction: magnetic circuits of electric machines, windings of electric machines with revolving magnetic field.  Analytical and numerical calculation of magnetic circuits of electric machines.  Transformer: inrush current, short circuit transients.  Induction machine: influence of higher harmonic components on torque characteristic, saturation harmonics, induction generator on own network.  Synchronous machine: synchronous generator on own network, Swedish diagram, V-curves.  Reactance calculations of standard electric machines.  Permanent magnet synchronous machines: configurations, working principles (BLAC and BLDC mode).  Switched reluctance machines: working principle, feasibility-selection of phase and pole number combination.  Brushless doubly fed motors and generators: induction machine, synchronous machine, switched-reluctance machine.  Theory of additional losses, bearing currents, noise and vibrations.  Theory of heat transfer in electric machines. | | | | | | | | |
| **Temeljni literatura in viri / Readings:** | | | | | | | | | | | | | | | | | | | | |
| Recommended reading:  I. Zagradišnik: *Izbrana poglavja iz transformatorjev*, skripta, Fakulteta za elektrotehniko, računalništvo in informatiko, 1. izdaja, Maribor, 2003, ponatis Maribor, 2006.  I. Zagradišnik, B. Slemnik: *Električni rotacijski stroji*, Založba tehniških fakultet, FERI, Maribor, 2007  G. Mueller: *Elektrische Maschinen – Theorie,* VEB Verlag Technik Berlin, 1967.  R. Richter: *Elektrische Maschinen*, I-IV, Birkhäuser Verlag, Basel und Stuttgart, 1967, 1953, 1954, 1954  W. Nürnberg: *Die Asynchronmaschine*, Springer-Verlag, Berlin-Heidelberg-New-York,1979  T. A. Lipo: *Introduction to AC Machine Design*, University of Wisconsin, 1996  J. F. Gieras, C. Wang. J. C. Lai, *Noise of Polyphase Electric Motors*, Taylor&Francis, New York, 2006  J. F. Gieras, M. Wing: *Permanent Magnet Motor Technology*, Second Edition, Marcel Dekker, Inc., New York, 2002.  T. J.E. Miller: *Brushless permanent-magnet and reluctance motor drives*, Oxford University Press, Oxford, 1989.  T. J.E. Miller: *Switched Reluctance Motors and Their Control*, Magna Physics Publishing, Hillsboro, 1993.  N. Bianchi: Electrical Machine Analysis Using Finite Elements, Taylor&Francis, New York, 2005 | | | | | | | | | | | | | | | | | | | | |
| **Cilji in kompetence:** | | | | | | | | |  | | **Objectives and competences:** | | | | | | | | | |
| Študent dobi poglobljena znanja iz posebnih poglavij o električnih strojih in je seznanjen z delovanjem in zgradbo novejših izvedb električnih strojev. | | | | | | | | |  | | Student gets deeper knowledge from the field of electric machines and it is acquainted with construction and working principles of modern electric machines. | | | | | | | | | |
| **Predvideni študijski rezultati:** | | | | | | | | | |  | **Intended learning outcomes:** | | | | | | | | | |
| Znanje in razumevanje:  Globlje razumevanje principov delovanja klasičnih in novejših izvedb električnih strojev. | | | | | | | | | |  | Knowledge and understanding:  Deeper understanding of working principles of classical and modern electric machines. | | | | | | | | | |
| Prenesljive/ključne spretnosti in drugi atributi:  Reševanje problemov, ki so povezani z delovanjem klasičnih in novejših izvedb električnih strojev. | | | | | | | | | |  | Transferable/Key Skills and other attributes:  Solving problems related with working of classical and modern electric machines. | | | | | | | | | |
| **Metode poučevanja in učenja:** | | | | | | | | | |  | **Learning and teaching methods:** | | | | | | | | | |
| predavanja,  projekt,  laboratorijske vaje,  samostojno delo,  poučevanje in učenje poteka z didaktično uporabo IKT | | | | | | | | | |  | lectures,  project,  labor work,  individual work,  teaching and learning is done using didactic use of ICT | | | | | | | | | |
| **Načini ocenjevanja:** | | | | | | | Delež (v %) /  Weight (in %) | | | | | | **Assessment:** | | | | | | | |
| Način (pisni izpit, ustno izpraševanje, naloge, projekt):  pisni izpit  ustni izpit  projekt | | | | | | | **30%**  **40%**  **30%** | | | | | | Type (examination, oral, coursework, project):  written examination  oral examination  project | | | | | | | |
| **Reference nosilca / Lecturer's references:** | | | | | | | | | | | | | | | | | | | | |
| BRINOVAR, Iztok, SRPČIČ, Gregor, **ŠTUMBERGER, Bojan**, HADŽISELIMOVIĆ, Miralem, SEME, Sebastijan. Numerical analysis of the electromagnetic brake. *Przegląd Elektrotechniczny*, ISSN 2449-9544, **2019**, r. 95, nr. 1, str. 1-3, graf. prikazi, doi: [10.15199/48.2019.01.01](https://doi.org/10.15199/48.2019.01.01). [COBISS.SI-ID [1024332380](https://plus.si.cobiss.net/opac7/bib/1024332380?lang=sl)]  SRPČIČ, Gregor, BRINOVAR, Iztok, HADŽISELIMOVIĆ, Miralem, **ŠTUMBERGER, Bojan**, SEME, Sebastijan. Numerical modelling of linear generators. *Przegląd Elektrotechniczny*, ISSN 2449-9544, **2019**, r. 95, nr. 1, str. 4-6, graf. prikazi, doi: [10.15199/48.2019.01.02](https://doi.org/10.15199/48.2019.01.02). [COBISS.SI-ID [1024332636](https://plus.si.cobiss.net/opac7/bib/1024332636?lang=sl)],  IGREC, Dalibor, CHOWDHURY, Amor, **ŠTUMBERGER, Bojan**, SARJAŠ, Andrej. Robust tracking system design for a synchronous reluctance motor - SynRM based on a new modified bat optimization algorithm. *Applied soft computing*, ISSN 1568-4946. [Print ed.], aug. **2018**, vol. 69, str. 568-584, doi: [10.1016/j.asoc.2018.05.002](https://doi.org/10.1016/j.asoc.2018.05.002). [COBISS.SI-ID [1024306524](https://plus.si.cobiss.net/opac7/bib/1024306524?lang=sl)]  SEME, Sebastijan, SREDENŠEK, Klemen, PRAUNSEIS, Zdravko, **ŠTUMBERGER, Bojan**, HADŽISELIMOVIĆ, Miralem. Optimal price of electricity of solar power plants and small hydro power plants : technical and economical part of investments. *Energy*, ISSN 0360-5442. [Print ed.], avg. **2018**, vol. 157, str. 87-95, graf. prikazi, doi: [10.1016/j.energy.2018.05.121](https://doi.org/10.1016/j.energy.2018.05.121). [COBISS.SI-ID [1024307804](https://plus.si.cobiss.net/opac7/bib/1024307804?lang=sl)]  MARČIČ, Tine, **ŠTUMBERGER, Bojan**, ŠTUMBERGER, Gorazd. Differential-evolution-based parameter Identification of a line-start IPM synchronous motor. *IEEE transactions on industrial electronics*, ISSN 0278-0046. [Print ed.], Nov. **2014**, vol. 61, iss. 11, str. 5921-5929, doi: [10.1109/TIE.2014.2308160](https://doi.org/10.1109/TIE.2014.2308160). [COBISS.SI-ID [17638166](https://plus.si.cobiss.net/opac7/bib/17638166?lang=sl)] | | | | | | | | | | | | | | | | | | | | | |

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| **UČNI NAČRT PREDMETA / COURSE SYLLABUS** | | | | | | | | | | | | | | | | | | | | |
| **Predmet:** | | | **PRETVARJANJE V ELEKTRIČNO ENERGIJO IN SHRANJEVANJE ENERGIJE** | | | | | | | | | | | | | | | | | |
| **Course title:** | | | **ENERGY CONVERSION AND ENERGY STORAGE** | | | | | | | | | | | | | | | | | |
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| **Študijski program in stopnja**  **Study programme and level** | | | | | **Študijska smer**  **Study field** | | | | | | | | | | | **Letnik**  **Academic year** | | **Semester**  **Semester** | | |
| **ENERGETIKA, 3. stopnja** | | | | | **-** | | | | | | | | | | | **1/2** | | **1/2/3** | | |
| **ENERGY TECHNOLOGY, 3. Degree** | | | | | **-** | | | | | | | | | | | **1/2** | | **1/2/3** | | |
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| **Vrsta predmeta / Course type** | | | | | | | | | | | | | | | Izbirni/Elective | | | | | |
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| **Univerzitetna koda predmeta / University course code:** | | | | | | | | | | | | | | | D | | | | | |
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| **Predavanja**  **Lectures** | **Seminar**  **Seminar** | | | **Vaje**  **Tutorial** | | | | **Klinične vaje**  **work** | | | | | | **Druge oblike študija** | | | **Samost. delo**  **Individ. work** | |  | **ECTS** |
| **30** | **-** | | | **-** | | | | **-** | | | | | | **-** | | | **150** | |  | **6** |
|  | | | | | | | | | | | | | | | | | | | | |
| **Nosilec predmeta / Lecturer:** | | | | | **GORAZD ŠTUMBERGER** | | | | | | | | | | | | | | | |
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| **Jeziki /**  **Languages:** | | **Predavanja / Lectures:** | | | | **Slovenski/Slovene** | | | | | | | | | | | | | | |
| **Vaje / Tutorial:** | | | | **Slovenski/Slovene** | | | | | | | | | | | | | | |
| **Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:** | | | | | | | | | |  | | **Prerequisits:** | | | | | | | | |
| Ni posebnih obveznosti: | | | | | | | | | |  | | No prerequisits. | | | | | | | | |
| **Vsebina:** | | | | | | | | | |  | | **Content (Syllabus outline):** | | | | | | | | |
| Principi pretvarjanja v električno energijo: elekro-mehanska pretvorba, elektro-kemična pretvorba, termo-električna pretvorba;foto-električna pretvorba, magneto-hidravlična pretvorba, električno-električna pretvorba.  Uporaba principov pretvarjanja energije v proizvodnji, prenosu, razdeljevanju in rabi energije.  Principi shranjevanja energija in njihova uporaba: črpalne hidroelektrarne; plinske turbine s hranilniki stisnjenega zraka; vztrajniki; superprevodni in porazdeljenimi superprevodni magneti, super kondenzatorji, pretočni akumulatorji; akumulatorji. | | | | | | | | | |  | | Principles of energy conversion: electro-mechanical conversion, electro-chemical conversion, thermo-electrical conversion, photo-electrical conversion, magneto-hydrodynamic conversion, electrical-electrical conversion.  Applications of energy conversion principles in electric power generation, transmission, distribution, and usage.  Energy storage principles and their applications in: pumped hydroelectric energy storage; compressed air energy storage; flywheels; superconducting magnet and distributed superconducting magnet energy storage systems; super capacitor energy storage systems; flow batteries, batteries. | | | | | | | | |
| **Temeljni literatura in viri / Readings:** | | | | | | | | | | | | | | | | | | | | |
| A. Rufer, Energy Storage Systems and Components, London: CRC Press, 2018  P. Komarnicki et al, Electric Energy Storage Systems, Springer, 2017.  B. Robyns et al, Energy Storage in Electric Power Grids, London: Wiley, 2015.  Y. Demirel, Energy Production, Conversion, Strage, Conservation and Coupling, Springer, 2016  K. R. Khalilpour et all. Comunity Energy Networks With Storage, Springer, 2016  A. F, Zobaa, Energy Storage at Different Voltage Levels, IET, 2018  L. Zhang et al, Lithium-Ion Supercapacitors: Fundamentals and Energy Applications, CRC, 2018  B. Zohuri, Hybrid Energy Systems: Driving Reliable Renewable Sources of Energy Storage, Springer 2017 | | | | | | | | | | | | | | | | | | | | |
