| UČNI NAČRT PREDMETA / COURSE SYLLABUS | |
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| **Ime predmeta:** | OPTIMIZACIJA LOGISTIČNIH PROCESOV |
| **Course title:** | OPTIMIZATION OF LOGISTICS PROCESSES |

| Študijski program in stopnja<br>Study programme and cycle | Študijska smer<br>Study option | Letnik<br>Year of study | Semester<br>Semester |
|---|---|---|---|
| LOGISTIKA SISTEMOV 2. stopnja | | 1. | 1. |
| SYSTEM LOGISTICS 2nd degree | | 1. | 1. |

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| **Vrsta predmeta (obvezni ali izbirni) /<br>Course type (compulsory or elective)** | OBVEZNI<br>COMPULSORY |
| **Univerzitetna koda predmeta / University course code:** | MAG |

| Predavanja<br>Lectures | Seminar<br>Seminar | Vaje<br>Tutorial | Klinične vaje<br>Clinical training | Druge oblike študija<br>Other forms of study | Samost. delo<br>Individual work | ECTS |
|---|---|---|---|---|---|---|
| 24 e-P<br>21 a-P | | 10 e-V<br>30 a-V | | | 155 | 8 |

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| **Nosilec predmeta / Course coordinator:** | **DEJAN DRAGAN** |
| **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: |
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| Ni pogojev. | None. |

| Vsebina (kratek pregled učnega načrta): | Content (syllabus outline): |
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| Nelinearno programiranje in nelinearna optimizacija logističnih procesov: Modeliranje nelinearnih problemov v logistiki, Enodimenzionalna numerična nelinearna optimizacija, Večdimenzionalna numerična nelinearna optimizacija (osnovne in sofisticirane metode), Geometrijsko programiranje.<br><br>Predstavitev optimizacije pri reševanju praktičnih lokacijskih problemov v logistiki: Optimizacijski in hevristični algoritmi pri lokacijskih problemih, Uporaba Monte Carlo simulacije pri optimizaciji prevoza otrok v šolo in pri optimizaciji dostavnih mest.<br><br>Optimalno upravljanje zalog pri konstantnem deterministčnem povpraševanju: Določitev | Non-linear programming and nonlinear optimization of logistic processes: Modeling of nonlinear problems in logistics, One-dimensional nonlinear numerical optimization, Multidimensional nonlinear numerical optimization (basic and sophisticated methods), Geometric programming.<br><br>Presentation of optimization for the case of solving of practical location problems in logistics: Optimization and heuristic algorithms for location problems, Use of Monte Carlo simulation for the optimization of bus stops and school bus routing problem, Use of Monte Carlo simulation for the optimization of the freight transport delivery spots.<br><br>Optimal inventory management in the case of constant deterministic demand: Determination of |

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| optimalne naročilne količine, optimalnega časa naročila in optimalnega maksimalnega dovoljenega primanjkljaja (hipno ali postopno polnjenje, primanjkljaj je ali pa ni dovoljen).<br><br>Uvod v regresijo in napovedovanje v operacijskih raziskavah:<br>Predstavitev modeliranja z enostavno linearno regresijo in regresijsko premico, Predstavitev modeliranja z multiplo linearno regresijo, Primeri iz operacijskih raziskav.<br>Uvod v napovedovanje časovno odvisnega povpraševanja: Določanje komponent časovnih vrst in dekompozicija, Model regresijske premice, Brownova metoda pri konstantnem trendu, Holtova metoda pri dodatnem linearnem trendu, Wintersova metoda pri dodatnem sezonskem trendu.<br><br>Modeliranje in optimalno upravljanje prometnih tokov: Matematično modeliranje stacionarnega in dinamičnega prometnega toka. Whitham-Payne-ov model prometnega toka. Nelinearne teorije sledenja. Celično modeliranje prometnega toka. Prometni zastoji. Raziskovanje zakonitosti matematičnega modeliranja prometnih tokov. Modeliranje dinamike prometnih tokov. Makroskopski modeli. Kinetični modeli. Mikroskopski modeli.<br><br>Programska orodja: Scilab, Matlab in kloni. | the optimal order quantity, optimal time of order, and the optimal maximum allowed shortage (instant or gradual replenishment, shortage allowed or not allowed).<br><br>Introduction to the regression and forecasting in operations research:<br>Introduction to simple linear regression modeling with regression line, Introduction to multiple linear regression modeling, Examples in operations research.<br>Introduction to forecasting of the time-dependent demand: Determination of the components of time series and decomposition, Regression line model, Brown's method at constant trend, Holt method with an additional linear trend, Winters method with an additional seasonal trend.<br><br>Modeling and optimal control of traffic flows: Mathematical modeling of stationary and dynamic traffic flow. Payne- Whitham's model of traffic flow. Non-linear tracking theory. Cell modeling of traffic flow. Traffic congestions. Research of mathematical modeling of traffic flows. Modeling the dynamics of traffic flows. Macroscopic models. Kinetic models. Microscopic models.<br><br>Software tools : Scilab, Matlab and clones. |