| **Cilji in kompetence:** | | | | | | | | |  | | **Objectives and competences:** | | | | | | | | | |
| Seznaniti študente s različnimi sistemi za pretvorbo in shranjevanje energije, z njihovimi izvedbami in z možnostjo njihove uporabe. Poseben poudarek je dan na sistemih, ki so primerni za shranjevanje energije v kombinaciji s sistemi za proizvodnjo električne energije in obnovljivimi viri. | | | | | | | | |  | | Students become familiar with different energy conversion and energy storage systems, with different realizations of these systems and with their advantages and drawbacks. A special attention is paid to the energy storage systems which are appropriate to be used together with electric power generation units and renewable energy sources. | | | | | | | | | |
| **Predvideni študijski rezultati:** | | | | | | | | | |  | **Intended learning outcomes:** | | | | | | | | | |
| Znanje in razumevanje:  Poglobljeno razumevanje teoretskih in metodoloških konceptov ter usposobljenost za samostojno razvijanje novega znanja in reševanje najzahtevnejših problemov delovanja različnih sistemov za pretvorbo in shranjevanje energije. | | | | | | | | | |  | Knowledge and Understanding:  In-depth understanding of theoretical and methodological concepts and the ability to independently develop new knowledge and solving the most challenging problems of different energy conversion and energy storage systems. | | | | | | | | | |
| Prenesljive/ključne spretnosti in drugi atributi:  Poznavanje različnih sistemov za pretvorbo in shranjevanje energije. | | | | | | | | | |  | Transferable/Key Skills and other attributes:  Knowledge of different energy conversion and energy storage systems. | | | | | | | | | |
| **Metode poučevanja in učenja:** | | | | | | | | | |  | **Learning and teaching methods:** | | | | | | | | | |
| predavanja,  projekt  seminarske vaje  samostojno delo  poučevanje in učenje poteka z didaktično uporabo IKT | | | | | | | | | |  | Lectures  project  tutorial  individual work  teaching and learning is done using didactic use of ICT | | | | | | | | | |
| **Načini ocenjevanja:** | | | | | | | Delež (v %) /  Weight (in %) | | | | | | **Assessment:** | | | | | | | |
| pisni izpit,  ustno izpraševanje  naloge,  projekt | | | | | | | **30%**  **30%**  **20%**  **20%** | | | | | | examination,  oral,  coursework,  project | | | | | | | |
| **Reference nosilca / Lecturer's references:** | | | | | | | | | | | | | | | | | | | | |
| SUKIČ, Primož, PETRUN, Martin, **ŠTUMBERGER, Gorazd,** KLOPČIČ, Beno, DOLINAR, Drago, ČERNELIČ, Jernej. Device and method for detecting the iron core saturation of a resistance spot welding transformer utilising measurement of the primary current of the transformer: European patent specification EP 3 079 162 B1, 2019-09-04. Munich: European Patent Office, 2019. 19 f., ilustr. [COBISS.SI-ID 20065046] patentna družina: EP3079162 (A1), 2016-10-12; P-201500091, 2015-04-10; SI 24979 (A), 2016-10-28  **ŠTUMBERGER, Gorazd**, ŠTUMBERGER, Bojan, MARČIČ, Tine. Magnetically nonlinear dynamic models of synchronous machines and experimental methods for determining their parameters. Energies. 2019, vol. 12, no. 18, str. 1-22. ISSN 1996-1073. DOI: 10.3390/en12183519. [COBISS.SI-ID 22575126]  PLANTIĆ, Željko, MARČIČ, Tine, BEKOVIĆ, Miloš, **ŠTUMBERGER, Gorazd**. Sensorless PMSM drive implementation by introduction of maximum efficiency characteristics in reference current generation. Energies. 2019, vol. 12, no. 8, str. 1-14. ISSN 1996-1073. DOI: 10.3390/en12183502. [COBISS.SI-ID 22573078] | | | | | | | | | | | | | | | | | | | | |

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| **UČNI NAČRT PREDMETA / COURSE SYLLABUS** | | | | | | | | | | | | | | | | | | | | |
| **Predmet:** | | | **IZBRANA POGLAVJA IZ MATEMATIKE** | | | | | | | | | | | | | | | | | |
| **Course title:** | | | **SELECTED TOPICS FROM MATHEMATICS** | | | | | | | | | | | | | | | | | |
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| **Študijski program in stopnja**  **Study programme and level** | | | | | **Študijska smer**  **Study field** | | | | | | | | | | | **Letnik**  **Academic year** | | **Semester**  **Semester** | | |
| **ENERGETIKA, 3. stopnja** | | | | | **-** | | | | | | | | | | | **1/2** | | **1/2/3** | | |
| **ENERGY TECHNOLOGY, 3. Degree** | | | | | **-** | | | | | | | | | | | **1/2** | | **1/2/3** | | |
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| **Vrsta predmeta / Course type** | | | | | | | | | | | | | | | Izbirni/Elective | | | | | |
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| **Univerzitetna koda predmeta / University course code:** | | | | | | | | | | | | | | | D | | | | | |
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| **Predavanja**  **Lectures** | **Seminar**  **Seminar** | | | **Vaje**  **Tutorial** | | | | **Klinične vaje**  **work** | | | | | | **Druge oblike študija** | | | **Samost. delo**  **Individ. work** | |  | **ECTS** |
| **30** | **-** | | | **-** | | | | **-** | | | | | | **-** | | | **150** | |  | **6** |
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| **Nosilec predmeta / Lecturer:** | | | | | **JANEZ USENIK** | | | | | | | | | | | | | | | |
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| **Jeziki /**  **Languages:** | | **Predavanja / Lectures:** | | | | **Slovenski/Slovene** | | | | | | | | | | | | | | |
| **Vaje / Tutorial:** | | | | **Slovenski/Slovene** | | | | | | | | | | | | | | |
| **Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:** | | | | | | | | | |  | | **Prerequisits:** | | | | | | | | |
| Predhodno znanje matematike na nivoju univerzitetnega študijskega programa energetika. | | | | | | | | | |  | | General knowledge of mathematics on graduate level in study programm »energy technology«. | | | | | | | | |
| **Vsebina:** | | | | | | | | | |  | | **Content (Syllabus outline):** | | | | | | | | |
| * kompleksna analiza   + analitične funkcije   + Cauchy-Riemanova enačba, Laplaceova enačba   + Geometrija analitičnih funkcij, konformne preslikave   + Kompleksni integral   + Analitične vrste   + residui * kompleksne Fourierove vrste * parcialne diferencialne enačbe * Fourierova metoda * Laplaceova enačba * Nihanje strune * Prenos toplote * Nihanje opne | | | | | | | | | |  | | * complex analysis   + analytic functions   + Cauchy-Riemanova equation, Laplace´s equation   + Geometry of analytic functions, conformal mapping   + Complex integration   + Analitycal series   + Residues * Complex Fourier series * Partial differential equations * Use of Fourier series * Laplace´s equation * Vibrating string, wave equation * Heat equation * Circular membrane | | | | | | | | |
| **Temeljni literatura in viri / Readings:** | | | | | | | | | | | | | | | | | | | | |
| Kreyszig, Erwin: Advanced engineering mathematics, John Willey&Sons, 1999.  Križanič, France: Linearna algebra in linearna analiza, Mladinska knjiga, Ljubljana, 1969.  Usenik, Janez: Zapiski predavanj. | | | | | | | | | | | | | | | | | | | | |
| **Cilji in kompetence:** | | | | | | | | |  | | **Objectives and competences:** | | | | | | | | | |
| Študenti pridobijo poglobljena znanja s področja matematične analize, ki jo uporabljajo kot temeljno orodje pri reševanju praktičnih inženirskih problemov. | | | | | | | | |  | | Students get deeper insight into mathematical analysis, using in solving of the sophisticated engineering problems in connection with practical problems. | | | | | | | | | |
| **Predvideni študijski rezultati:** | | | | | | | | | |  | **Intended learning outcomes:** | | | | | | | | | |
| Znanje in razumevanje:  Poglobljeno razumevanje teoretskih in metodoloških konceptov klasične matematične analize ter usposobljenost za samostojno razvijanje novega znanja in reševanje najzahtevnejših problemov. | | | | | | | | | |  | Knowledge and understanding:.  Indepth understanding of theoretical and methodological concepts of the classical mathematical analysis and the ability to independently develop new knowledge and solving the most challenging problems. | | | | | | | | | |
| Prenesljive/ključne spretnosti in drugi atributi:  Kombinirana uporaba različnih matematičnih znanj za reševanje inženirskih problemov. | | | | | | | | | |  | Transferable/Key skills and other attributes:  Ccombined use of differentmathematical fundamental skills for solution of engineering problems. | | | | | | | | | |
| **Metode poučevanja in učenja:** | | | | | | | | | |  | **Learning and teaching methods:** | | | | | | | | | |
| Predavanja.  samostojno reševanje nalog  Seminarska naloga  poučevanje in učenje poteka z didaktično uporabo IKT | | | | | | | | | |  | Lectures.  individual solving of problems  Seminar work  teaching and learning is done using didactic use of ICT | | | | | | | | | |
| **Načini ocenjevanja:** | | | | | | | Delež (v %) /  Weight (in %) | | | | | | **Assessment:** | | | | | | | |
| Način (pisni izpit, ustno izpraševanje, naloge, projekt):  pisni izpit  ustni izpit  projektno delo | | | | | | | **30%**  **30%**  **40%** | | | | | | Type (examination, oral, coursework, project):  written examination  oral examination  project work | | | | | | | |
| **Reference nosilca / Lecturer's references:** | | | | | | | | | | | | | | | | | | | | |
| VIDIČEK, Meta, VIDIČEK, Matija, USENIK, Janez. Fuzzy approach to determining the sustainability index of energy using biomass. Journal of landscape governance : JLG, ISSN 2463-9834, May 2017, vol. 2, iss. 1, str. 57-65, ilustr. <https://docs.google.com/a/vsgrm.unm.si/viewer?a=v&pid=sites&srcid=dW5tLnNpfHZzZ3JtdW5tfGd4OjE1YTUxODc4ZjdiY2RlMA>. [COBISS.SI-ID [2048427266](https://plus.si.cobiss.net/opac7/bib/2048427266?lang=sl)]  USENIK, Janez. Generalizirano zvezno variabilno dinamično linearno programiranje : (generalizirano c/b/A - ZDLP) : [znanstvena monografija]. 1. izd. Novo mesto: Fakulteta za industrijski inženiring, 2017. 201 str., ilustr. ISBN 978-961-94246-2-9. [COBISS.SI-ID [292963328](https://plus.si.cobiss.net/opac7/bib/292963328?lang=sl)]  USENIK, Janez. Differential equations, difference equations and fuzzy logic in control of dynamic systems = Diferencialne enačbe, diferenčne enačbe in mehka logika v upravljanju dinamičnih sistemov. Journal of energy technology, ISSN 1855-5748. [Tiskana izd.], aug. 2016, vol. 9, iss. 2, str. 39-54, graf. prikazi. [COBISS.SI-ID [1024237916](https://plus.si.cobiss.net/opac7/bib/1024237916?lang=sl)]  USENIK, Janez, VIDIČEK, Meta, VIDIČEK, Matija. Logistics system with fuzzy inputs. V: LISEC, Andrej (ur.). Proceedings. Celje: Faculty of Logistics. 2014, [9] f., tabele, graf. prikazi. [COBISS.SI-ID [2048247042](https://plus.si.cobiss.net/opac7/bib/2048247042?lang=sl)]  USENIK, Janez, VIDIČEK, Meta, VIDIČEK, Matija. Decision making in the control of the logistic system with stochastic or fuzzy variables. V: LISEC, Andrej (ur.). Proceedings. Celje: Faculty of Logistics. 2014, [11] f., tabele, graf. prikazi. [COBISS.SI-ID [2048246786](https://plus.si.cobiss.net/opac7/bib/2048246786?lang=sl)] | | | | | | | | | | | | | | | | | | | | |

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| **UČNI NAČRT PREDMETA / COURSE SYLLABUS** | | | | | | | | | | | | | | | | | | | | |
| **Predmet:** | | | **MEHKO LINEARNO PROGRAMIRANJE** | | | | | | | | | | | | | | | | | |
| **Course title:** | | | **FUZZY LINEAR PROGRAMMING** | | | | | | | | | | | | | | | | | |
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| **Študijski program in stopnja**  **Study programme and level** | | | | | **Študijska smer**  **Study field** | | | | | | | | | | | **Letnik**  **Academic year** | | **Semester**  **Semester** | | |
| **ENERGETIKA, 3. stopnja** | | | | | **-** | | | | | | | | | | | **1/2** | | **1/2/3** | | |
| **ENERGY TECHNOLOGY, 3. Degree** | | | | | **-** | | | | | | | | | | | **1/2** | | **1/2/3** | | |
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| **Vrsta predmeta / Course type** | | | | | | | | | | | | | | | Izbirni/Elective | | | | | |
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| **Univerzitetna koda predmeta / University course code:** | | | | | | | | | | | | | | | D | | | | | |
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| **Predavanja**  **Lectures** | **Seminar**  **Seminar** | | | **Vaje**  **Tutorial** | | | | **Klinične vaje**  **work** | | | | | | **Druge oblike študija** | | | **Samost. delo**  **Individ. work** | |  | **ECTS** |
| **30** | **-** | | | **-** | | | | **-** | | | | | | **-** | | | **150** | |  | **6** |
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| **Nosilec predmeta / Lecturer:** | | | | | **JANEZ USENIK** | | | | | | | | | | | | | | | |
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| **Jeziki /**  **Languages:** | | **Predavanja / Lectures:** | | | | **Slovenski/Slovene** | | | | | | | | | | | | | | |
| **Vaje / Tutorial:** | | | | **Slovenski/Slovene** | | | | | | | | | | | | | | |
| **Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:** | | | | | | | | | |  | | **Prerequisits:** | | | | | | | | |
| Predhodno znanje operacijskih raziskav na nivoju univerzitetnega študijskega programa energetika. | | | | | | | | | |  | | General knowledge of operation research on graduate level in study programm »energy technology«. | | | | | | | | |
| **Vsebina:** | | | | | | | | | |  | | **Content (Syllabus outline):** | | | | | | | | |
| * Problem linearnega programiranje, Dantzigov pristop * Simpleksni algoritem * Postoptimalna senzitivnostna analiza * Mehka logika * Mehke množice, mehka števila * Rangiranje mehkih števil * Mehko sklepanje * Uvedba mehkega pristopa v linearni program * Mehki linearni program (MLP) glede na   + Mehke elemente matrike B   + Mehke elemente matrike A   + Mehke elemente matrike C * Optimalna rešitev * Simpleksni algoritem za MLP * Računalniški programi * Aplikacije v energetskem sistemu | | | | | | | | | |  | | * Linear programming problem, Dantzig approach * Simplex algorithem * Postoptimal sensivity analysis * Fuzzy logic * Fuzzy sets, fuzzy numbers * Rank of fuzzy numbers * Fuzzy inference * Fuzzy approach in linear programming problems * Fuzzy linear programming (FLP) regards to   + Fuzzy elements of matrix B   + Fuzzy elements of matrix A   + Fuzzy elements of matrix C * Optimal solution * Simplex algorithm for FLP * Software programms * Aplications in energy system | | | | | | | | |
| **Temeljni literatura in viri / Readings:** | | | | | | | | | | | | | | | | | | | | |
| Ross, J., T.: Fuzzy Logic with Engineering Applications, second edition, John Wiley&Sons Ltd,The Atrium, Southern  Gate, Chichester, 2004.  Teodorović, D., Vukadinović, K., Traffic Control and Transport Planning: A Fuzzy Sets and Neural Networks Approach, Kluwer Academic Publishers, Dordrecht, 1998.  Zimmermann, H.J.: Fuzzy Set Theory - and Its Applications, 4th edition, Kluwer Academic Publishers, Dordrecht, 2001.  Usenik, Janez: Zapiski predavanj. | | | | | | | | | | | | | | | | | | | | |
| **Cilji in kompetence:** | | | | | | | | |  | | **Objectives and competences:** | | | | | | | | | |
| Študenti pridobijo poglobljena znanja s področja optimiranja in uporabe mehke logike, ki jih uporabljajo kot učinkovito orodje pri reševanju praktičnih inženirskih problemov. | | | | | | | | |  | | Students get deeper insight into optimisation field and fuzzy logic, using as very effective tools in solving of the sophisticated engineering problems in connection with practical problems. | | | | | | | | | |
| **Predvideni študijski rezultati:** | | | | | | | | | |  | **Intended learning outcomes:** | | | | | | | | | |
| Znanje in razumevanje:  Poglobljeno razumevanje teoretskih in metodoloških konceptov problemov optimizacije z mehkim pristopom ter usposobljenost za samostojno razvijanje novega znanja in reševanje najzahtevnejših problemov. | | | | | | | | | |  | Knowledge and understanding:.  Indepth understanding of theoretical and methodological concepts otpimization problems with fuzzy approach and the ability to independently development of teh new knowledge and solving the most challenging problems. | | | | | | | | | |
| Prenesljive/ključne spretnosti in drugi atributi:  Kombinirana uporaba različnih matematičnih znanj za reševanje inženirskih problemov. | | | | | | | | | |  | Transferable/Key skills and other attributes:  Ccombined use of different mathematical fundamental skills for solution of engineering problems. | | | | | | | | | |
| **Metode poučevanja in učenja:** | | | | | | | | | |  | **Learning and teaching methods:** | | | | | | | | | |
| Predavanja.  samostojno reševanje nalog  Seminarska naloga  poučevanje in učenje poteka z didaktično uporabo IKT | | | | | | | | | |  | Lectures.  individual solving of problems  Seminar work  teaching and learning is done using didactic use of ICT | | | | | | | | | |
| **Načini ocenjevanja:** | | | | | | | Delež (v %) /  Weight (in %) | | | | | | **Assessment:** | | | | | | | |
| Način (pisni izpit, ustno izpraševanje, naloge, projekt):  pisni izpit  ustni izpit  projektno delo | | | | | | | **30%**  **30%**  **40%** | | | | | | Type (examination, oral, coursework, project):  written examination  oral examination  project work | | | | | | | |
| **Reference nosilca / Lecturer's references:** | | | | | | | | | | | | | | | | | | | | |
| VIDIČEK, Meta, VIDIČEK, Matija, USENIK, Janez. Fuzzy approach to determining the sustainability index of energy using biomass. Journal of landscape governance : JLG, ISSN 2463-9834, May 2017, vol. 2, iss. 1, str. 57-65, ilustr. <https://docs.google.com/a/vsgrm.unm.si/viewer?a=v&pid=sites&srcid=dW5tLnNpfHZzZ3JtdW5tfGd4OjE1YTUxODc4ZjdiY2RlMA>. [COBISS.SI-ID [2048427266](https://plus.si.cobiss.net/opac7/bib/2048427266?lang=sl)]  USENIK, Janez. Generalizirano zvezno variabilno dinamično linearno programiranje : (generalizirano c/b/A - ZDLP) : [znanstvena monografija]. 1. izd. Novo mesto: Fakulteta za industrijski inženiring, 2017. 201 str., ilustr. ISBN 978-961-94246-2-9. [COBISS.SI-ID [292963328](https://plus.si.cobiss.net/opac7/bib/292963328?lang=sl)]  USENIK, Janez. Differential equations, difference equations and fuzzy logic in control of dynamic systems = Diferencialne enačbe, diferenčne enačbe in mehka logika v upravljanju dinamičnih sistemov. Journal of energy technology, ISSN 1855-5748. [Tiskana izd.], aug. 2016, vol. 9, iss. 2, str. 39-54, graf. prikazi. [COBISS.SI-ID [1024237916](https://plus.si.cobiss.net/opac7/bib/1024237916?lang=sl)]  USENIK, Janez, VIDIČEK, Meta, VIDIČEK, Matija. Logistics system with fuzzy inputs. V: LISEC, Andrej (ur.). Proceedings. Celje: Faculty of Logistics. 2014, [9] f., tabele, graf. prikazi. [COBISS.SI-ID [2048247042](https://plus.si.cobiss.net/opac7/bib/2048247042?lang=sl)]  USENIK, Janez, VIDIČEK, Meta, VIDIČEK, Matija. Decision making in the control of the logistic system with stochastic or fuzzy variables. V: LISEC, Andrej (ur.). Proceedings. Celje: Faculty of Logistics. 2014, [11] f., tabele, graf. prikazi. [COBISS.SI-ID [2048246786](https://plus.si.cobiss.net/opac7/bib/2048246786?lang=sl)] | | | | | | | | | | | | | | | | | | | | |

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| **UČNI NAČRT PREDMETA / COURSE SYLLABUS** | | | | | | | | | | | | | | | | | | | | |
| **Predmet:** | | | **IZBRANA POGLAVJA IZ ELEKTROENERGETSKIH SISTEMOV** | | | | | | | | | | | | | | | | | |
| **Course title:** | | | **SELECTED TOPICS ON POWER SYSTEMS** | | | | | | | | | | | | | | | | | |
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| **Študijski program in stopnja**  **Study programme and level** | | | | | **Študijska smer**  **Study field** | | | | | | | | | | | **Letnik**  **Academic year** | | **Semester**  **Semester** | | |
| **ENERGETIKA, 3. stopnja** | | | | | **-** | | | | | | | | | | | **1/2** | | **1/2/3** | | |
| **ENERGY TECHNOLOGY, 3. Degree** | | | | | **-** | | | | | | | | | | | **1/2** | | **1/2/3** | | |
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| **Vrsta predmeta / Course type** | | | | | | | | | | | | | | | Izbirni/Elective | | | | | |
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| **Univerzitetna koda predmeta / University course code:** | | | | | | | | | | | | | | | D | | | | | |
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| **Predavanja**  **Lectures** | **Seminar**  **Seminar** | | | **Vaje**  **Tutorial** | | | | **Klinične vaje**  **work** | | | | | | **Druge oblike študija** | | | **Samost. delo**  **Individ. work** | |  | **ECTS** |
| **30** | **-** | | | **-** | | | | **-** | | | | | | **-** | | | **150** | |  | **6** |
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| **Nosilec predmeta / Lecturer:** | | | | | **PETER VIRTIČ** | | | | | | | | | | | | | | | |
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| **Jeziki /**  **Languages:** | | **Predavanja / Lectures:** | | | | **Slovenski/Slovene** | | | | | | | | | | | | | | |
| **Vaje / Tutorial:** | | | | **Slovenski/Slovene** | | | | | | | | | | | | | | |
| **Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:** | | | | | | | | | |  | | **Prerequisits:** | | | | | | | | |
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| **Vsebina:** | | | | | | | | | |  | | **Content (Syllabus outline):** | | | | | | | | |
| Merjenja, sistemi za zajemanje podatkov in sistemi za spremljanje.  Obdelava, analiza in vizualizacija podatkov.  Vodenje, spoznavnost, nadzor in zaščita v EES.  Neposredna pretvorba neelektričnih veličin v električne.  Analiza karakteristik elektroenergetskega sistema (EES).  Komponente in topologije EES.  Upravljanje s fleksibilnostmi in težje predvidljivimi viri v EES.  Povezljivost, komunikacije, platforme in programska oprema v EES.  Hranilniki energije.  Povezljivost med električno energijo, toploto in e-mobilnostjo.  Optimiranje in ekonomika obratovanja EES.  Načrtovanje električnih strojev.  Zakonodaja in predpisi v EES.  Energetska učinkovitost in obnovljivi viri energije.  Okoljski vplivi obratovanja EES. | | | | | | | | | |  | | Measurements, data acquisition systems and monitoring systems.  Data processing, analysis and visualization.  Control, observability, supervision and protection in power systems.  Direct conversion of non-electrical into electrical quantities.  Power system characteristics analysis.  Power system components and topologies.  Management of power system flexibility and hardly predicable energy sources.  Connectivities, communications, platforms and software in power systems.  Energy storage systems.  Connectivity between electrical energy, heat and e-mobility.  Optimization and economy of power systems operation.  Design of electrical machines.  Legislation and regulations on power systems.  Energy efficiency and renewable energy sources.  Environmental impacts of power systems operation. | | | | | | | | |
| **Temeljni literatura in viri / Readings:** | | | | | | | | | | | | | | | | | | | | |
| Recommended reading:  J. Voršič, T. Zorič, M. Horvat, Izračun obratovalnih stanj v elektroenergetskih omrežjih, Univerza v Mariboru, Maribor, 2009.  Conejo, Antonio J., Baringo, Luis, Power System Operations, Springer International Publishing, 2018.  Peddapelli, S.K., & Virtic, P. (Eds.), Wind and Solar Energy Applications: Technological Challenges and Advances (1st ed.), CRC Press, 2023. https://doi.org/10.1201/9781003321897. | | | | | | | | | | | | | | | | | | | | |
| **Cilji in kompetence:** | | | | | | | | |  | | **Objectives and competences:** | | | | | | | | | |
| Cilji:   1. Pridobitev poglobljenih znanj iz posameznih področij elektroenergetskih sistemov. 2. Usposobljenost za izvajanje sinteze pridobljenih znanj v okviru tega predmeta v delovna okolja in druge kontekste. 3. Usposobljenost za analitični pristop k reševanju problemov na posameznem področju elektroenergetskih sistemov in vrednotenja rešitev problemov.   Kompetence:  Sposobnost poglobljenega analiziranja posameznih področij elektroenergetskih sistemov, samostojnega pridobivanja novih znanj, sinteze novo pridobljenih znanj z obstoječimi kompetencami ter vrednotenja rezultatov sinteze in analize. | | | | | | | | |  | | Objectives:   1. Acquisition of in-depth knowledge from individual areas of electric power systems. 2. The ability to synthesize acquired knowledge within this course into working environments and other contexts. 3. The ability for an analytical approach to solving problems in a particular field of electric power systems and evaluating solutions to problems.   Competences:  The ability to analyse individual areas of electric power systems in depth, independently acquire new knowledge, synthesize newly acquired knowledge with existing competencies, and evaluate the results of synthesis and analysis.  . | | | | | | | | | |
| **Predvideni študijski rezultati:** | | | | | | | | | |  | **Intended learning outcomes:** | | | | | | | | | |
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| Znanje in razumevanje:  Po zaključku tega predmeta bo študent sposoben:   1. poiskati znanstveno in strokovno literaturo iz področja elektroenergetskih sistemov; 2. vrednotiti predhodno pridobljena znanja ter poglobljena znanja pridobljena z analizo in sintezo s pomočjo primerjave z že objavljenimi publikacijami; 3. analizirati izbrano področje iz elektroenergetskih sistemov z namenom pridobitve pregleda in širine nad področjem ter boljše umestitve novo pridobljenih poglobljenih znanj; 4. preučiti teoretična, algoritemska in matematična ozadja komercialne in druge programske opreme, v primeru njene uporabe v okviru izbranih poglavij elektroenergetskih sistemov; 5. sestaviti poročila po IMRAD shemi v primeru zahteve izbranega poglavja v elektroenergetskih sistemih.   Prenosljive/ključne spretnosti in drugi atributi:   1. nadgrajevanje znanja s pred tem že pridobljenimi znanji   povezovanje pridobljenega znanja s področjem dela v svojem delovnem okolju | | | | | | | | | |  | Knowledge and Understanding:  Upon completion of this course, the student will be able to:   1. search for scientific and professional literature in the field of electric power systems. 2. to evaluate previously acquired knowledge and in-depth knowledge gained through analysis and synthesis through comparison with already published publications; 3. to analyse the selected area from electric power systems in order to gain an overview and breadth above the field and better position of newly acquired in-depth knowledge; 4. examine the theoretical, algorithmic and mathematical backgrounds of commercial and other software, if used within selected chapters of electricity systems; 5. prepare reports according to the IMRAD scheme in case of a request of the selected chapter in power systems.   Transferable/Key Skills and other attributes:   1. upgrading knowledge with previously acquired knowledge 2. linking the acquired knowledge with the field of work in your work environment | | | | | | | | | |
| **Metode poučevanja in učenja:** | | | | | | | | | |  | **Learning and teaching methods:** | | | | | | | | | |
| Predavanja ali konzultacije: pri predavanjih ali konzultacijah študent pridobi potrebne informacije, ki jih potrebuje za samostojno delo na določenem področju elektroenergetskih sistemov.  Samostojno delo: na osnovi konzultacij študent opravi samostojno delo in pripravi poročilo o samostojnem delu. | | | | | | | | | |  | Lectures or consultations: in lectures or consultations, students obtain the necessary information they need for independent work in a particular field of electric power systems.  Independent work: on the basis of consultations, the student performs independent work and prepares a report on independent work. | | | | | | | | | |
| **Načini ocenjevanja:** | | | | | | | Delež (v %) /  Weight (in %) | | | | | | **Assessment:** | | | | | | | |
| Način (pisni izpit, ustno izpraševanje, naloge, projekt):  Pisni izpit  Projekt in/ali poročilo | | | | | | | **50 %**  **50 %** | | | | | | Type (examination, oral, coursework, project):  Written exam  Project and/or report | | | | | | | |
| **Reference nosilca / Lecturer's references:** | | | | | | | | | | | | | | | | | | | | |
| LOKAR, Jan, **VIRTIČ, Peter**. The potential for integration of hydrogen for complete energy self-sufficiency in residential buildings with photovoltaic and battery storage systemstechnologies. International Journal of Hydrogen Energy. [Online ed.]. 2020, vol. 45, issue 60, str. 34566-34578. ISSN 1879-3487 <https://www.sciencedirect.com/science/article/pii/S0360319920315743?via%3Dihub>, DOI: [10.1016/j.ijhydene.2020.04.170](https://dx.doi.org/10.1016/j.ijhydene.2020.04.170). [COBISS.SI-ID [15605507](https://plus.si.cobiss.net/opac7/bib/15605507?lang=sl)]  **VIRTIČ, Peter**, KOVAČIČ LUKMAN, Rebeka. A photovoltaic net metering system and its environmental performance : a case study from Slovenia. Journal of cleaner production. [Online ed.]. 2019, 212, str. 334-342. ISSN 1879-1786. DOI: 10.1016/j.jclepro.2018.12.035. [COBISS.SI-ID 1024330332]  MARKOVIČ, Rene, GOSAK, Marko, GRUBELNIK, Vladimir, MARHL, Marko, **VIRTIČ, Peter**. Data-driven classification of residential energy consumption patterns by means of functional connectivity networks. Applied energy. 2019, vol. 242, str. 506-515, graf. prikazi. ISSN 0306-2619. DOI: [10.1016/j.apenergy.2019.03.134](https://dx.doi.org/10.1016/j.apenergy.2019.03.134). [COBISS.SI-ID [1024346460](https://plus.si.cobiss.net/opac7/bib/1024346460?lang=sl)] | | | | | | | | | | | | | | | | | | | | |

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| **UČNI NAČRT PREDMETA / COURSE SYLLABUS** | | | | | | | | | | | | | | | | | | | | |
| **Predmet:** | | | **MODELIRANJE, SIMULACIJE IN VARNOSTNE ANALIZE JEDRSKIH OBJEKTOV** | | | | | | | | | | | | | | | | | |
| **Course title:** | | | **MODELING, SIMULATIONS AND SAFETY ANALYSES OF NUCLEAR FACILITIES** | | | | | | | | | | | | | | | | | |
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| **Študijski program in stopnja**  **Study programme and level** | | | | | **Študijska smer**  **Study field** | | | | | | | | | | | **Letnik**  **Academic year** | | **Semester**  **Semester** | | |
| **ENERGETIKA, 3. stopnja** | | | | | **-** | | | | | | | | | | | **1/2** | | **1/2/3** | | |
| **ENERGY TECHNOLOGY, 3. Degree** | | | | | **-** | | | | | | | | | | | **1/2** | | **1/2/3** | | |
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| **Vrsta predmeta / Course type** | | | | | | | | | | | | | | | Izbirni/Elective | | | | | |
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| **Univerzitetna koda predmeta / University course code:** | | | | | | | | | | | | | | | D | | | | | |
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| **Predavanja**  **Lectures** | **Seminar**  **Seminar** | | | **Vaje**  **Tutorial** | | | | **Klinične vaje**  **work** | | | | | | **Druge oblike študija** | | | **Samost. delo**  **Individ. work** | |  | **ECTS** |
| **30** | **-** | | | **-** | | | | **-** | | | | | | **-** | | | **150** | |  | **6** |
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| **Nosilec predmeta / Lecturer:** | | | | | **TOMAŽ ŽAGAR** | | | | | | | | | | | | | | | |
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| **Jeziki /**  **Languages:** | | **Predavanja / Lectures:** | | | | **Slovenski/Slovene** | | | | | | | | | | | | | | |
| **Vaje / Tutorial:** | | | | **Slovenski/Slovene** | | | | | | | | | | | | | | |
| **Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:** | | | | | | | | | |  | | **Prerequisites:** | | | | | | | | |
| Osnovno poznavanje vsaj enega jedrskega objekta  Brez dodatnih posebnih obveznosti | | | | | | | | | |  | | Basic knowledge of at least one nuclear facility  No other prerequisite | | | | | | | | |
| **Vsebina:** | | | | | | | | | |  | | **Content (Syllabus outline):** | | | | | | | | |
| Računalniško simuliranje transporta nevtronov, transportna enačba, difuzijski približki. Izračuni potrebnih parametrov, preseki, knjižnice. Analize transporta nevtronov v reaktorski sredici, difuzijski izračuni – metode Core Design 2D/3D (CORD, TRIGLAV, …). Simulacije v reaktorski fiziki - metode Monte-Carlo (MCNP, …).  Termodinamske simulacije - reševanje navadnih diferencialnih enačb. 2D/3D simulacije prevoda toplote v trdninah. Reševanje eliptičnih parcialnih diferencialnih enačb z lastnimi in z obstoječimi računalniškimi programi - metoda končnih razlik. 2D/3D simulacije v hidrodinamiki z metodami končnih razlik in končnih volumnov. Uporaba obstoječih programov.  Jedrska termo hidravlika - simulacije kritičnega toka v šobi in tlačnih valov v ceveh - reševanje Eulerjevih enačb z metodami končnih volumnov. Lastni programi, program RELAP, TRACE in Apros. Sklopljene termo hidravlične in nevtronske simulacije v sredici jedrskega reaktorja.  Načela jedrske varnosti: nivoji varnosti, varnost v globino. Projektiranje za varnost sistemov, struktur in naprav ter njihove oblike: redundanca, neodvisnost in ločenost, raznolikost, varne odpovedi, načelo enojne odpovedi. Varnostni in varovalni sistemi po zasnovah reaktorjev.  Deterministične analize jedrskih elektrarn. Analize prehodnih pojavov in hipotetičnih nezgod ter težkih nesreč. Verjetnostne varnostne analize (PSA).  Zagotavljanje varnostne kulture – organizacija in vodenje. Odločanje z upoštevanjem parametrov tveganja. Licenciranje, projektiranje, dokumentiranje in varnostna poročila ter obratovalne omejitve. Obratovanje, vzdrževanje in periodični varnostni pregledi. | | | | | | | | | |  | | Computer simulations, neutron transport equation, diffusion approximation. Neutron diffusion calculations, core design methods 2D/3D Core Design (CORD, TRIGALV, …). Monte-Carlo methods (MCNP, …).  Thermo-dynamical simulations. Algorithms for solving of ordinary differential equations. 2D/3D simulations of heat conduction. Numerical methods for elliptic partial differential equations with own and existing computer codes - finite difference method.  2D/3D simulations in hydrodynamics with finite difference and finite volume methods. Development of own computer codes, application of existing computer codes.  Nuclear thermal-hydraulics - simulations of critical flow in the nozzle and pressure waves in the piping systems. Finite volume numerical methods for hyperbolic Euler equations. Own computer codes, existing codes RELAP, TRACE and Apros. Coupled thermal-hydraulics and neutron transport calculations in nuclear reactor core area.  Reactor safety fundamentals: safety levels, defence in depth, safety classification of systems, structures and components, redundancy, spatial and orientation separation, safe failure mode, single failure mode. Safety and protection systems of different reactor concepts.  Deterministic safety analyses, Transient phenomena analyses, severe accidents scenarios. Probabilistic safety analyses.  Safety culture, organization and leadership responsibility. Licensing, design, documentation and document control, safety reports, and operation limitations. Operation, maintenance, periodic safety reports. | | | | | | | | |
| **Temeljni literatura in viri / Readings:** | | | | | | | | | | | | | | | | | | | | |
| [1] W.H. Press, B.P.Flannery, S.A.Teukolsky, W.T.Vetterling: Numerical Recipes, Cambridge Univ. Press, 1986  [2] Computational Fluid Dynamics: The Basics with Applications, John David Anderson, Publisher: McGraw Hill, Pub. Date: 1995  [3] Computational Methods for Fluid Dynamics, Joel H. Ferziger and Milovan Peric, Springer Verlag, 1999  [4] H. Kumamoto, E. J. Henley, Probabilistic Risk Assessment and Management for Engineers and Scientists, IEEE Press, 1996.  [5] W. Vesely, J. Dugan, J. Fragola, J. Minarick, J. Railsback, Fault Tree Handbook with Aerospace Applications, National Aeronautics and Space Administration, NASA, 2002.  [6] B. Pershagen: Light Water Reactor Safety; Pergamon Press, Oxford, 1989  [7] IAEA Safety Standards Series: Nuclear Power Plants, Nuclear Safety, Radioactive waste management, Safety of nuclear fuel cycle facilities, … IAEA Publishing, Vienna  [8] R. A. Knief: Nuclear Energy Technology, McGraw – Hill.  [9] J. R. Lamarsh: Introduction to Nuclear Engineering, Addison – Wesley. | | | | | | | | | | | | | | | | | | | | |
| **Cilji in kompetence:** | | | | | | | | |  | | **Objectives and competences:** | | | | | | | | | |
| Pridobiti praktična znanja potrebna za numerične simulacije jedrskih reaktorjev, kar predstavlja tudi osnove za varnostne analize. Reševanje enačb mehanike tekočin, prenosa toplote in snovi, elasto-plastičnosti in reaktorske fizike. Razvoj lastnih računalniških programov in uporaba obstoječih računalniških paketov.  Osvojiti najnovejša in visoko specializirana znanja in spoznanja o varnosti in stabilnosti obratovanja jedrskih objektov. Osvojitev metod varnostnih analiz in oblikovanje dejavnikov varnostne kulture.  Specifične kompetence: Modeliranje in sposobnost reševanja problemov, računalniške spretnosti. Vsaka naloga predstavlja jedrski problem v kombinaciji z matematičnim orodjem. Matematična orodja predstavljajo tako obstoječe računalniške programe, kot programe in aplikacije, ki jih razvija študent sam. | | | | | | | | |  | | To obtain knowledge and practical experience required for numerical simulations of nuclear reactors, this is input for safety analyses. Experience in solving the equations of fluid mechanics, heat and mass transfer, structural dynamics and reactor physics. Development of own computer codes and application of existing software.  To obtain current specialized knowledge on safety and stability of nuclear power plants operation. Students learn and know latest safety analyses methods and elements of safety culture.  Specific competences: Numerical modelling, solution of the problems, computer skills. Each task represents particular nuclear related problem in combination with specific mathematical tool. Mathematical tools represent computer codes and applications developed by the student and existing computer codes. | | | | | | | | | |
| **Predvideni študijski rezultati:** | | | | | | | | | |  | **Intended learning outcomes:** | | | | | | | | | |
| Znanje modeliranja procesov v jedrski tehniki. Obvladovanje numeričnih metod in numerično reševanje problemov v jedrski tehniki. Uporaba obstoječih računalniških programov za simulacije konkretnih primerov. Spoznavanje navadnih in parcialnih diferencialnih enačb. Reševanje različnih tipov navadnih in parcialnih diferencialnih enačb. Numerične metode: reševanje sistemov linearnih in nelinearnih enačb, paralelno programiranje.  Uporaba zahtevnejših analitskih metod, postopkov in procesov v gospodarski praksi. Lastno razumevanje teorije in povezovanje s prakso, kritično vrednotenje skladnosti med teoretičnimi načeli in praktičnim ravnanjem. Uporaba svetovne in domače literature in raziskovalnih rezultatov pri razlagi, identifikacija in reševanje problemov, pisanje strokovnih poročil, varnostnih analiz in znanstvenih člankov. | | | | | | | | | |  | Skills required for modelling of processes in nuclear engineering. To master the numerical methods and numerical solutions of the problems in nuclear engineering. Application of existing computer codes for simulations of practical problems. Mastering of the ordinary and partial differential equations and mastering the numerical techniques required to solve different types of ordinary and partial differential equations. Numerical methods: solution of systems of linear and nonlinear equations, parallel computing.  Practical application of standard methods, procedures and processes. Understanding the theory and experience in practice, critical evaluation of harmony between theoretical principles and practical applications. Skilfulness of use of domestic and foreign literature and research results for interpretation ot data, of identifying problems and solving them, of writing reports, safety anayses and articles. | | | | | | | | | |
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| **Metode poučevanja in učenja:** | | | | | | | | | |  | **Learning and teaching methods:** | | | | | | | | | |
| Predavanja s teoretično vsebino, usmerjani individualni študij, konzultacije, raziskovalni seminarji, priprava projekta z uporabno industrijsko vrednostjo in predstavitev projekta.  poučevanje in učenje poteka z didaktično uporabo IKT | | | | | | | | | |  | Lectures, where student recognises theoretical contents, tutorial studies, consultations, research seminars, project work with practical industrial application value and presentation.  teaching and learning is done using didactic use of ICT | | | | | | | | | |
| **Načini ocenjevanja:** | | | | | | | Delež (v %) /  Weight (in %) | | | | | | **Assessment:** | | | | | | | |
| Ustni izpit  Projekt (poročilo in predstavitev) | | | | | | | **30%**  **70%** | | | | | | Oral examination  Project (written report and oral presentation) | | | | | | | |
| **Reference nosilca / Lecturer's references:** | | | | | | | | | | | | | | | | | | | | |
| [1] T. Žagar; **Theoretical Analysis of Three Parameters Determining Thermal Power Calibration Method for TRIGA Research Reactor**, Journal of Energy Technology, 11, 3, 2018  [2] A. Peršič, T.Žagar, et. al.; **TRIGLAV: A Program Package for TRIGA Reactor Calculations**, Nuclear Engineering and Design, 318, 2017  [3] T. Žagar, et. al.; **TRIGLAV-W a computer program package with graphical users interface for modern TRIGA reactor core management calculations**. V: 3rd World TRIGA users Conference, Belo Horizonte, 2006  [4] T. Žagar, I. Lengar, B. Žefran, **Instalacija programa ORIGEN-ARP in izračun izvornega člena s tem programom**, IJS-DP-8863, Izdaja 1, Ljubljana, 2003  [5] T. Žagar, **Fizikalni modeli v programu WIMSD**, IJS-DP-8178, Ljubljana, 2000  [6] T. Žagar, et. al.; **Fuel element burnup determination in mixed TRIGA core using reactor calculations**, Nuclear Technology, vol. 128, 1999 | | | | | | | | | | | | | | | | | | | | |

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| **UČNI NAČRT PREDMETA / COURSE SYLLABUS** | | | | | | | | | | | | | | | | | | | | |
| **Predmet:** | | | **RAVNANJE Z IZRABLJENIM JEDRSKIM GORIVOM IN RAO TER RAZGRADNJA** | | | | | | | | | | | | | | | | | |
| **Course title:** | | | **MANAGEMENT OF SPENT FUEL AND RW, DECOMMISSIONING** | | | | | | | | | | | | | | | | | |
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| **Študijski program in stopnja**  **Study programme and level** | | | | | **Študijska smer**  **Study field** | | | | | | | | | | | **Letnik**  **Academic year** | | **Semester**  **Semester** | | |
| **ENERGETIKA, 3. stopnja** | | | | | **-** | | | | | | | | | | | **1/2** | | **1/2/3** | | |
| **ENERGY TECHNOLOGY, 3. Degree** | | | | | **-** | | | | | | | | | | | **1/2** | | **1/2/3** | | |
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| **Vrsta predmeta / Course type** | | | | | | | | | | | | | | | Izbirni/Elective | | | | | |
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| **Univerzitetna koda predmeta / University course code:** | | | | | | | | | | | | | | | D | | | | | |
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| **Predavanja**  **Lectures** | **Seminar**  **Seminar** | | | **Vaje**  **Tutorial** | | | | **Klinične vaje**  **work** | | | | | | **Druge oblike študija** | | | **Samost. delo**  **Individ. work** | |  | **ECTS** |
| **30** | **-** | | | **-** | | | | **-** | | | | | | **-** | | | **150** | |  | **6** |
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| **Nosilec predmeta / Lecturer:** | | | | | **TOMAŽ ŽAGAR** | | | | | | | | | | | | | | | |
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| **Jeziki /**  **Languages:** | | **Predavanja / Lectures:** | | | | **Slovenski/Slovene** | | | | | | | | | | | | | | |
| **Vaje / Tutorial:** | | | | **Slovenski/Slovene** | | | | | | | | | | | | | | |
| **Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:** | | | | | | | | | |  | | **Prerequisites:** | | | | | | | | |
| Ni posebnih obveznosti | | | | | | | | | |  | | No prerequisite | | | | | | | | |
| **Vsebina:** | | | | | | | | | |  | | **Content (Syllabus outline):** | | | | | | | | |
| Radioaktivni odpadki in izrabljeno jedrsko gorivo: vrste in viri radioaktivnih odpadkov in izrabljenega jedrskega goriva (odprti in zaprti jedrski gorivni krog, odpadki iz drugih virov); predobdelava in obdelava radioaktivnih odpadkov; priprava radioaktivnih odpadkov; skladiščenje radioaktivnih odpadkov; ravnanje z izrabljenim jedrskim gorivom pred odlaganjem (predelava, skladiščenje); odlaganje radioaktivnih odpadkov in izrabljenega jedrskega goriva (pripovršinsko, globinsko) in tehnologije odlaganja; transport radioaktivnih odpadkov in transport izrabljenega jedrskega goriva, varnostne analize; od nastanka odpadkov do odložitve (raziskave, izbor in karakterizacija lokacije).  Predelava goriva in recikliranje IJG. Energija v obsevanem jedrskem gorivu. Teorija analiz gorivnih ciklov. Ločevanje in transmutacija TRU elementov.  Glavne družine jedrskih gorivnih ciklov: Gorivni cikel z direktnim odlaganjem ("Once-through"), Gorivni cikel s konvencionalnim reprocesiranjem goriva, Gorivni cikel z večkratnim recikliranjem plutonija v PWR, Zgorevanje trans-uranskih elementov v hitrih reaktorjih, Gorivni cikel v dveh nivojih ("Double strata"), Gorivni cikel, ki vsebuje samo hitre reaktorje ("All FR Strategy"). Napredni reaktorski sistemi in 4. generacija jedrskih elektrarn. ADS (sistemi za zgorevanje TRU elementov s pospeševalniki). Vodno procesiranje in pyro-procesiranje zgorelega goriva. Odpri problemi razvoja novih sistemov in potrebne lastnosti materialov. Multi kriterijska analiza naprednih gorivnih ciklov. Energetski potenciali nekonvencionalnih jedrskih goriv (Th). ATF – jedrsko gorivo odporno na nesreče.  Razgradnja jedrskih objektov: pojmi in zahteve za razgradnjo, vrste in načini razgradenj, tehnologije razgradenj, radioaktivni odpadki iz razgradnje, od programa razgradnje do izvedbe, primeri. | | | | | | | | | |  | | Radioactive waste and spent nuclear fuel: types and sources of radioactive waste (open and closed fuel cycle, other sources); pre-treatment and treatment of radioactive waste, conditioning of radioactive waste; storage of radioactive waste, pre-disposal spent fuel management (reprocessing, storage); disposal of radioactive waste and spent nuclear fuel (near-surface and geological) and disposal technologies; transport of radioactive waste and spent nuclear fuel; safety assessment; from waste generation to its disposal (research, site selection and site characterisation, underground laboratories, performance assessment).  Spent fuel recycling. Energy stored in irradiated nuclear fuel elements. Advanced fuel cycle analysis.  Partitioning & transmutation of TRU elements.  General fuel cycle families (existing, potential and under research): Once-trough fuel cycle, Single MOX fuel cycle, Pu multi reprocessing with MOX in PWR, TRU burning in fast reactors, ,All FR strategy, Double strata fuel cycles (with ADSs). Advanced reactor systems, generation IV, ADS. Aqueous processing, pyro processing. Advanced fuel cycle problems, material requirements. Multi-criteria analysis of fuel cycles. Energy potentials of unconventional fuel cycles (Th). Accident tolerant fuel – ATF.  Decommissioning of nuclear facilities: concepts and requirements for decommissioning, decommissioning strategies and technologies, radioactive waste from decommissioning, decommissioning programme and its implementation, cases and examples. | | | | | | | | |
| **Temeljni literatura in viri / Readings:** | | | | | | | | | | | | | | | | | | | | |
| [1] Status and Trends in Spent Fuel and Radioactive Waste Management, IAEA Nuclear Energy Series, Nr: NW-T-1.14, 2018  [2] Geological Disposal of Radioactive Waste In Perspective, OECD-NEA, 2000  [3] Geological Challenges in Radioactive Waste Isolation, Fifith Worldwide Review, Berkely National Laboratory, University of California, 2016  [4] The Decommissioning and Dismantling of Nuclear Facilities, OECD-NEA, 2002  [5] Decommissioning Nuclear Power Plants, OECD-NEA, 2003  [6] Implications of Partitioning and Transmutation in Radioactive Waste Management, Technical Report Series No. 435, IAEA, 2004  [7] Advanced Nuclear Fuel Cycles and Radioactive Waste Management, NEA No.5990, OECD NEA ND, Pariz, 2006.  [8] French R&D on the Partitioning and Transmutation of Long-lived Radionuclides, NEA No.6210, OECD NEA ND, Pariz 2006.  [9] A.E.Waltar, Radiation and modern life, Prometheus Books, 2004. | | | | | | | | | | | | | | | | | | | | |
| **Cilji in kompetence:** | | | | | | | | |  | | **Objectives and competences:** | | | | | | | | | |
| Pridobiti vpogled v trenutni napredek tehnologij za uporabo izrabljenega jedrskega goriva po svetu. To vključuje delno zaprte in odprte gorivne kroge, ki se danes že uporabljajo po svetu. Poglavitni del tega predmeta pa je usmerjen v spoznavanje naprednih gorivnih krogov, ki so trenutno še v fazi razvoja.  Pridobiti poglobljeno znanje o strategijah, načinih in tehnikah razgradnje jedrskih objektov. Seznaniti se z lastnostmi, možnimi načini in tehnološkimi postopki za varno ravnanje z radioaktivnimi odpadki in izrabljenim jedrskim gorivom. Spoznati konkretne primere varnega ravnanja z radioaktivnimi odpadki in izrabljenim jedrskim gorivom od nastanka do trajne odložitve in primere razgradnje jedrskih objektov. Razvijati odgovoren odnos do odpadkov in skrb za varno ravnanje z njimi. | | | | | | | | |  | | To present an overview of current advanced fuel cycle technologies and studies. This includes opened and partially closed fuel cycles currently used in the world. Majority of the subject is dedicated to advanced fuel cycles which are currently in different phases of research and development.  To gain knowledge on strategies and technologies for the decommissioning of nuclear facilities. To get acquainted with main characteristics and technical and technological options and procedures for safe management of radioactive waste and spent nuclear fuel. To get familiar with real cases of safe waste management and spent nuclear fuel from its generation to its disposal and cases of decommissioning of nuclear facilities. To develop responsible attitude towards waste and its safe disposal. | | | | | | | | | |
| **Predvideni študijski rezultati:** | | | | | | | | | |  | **Intended learning outcomes:** | | | | | | | | | |
| Študent spozna, da en sam izrabljen gorivni element iz klasičnih PWR elektrarn vsebuje še vedno toliko energije kot deset tisoč ton nafte. Študent spozna možnosti za izkoriščanje te energije skozi napredne gorivne kroge in spozna, kako je z uporabo procesiranja TRU možno zmanjšati količino radioaktivnih odpadkov za več velikostnih redov.  Poznavanje in razumevanje poglobljenih načinov in tehnik razgradnje jedrskih objektov; razumevanje poglobljenih principov ravnanja z radioaktivnimi odpadki in izrabljenim jedrskim gorivom; razumevanje zahtev in omejitev, ki izhajajo iz varnostne analize.  Pridobljeno znanje se lahko uporabi neposredno v praksi pri razgradnjah jedrskih objektov in za ravnanje z radioaktivnimi odpadki. Principi ravnanja z radioaktivnimi odpadki so enaki in uporabni v vseh fazah jedrskega gorivnega cikla in tudi za nejedrske dejavnosti. Ravnanje z odpadki in razgradnje jedrskih objektov dobivajo pomembno težo tudi pri razvoju in načrtovanju novih jedrskih tehnologij in nove generacije reaktorjev. Jedrska tehnologija kot primer »zero-waste« tehnologije. | | | | | | | | | |  | To learn that irradiated fuel element from typical PWR is still packed with energy (the amount of this energy is in the order of ten thousand tons of oil). Advanced fuel cycles offer the possibility to use this energy and at the same time to reduce the amount of HLW.  Knowledge and understanding of approaches and techniques for decommissioning of nuclear facilities; understanding of principles of waste and spent nuclear fuel management; understanding of requirements and limits being put by the safety analysis.  The gained knowledge can be used practically at the decommissionin g of nuclear facilities and for safe management of radioactive waste. The principles of radioactive waste management are the same and can be applied in all stages of nuclear fuel cycle but also for non-nuclear activities. Radioactive waste management and decommissioning of nuclear facilities are gaining attention also at planning and development of new nuclear technologies and new generation of reactors.  Principles of waste managment in nuclear are an example of an existing »zero-waste« technology. | | | | | | | | | |
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| **Metode poučevanja in učenja:** | | | | | | | | | |  | **Learning and teaching methods:** | | | | | | | | | |
| Predavanja s teoretično vsebino, usmerjani individualni študij, konzultacije, raziskovalni seminarji, priprava projekta z uporabno industrijsko vrednostjo in predstavitev projekta.  poučevanje in učenje poteka z didaktično uporabo IKT | | | | | | | | | |  | Lectures, where student recognises theoretical contents, tutorial studies, consultations, research seminars, project work with practical industrial application value and presentation  teaching and learning is done using didactic use of ICT | | | | | | | | | |
| **Načini ocenjevanja:** | | | | | | | Delež (v %) /  Weight (in %) | | | | | | **Assessment:** | | | | | | | |
| Ustni izpit  Projekt (poročilo in predstavitev) | | | | | | | **30%**  **70%** | | | | | | Oral examination  Project (written report and oral presentation) | | | | | | | |
| **Reference nosilca / Lecturer's references:** | | | | | | | | | | | | | | | | | | | | |
| [1] T. Žagar in J. Magill; Slow breeding and transmutation process in low flux reactor, Journal of energy technology, JET Volume 1, 2008  [2] T. Žagar, Fuel Cycle Studies on Partitioning and Transmutaion Strategies, JRC-ITU-TN-2005/08, European Commission, Karlsruhe, 2005  [3] T. Žagar in D. Škanata; Experience in Managing Common Responsibilities for Radioactive Waste; Joint Convention Report: Challenges and Responsibilities of Multinational Radioactive Waste Disposal IAEA, Vienna, 2016.  [4] T. Žagar, L. Kegel, and M. Rupret; Slovenian Approach to Strategy and Planning for High Level Waste and Spent Fuel Deep Geological Disposa, V: International Approaches for Nuclear Waste Disposal in Geological Formations – Fifth Worldwide Review, Editors: B. Faybishenko, J. Birkholzer, D. Sassani, and P. Swift, LBNL-1006984, USA, Berkely, 2016.  [5] S. Viršek, J. Špiler, T. Žagar; Safety case for Slovenian LILW nearsurface repository; ID65, CN242, Safety of Radioactive Waste Management, Vienna, Austria, 2016.  [6] A. Buršič in T. Žagar, Future Generation IV SMRr Reactors: Assessment and Possibility of Integration in Closed Nuclear Fuel Cycles, Journal of Energy Technology, JET Volume 10, 2017.  [7] T. Žagar; Multinational Approaches to Spent Fuel and High Level Waste Disposal – Overview of Recent Developments, S8-169, Nuclear Option for CO2 Free Energy Generation, Zadar, Croatia, 2018. | | | | | | | | | | | | | | | | | | | | |

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| **UČNI NAČRT PREDMETA/ COURSE SYLLABUS** | | | | | | | | | | | | | | | | | |
| **Ime predmeta:** | | **NAČELA JEDRSKE FIZIKE** | | | | | | | | | | | | | | | |
| **Course title:** | | **PRINCIPLES OF NUCLEAR PHYSICS** | | | | | | | | | | | | | | | |
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| **Študijski program in stopnja**  **Study programme and cycle** | | | | | | **Študijska smer**  **Study option** | | | | | | | **Letnik**  **Year of study** | | **Semester**  **Semester** | | |
| ENERGETIKA, 3. stopnja | | | | | |  | | | | | | | 1/2 | | 1/2 | | |
| ENERGY TECHNOLOGY, 3.degree | | | | | |  | | | | | | | 1/2 | | 1/2 | | |
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| **Vrsta predmeta (obvezni ali izbirni) /**  **Course type (compulsory or elective)** | | | | | | | | | | | | Izbirni | | | | | |
| Optional | | | | | |
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| **Univerzitetna koda predmeta / University course code:** | | | | | | | | | | | |  | | | | | |
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| **Predavanja**  **Lectures** | **Seminar**  **Seminar** | | | **Vaje**  **Tutorial** | | | | **Klinične vaje**  **Clinical training** | | | **Druge oblike študija**  **Other forms of study** | | | **Samost. delo**  **Individual work** | |  | **ECTS** |
| 30 |  | | |  | | | |  | | |  | | | 150 | |  | 6 |
| **AV** | **LV** | | **RV** |  |
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| **Nosilec predmeta / Course coordinator:** | | | | | | | | | **ANITA PRAPOTNIK BRDNIK** | | | | | | | | |
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| **Jeziki /Languages:** | | | **Predavanja / Lectures:** | | | | | | slovenski / Slovene | | | | | | | | |
| **Vaje / Tutorial:** | | | | | | slovenski / Slovene | | | | | | | | |
| **Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:** | | | | | | | | |  | **Prerequisites for enrolling in the course or for performing study obligations:** | | | | | | | |
| Ni pogojev | | | | | | | | |  | None | | | | | | | |
| **Vsebina (kratek pregled učnega načrta):** | | | | | | | | |  | **Content (syllabus outline):** | | | | | | | |
| - Osnove specialne teorije relativnosti (vektor četverec, sprememba razpadnega časa gibajočega se delca, zapis gibalne količine, energijski zakon)  - Osnove kvantne mehanike (Heisenbergvo načelo nedoločenosti, valovna funkcija, kvantna števila, spin, fermionska in bozonska narava delcev)  - Osnove standardnega modela: delci, interakcije, ohranitveni zakoni, predstavitev procesof z Feynamovimi diagrami  - Energijski ninovji in sestava jedra  - Jedrske interakcije: prečni presek, Breit-Wignerjeva rezonanca in razpadni čas, jederski razpadi, sipanje  - Pridobivanja električne energije s pomočjo nuklearnih reakcij: fizija in fuzija | | | | | | | | |  | - Basic of special relativistic theory (four-vector, decay rate of a fast moving particle, momentum and energy law)  - Basic of quantum mechanic (Haiseberg uncertainty principle, wave function, quantum numbers, spin, fermions and bosons)  - Basic of standard model (particles, interactions, conservation laws, basic principles of Feyman diagrams)  - Nuclear structure and energy levels  - Nuclear interacions: cross-section, Breit-Wigner resonance, decay rate, nuclear decays, nuclear scattering  -Principles behind nuclear power plants: fizion and fusion | | | | | | | |

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| **Temeljni literatura in viri / Reading materials:** | | | | | |
| 1. G.F.Knoll, Radiation Detection And Measurement, J.Wiley and Sons, 4th Edition ,2010.  2. J.P.Gibbons, Khan’s The Physics of Radiation Therapy, Lippincott Williams & Wilkins, 6th Edition, 2019  3. M.Koželj, R.Erman, R. Istenič, M. Černilogar Radež, Delo z viri sevanj, Ministrsstvo za okolje in prostor, Uprava RS za jedrsko varnost, Ljubljana, 2006  4. E.B.Podgorsak, Radiation Oncology physics: a handbook forteachers and students, International Atomic Energy Agency, Vienna, 2005 | | | | | |
| **Cilji in kompetence:** | |  | **Objectives and competences:** | | |
| Cilji:  Spoznati osnovne principe in sile, ki določajo sestavo jedra, lastnosti in stabilnost jedra, jedrske razpade in jedrske interakcije.  Kompetence:  Študent pridobi sposobnost razumevanja sestave atomskih jeder in vzrkov za jedrsko reakcijo, zna napovedati s kakšnim razpadom bo neko nestabilno jedro razpadlo in oceniti koliko energije se bo pri razpadu sprostilo. Prav tako zna izračunati prečne preseke in razpadne čase za preproste primere. | |  | Objectives:  To learn the basic principles and forces that determine the composition, properties and stability of the nucleus, nuclear decays and nuclear interactions.  Competences:  the student acquires the ability to understand the composition of atomic nuclei and the causes for a nuclear reaction, is able to predict with what decay an unstable nucleus will decay and estimate how much energy will be released during the decay. It can also calculate cross sections and decay times for simple cases. | | |
| **Predvideni študijski rezultati:** | |  | **Intended learning outcomes:** | | |
| Znanje in razumevanje  Po zaključku tega predmeta bo študent sposoben:   * Razložiti osnovne principe specialne teroije relativnosti in kvantne mehanike * Ovrednotiti vlogo osnovih principov specialne teorije relativnosti in kvantne mehanike pri sestavi jedra in pri jedrskih reakcijah * Analizirati lastnosti in obnašanje atomskega jedra s pomočjo znanja o jederskih silah in energijskih nivojih * S pomočjo znanja o jederskih reakcijah napovedati razpadne načine jedra * S pomočjo znanja o jederskih silah in iz fizikalnih izrekov o ohranitvi energije in gibalne količine napovedati rezultat sipanja * Ovrednotiti razlike med pridobivanjem električne energije s pomočjo fuzije in fizije | |  | Knowledge and understanding:  Upon completion of this course, the student will be able to:   * Explain the basic principles of the special theory of relativity and quantum mechanics. * Evaluate the role of the basic principles of the special theory of relativity and quantum mechanics in the composition of the nucleus and in nuclear reactions. * Analyze the properties and behavior of the atomic nucleus using knowledge of nuclear forces and energy level * With the knowledge about nuclear reactions, predict the decay modes of the nucleus. * Predict the result of scattering with the knowledge about nuclear forces and from physics theorems about the conservation of energy and momentum. * Evaluate the differences between generating electricity through fusion and fission | | |
| Prenosljive/ključne spretnosti in drugi atributi:  Računske spretnosti:  - Napovedati razpadne čase in prečne preseke za preproste razpade in reakcije sipanja | |  | Transferable/key compentences and other abilities:  Calculation skills:  - Predict decay times and cross sections for simple decays and scattering reaction | | |
| **Metode poučevanja in učenja:** | |  | **Learning and teaching methods** | | |
| Pri predavanjih študent spozna teoretične vsebine predmeta.  Pri izdelavi seminarske naloge utrdi teoretično znanje skozi analizo konkretnega problema. | |  | During lectures, the student learns the theoretical fundamentals of the course.  During auditor exercises students upgrades theoretical knoweledge by problem analysis. | | |
| **Načini ocenjevanja:** | Delež (v %) /  Share (in %) | | | **Assessment methods:** | |
| Način (pisni izpit, ustno izpraševanje, naloge, projekt):  Usni izpit  *Sprotne oblike preverjanja znanja:* Seminarska naloga | **50**  **50** | | | Method (written or oral exam, coursework, project):  Oral exam  *Ongoing assessment:*  Seminar work | |
| **Reference nosilca / Course coordinator's refer** | | | | |
| **1.** PRAPOTNIK BRDNIK, Anita. Thermal performance optimization of double and triple glazing systems for Slovenian climate conditions. *Sustainability*. Oct. 2021, vol. 13, iss. 21 (11857), str. 1-33. ISSN 2071-1050. DOI: [10.3390/su132111857](https://dx.doi.org/10.3390/su132111857). [COBISS.SI-ID [83776259](https://plus.si.cobiss.net/opac7/bib/83776259?lang=sl)],  **2.** PRAPOTNIK BRDNIK, Anita, KAMNIK, Rok, MARKSEL, Maršenka, BOŽIČNIK, Stanislav. Market and technological perspectives for the new generation of regional passenger aircraft. *Energies*. 2019, vol. 12, no. 10, str. 1-14. ISSN 1996-1073. DOI: [10.3390/en12101864](https://dx.doi.org/10.3390/en12101864). [COBISS.SI-ID [22345494](https://plus.si.cobiss.net/opac7/bib/22345494?lang=sl)],  **3.** PRAPOTNIK BRDNIK, Anita, KAMNIK, Rok, BOŽIČNIK, Stanislav, MARKSEL, Maršenka. Ground infrastructure investments for operation of hybrid-electric aircraft. *IOP conference series. Materials science and engineering*, International Conference on Innovation in Aviation & Space to the Satisfaction of the European Citizens (11th EASN 2021) 01/09/2021 - 03/09/2021 Online. 2022, vol. 1226, 8 str. ISSN 1757-899X. DOI: [10.1088/1757-899X/1226/1/012073](https://dx.doi.org/10.1088/1757-899X/1226/1/012073). [COBISS.SI-ID [104140291](https://plus.si.cobiss.net/opac7/bib/104140291?lang=sl)],  **4.** MARKSEL, Maršenka, PRAPOTNIK BRDNIK, Anita, KAMNIK, Rok, BOŽIČNIK, Stanislav, TRAINELLI, Lorenzo, RIBOLDI, Carlo E. D., ROLANDO, Alberto L. M. *D10.1: Ground infrastructure investment plan : [project full title Modular approach to hybrid electric propulsion architecture : project acronym MAHEPA : project number 723368 : R: document, report]*. [S. l.: s. n.], 2019. 86 str., ilustr., graf. prikazi. [COBISS.SI-ID [16946435](https://plus.si.cobiss.net/opac7/bib/16946435?lang=sl)] | | | | |

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| **UČNI NAČRT PREDMETA/ COURSE SYLLABUS** | | | | | | | | | | | | | | | | | | | | | |
| **Ime predmeta:** | | **SIMULACIJSKO PREDIKCIJSKO MODELIRANJE NELINEARNIH ENERGETSKIH SISTEMOV Z METODAMI STROJNEGA UČENJA** | | | | | | | | | | | | | | | | | | | |
| **Cousre title:** | | **SIMULATION PREDICTION MODELING OF NONLINEAR ENERGY SYSTEMS WITH MACHINE LEARNING METHODS** | | | | | | | | | | | | | | | | | | | |
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| **Študijski program in stopnja**  **Study programme and cycle** | | | | | **Študijska smer**  **Study option** | | | | | | | | | | | | **Letnik**  **Year of study** | | **Semester**  **Semester** | | |
| ENERGETIKA, 3. STOPNJA | | | | |  | | | | | | | | | | | | 1/2 | | 1/2 | | |
| ENERGY TECHNOLOGY,3.degree | | | | |  | | | | | | | | | | | | 1/2 | | 1/2 | | |
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| **Vrsta predmeta (obvezni ali izbirni) /**  **Course type (compulsory or elective)** | | | | | | | | | | | | | | | | Izbirni/elective | | | | | |
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| **Univerzitetna koda predmeta / University course code:** | | | | | | | | | | | | | | | | DR | | | | | |
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| **Predavanja**  **Lectures** | **Seminar**  **Seminar** | | | **Vaje**  **Tutorial** | | | | | **Klinične vaje**  **Clinical training** | | | | | | **Druge oblike študija**  **Other forms of study** | | | **Samost. delo**  **Individual work** | |  | **ECTS** |
| 30 |  | | |  | | | | |  | | | | | |  | | | 150 | |  | 6 |
| **AV** | **LV** | **RV** | | |  |
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| **Nosilec predmeta / Course coordinator:** | | | | | | | DUŠAN STRUŠNIK | | | | | | |
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| **Jeziki /Languages:** | | | **Predavanja / Lectures:** | | | | | | | Slovenski; Slovene | | | | | | | | | | | |
| **Vaje / Tutorial:** | | | | | | | Slovenski; Slovene | | | | | | | | | | | |
| **Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:** | | | | | | | | | | |  | **Prerequisites for enrolling in the course or for performing study obligations:** | | | | | | | | | |
| Priporočeno predhodno znanje matematike, mehanike, termodinamike, toplotnih strojev, energetskih procesov in Matlab simulacijskega modeliranja. | | | | | | | | | | |  | Recomended courses in the following subjects: Mathematics, Mechanics, Thermodynamics, Heat engines, Energy processes and Matlab simulation modelling | | | | | | | | | |
| **Vsebina (kratek pregled učnega načrta):** | | | | | | | | | |  | | **Content (syllabus outline):** | | | | | | | | | |
| Vsebina predmeta obsega sledeča poglavja:  1. Osnove simulacijskega predikcijskega modeliranja nelinearnih energetskih sistemov z metodami strojnega učenja.  2. Načini simulacijskega predikcijskega modeliranja z metodami strojnega učenja.  3. Orodja simulacijskega predikcijskega modeliranja z metodami strojnega učenja.  4. Zajem in obdelava procesnih nelinearnih podatkov.  5. Postopki priprave in grupiranja procesnih nelinearnih podatkov.  6. Izdelava različnih praktičnih primerov simulacijskega predikcijskega modeliranja nelinearnih energetskih sistemov z metodami strojnega učenja.  6. Postopki validiranja izdelanih simulacijskih predikcijskih modelo.  7. Grafično oblikovanje, analiza in izpis rezultatov simulacijskega predikcijskega modeliranja. | | | | | | | | | |  | | Content of the Subject:  1. Basics of simulation predictive modeling of nonlinear energy systems using machine learning methods.  2. Ways of simulation predictive modeling with machine learning methods.  3. Simulation predictive modeling tools with machine learning methods.  4. Capture and processing of process nonlinear data.  5. Process nonlinear data preparation and grouping procedures.  6. Creation of various practical examples of simulation prediction modeling of non-linear energy systems using machine learning methods.  6. Procedures for validating the developed simulation prediction model.  7. Graphic design, analysis and output of simulation prediction modeling results | | | | | | | | | |
| **Temeljni literatura in viri / Reading materials:** | | | | | | | | | | | | | | | | | | | | | |
| O Theobald, Machine Learning For Absolute Beginners, 2021;  F. Magoules, H.-X. Zhao, Data Mining and Machine Learning in Building Energy Analysis, 2016;  C. C. Aggarwal, Neural Networks and Deep Learning, 2018;  H. Singh, Y. A. Lone, Deep Neuro-Fuzzy Systems with Python, 2019;  F. Asadi, Simulation of Power Electronics Circuits with MATLAB®/Simulink, 2022. | | | | | | | | | | | | | | | | | | | | | |
| **Cilji in kompetence:** | | | | | | | | | |  | | **Objectives and competences:** | | | | | | | | | |
| Cilji:  Cilj in kompetence predmeta je pridobitev znanja o simulacijskem predikcijskem modeliranju in o validacijskih postopkih nelinearnih energetskih sistemih z metodami strojnega učenja. | | | | | | | | | |  | | Objectives:  The objectives and competence of the course is to acquire knowledge about simulation predictive modeling and validation procedures of nonlinear energy systems using machine learning methods. | | | | | | | | | |
| **Predvideni študijski rezultati:** | | | | | | | | | | |  | **Intended learning outcomes:** | | | | | | | | | |
| Znanje in razumevanje:  Študent si pridobi znanja o simulacijskem predikcijskem modeliranju in o validacijskih postopkih nelinearnih energetskih sistemih z metodami strojnega učenja.  Prenesljive/ključne spretnosti in drugi atributi:  Izdelava nelinearnih simulacijskih modelov z metodami strojnega učenja in predikcija obratovanja procesnih sistemov. | | | | | | | | | | |  | The student acquires knowledge of simulation predictive modeling and validation procedures of nonlinear energy systems using machine learning methods.  Transferable/key competences and other abilities:  Creation of non-linear simulation models using machine learning methods and prediction of operation of process systems. | | | | | | | | | |
| **Metode poučevanja in učenja:** | | | | | | | | | | |  | **Learning and teaching methods:** | | | | | | | | | |
| 1. Predavanja,  2. Avditorne vaje  3. Laboratorijske vaje | | | | | | | | | | |  | 1. Lectures,  2. Auditorium exercises  3. Laboratory exercises | | | | | | | | | |
| **Načini ocenjevanja:** | | | | | | | | Delež (v %) /  Share (in %) | | | | | **Assessment methods:** | | | | | | | | |
| Sprotne oblike preverjanja znanj (kolokviji, domače naloge, kvizi).  Seminarske ter računske vaje (predstavitev seminarske naloge, poročilo laboratorijskih vaj, poročilo računskih vaj).  Sprotne oblike preverjanja znanj se lahko nadomestijo z izpitom (pisni izpit, ustni izpit).  1. Pisni izpit (računske naloge).  2. Ustni izpit (teorija).  3. Seminarska naloga.  Za opravljen izpit mora študent vsak del izpita (praktični del izpita, teoretični del izpita in seminarsko ter računsko vajo) opraviti z najmanj 50%. | | | | | | | | **30**  **50**  **20** | | | | | Real-time forms of knowledge testing (colloquia, homework, quizzes).  Seminar and calculation exercises (presentation of seminar work, report of laboratory exercises, report of calculation exercises).  Real-time forms of knowledge testing can be replaced by an exam (written exam, oral exam).  1. Written exam . (calculation exercises)  2. Oral exam (theory).  3. Seminar work.  To pass the exam, the student must pass each part of the exam (practical part of the exam, theoretical part of the exam and seminar with arithmetic exercises) with at least 50%. | | | | | | | | |
| **Reference nosilca / Course coordinator's references:** | | | | | | | | | | | | | | | | | | | | | |
| STRUŠNIK Dušan, AVSEC Jurij. Exergoeconomic machine-learning method of integrating a thermochemical Cu–Cl cycle in a multigeneration combined cycle gas turbine for hydrogen production*. International Journal of Hydrogen Energy*. [Online ed.]. 2022, vol. 47, iss. 39, str. 17121-17149, graf. prikazi. ISSN 1879-3487. DOI: 10.1016/j.ijhydene.2022.03.230. [COBISS.SI-ID 104668675].  STRUŠNIK, Dušan, AVSEC, Jurij. Artificial neural networking and fuzzy logic exergy controlling model of combined heat and power system in thermal power plant. Energy. feb. 2015, vol. 80, str. 318-330, graf. prikazi. ISSN 0360-5442. http://www.sciencedirect.com/science/article/pii/S0360544214013449, DOI: 10.1016/j.energy.2014.11.074. [COBISS.SI-ID 1024198748]  STRUŠNIK, Dušan, GOLOB, Marjan, AVSEC, Jurij. Artificial neural networking model for the prediction of high efficiency boiler steam generation and distribution. Simulation modelling practice and theory. 2015, vol. 57, str. 58-70, graf. prikazi. ISSN 1569-190X. DOI: 10.1016/j.simpat.2015.06.003. [COBISS.SI-ID 82929921  STRUŠNIK, Dušan, AVSEC, Jurij. Artificial neural networking model of district heating energy and exergy mony flows. Energy and buildings. [Print ed.]. Jan. 2015, vol. 86, pp. 366-375, graf. prikazi. ISSN 0378-7788. DOI: 10.1016/j.enbuild.2014.09.075. [COBISS.SI-ID 1024193116]  STRUŠNIK, Dušan, GOLOB, Marjan, AVSEC, Jurij. Effect of non-condensable gas on heat transfer in steam turbine condenser and modelling of ejector pump system by controlling the gas extraction rate through extraction tubes. Energy conversion and management. [Print ed.]. oct. 2016, vol. 126, str. 228-246. ISSN 0196-8904. DOI: 10.1016/j.enconman.2016.07.082. [COBISS.SI-ID 19707158]  STRUŠNIK, Dušan, AVSEC, Jurij. Analysis of dual-stage filtration and validation of high-dimensional real process data for creation of machine learning algorithms. V: International Conference on Electrical, Computer, Communications and Mechatronics Engineering (ICECCME) : 7.-8. October 2021 : [proceedings]. Piscataway: IEEE, cop. 2021. 6 str. ISBN 978-1-6654-1262-9. DOI: 10.1109/ICECCME52200.2021.9591094. [COBISS.SI-ID 85022467] | | | | | | | | | | | | | | | | | | | | | |