**Temeljni literatura in viri / Reading materials:**


E-gradivo predmeta.
DRAGAN, Dejan: Upravljanje logističnih sistemov : visokošolski učbenik. Celje: Fakulteta za logistiko, 2009.
DRAGAN, Dejan: Statistika, analiza podatkov in statistični modeli, neobjavljen učbenik v pripravi, 2014.
DRAGAN, Dejan: Optimizacija logističnih procesov: visokošolski učbenik. Celje: Fakulteta za logistiko, 2010.
Rardin, R.: Optimization in Operations Research, Prentice Hall, 1st edition, 1997, ISBN: 978-0023984150.
Chong, E. K. P.: An introduction to optimization, Wiley-Interscience, 2 Sub edition, 2001, ISBN: 978-0471391265.
Rao, Engineering optimization: theory and practice, Wiley-Interscience, 3 Sub edition, 1996, ISBN: 978-0471550341.
Vanderplaats, G. N.: Numerical optimization techniques for engineering design, Vanderplaats Research and Development, Inc, 3rd ed., 4th printing edition, 2001, ISBN: 978-0944956014.
Fletcher, R.: Practical Methods of Optimization, John Wiley & Sons, 2 Sub edition, 2000, ISBN: 0-471-49463-1.
Kutner, M.: Applied Linear Regression Models, McGraw-Hill, 4th ed., 2004.
Winston W.L.: Operations Research: Applications and Algorithms, Cengage Learning, 4th ed., 2003.
Waters D., inventory Control and Management, Wiley, 2nd ed., 2003.
Haberman R.: Mathematical Models: Mechanical Vibrations, Population Dynamics, and Traffic Flow, Society for Industrial and Applied Mathematics, 1998.

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| Treiber M.: Traffic Flow Dynamics: Data, Models and Simulation, Springer, 2012.<br>Bowerman B.L.: Forecasting, Time Series, and Regression, Cengage Learning, 4th edition, 2004. |

**Cilji in kompetence:**

Cilj tega predmeta je:

- nadgraditi razumevanje postopkov in orodij za optimizacijo logističnih procesov,
- se naučiti uporabe teh orodij kot podlage za optimiranje logističnih procesov,
- spoznati raziskovalno področje optimizacije logističnih procesov in ga prepoznati kot morebitno polje bodočega znanstvenega dela,
- pridobiti poglobljeno razumevanje iz optimizacije logističnih procesov ter uporabe optimizacijskih metod,
- se usposobiti za učinkovito reševanje zahtevnejših problemov na področju optimizacije logističnih procesov,
- se usposobiti za samostojno znanstveno raziskovalno delo na tem področju,
- se usposobiti za predstavitev svojega raziskovalnega dela (članki, referati),
- spoznati uporabne vsebine in se naučiti sistemskega razmišljanja, kako pristopiti k reševanju realnih problemov,
- pridobiti razumevanje teoretičnih ozadij, nujno potrebnih za interpretacijo dobljenih rezultatov računalniških orodij in ocenitev kakovosti razvitih matematičnih modelov**.**

**Objectives and competences:**

The objective of the course is to:

- enhance the understanding of procedures and tools for the optimization of logistics processes,
- be familiarized with software support in order to learn to use these tools as a basis for optimization of logistics processes.
- introduce the research field of optimization of logistics processes, and recognise the possibility of its adoption for research work in the future,
- gain the ability of deeper understanding of optimization of logistics processes and the use of optimization methods,
- qualify for efficient solving of more complicated problems in the field of optimization of logistics processes,
- qualify for independent research and scientific work in this field,
- qualify for presentation of scientific work by publishing it (papers),
- to get familiar with useful contents and to gain the possibility of systematical thinking about solving of real problems,
- to gain the understanding of theoretical background, necessary for the interpretation of achieved results given by computer software and to verify the quality of developed matematical models.

**Predvideni študijski rezultati:**

- Študent je ob koncu študija sposoben obvladati raziskovalne metode, postopke in procese na področju optimizacije logističnih sistemov.
- Sposobnost za samostojno znanstveno raziskovalno delo na področju optimizacije logističnih procesov. Sposobnost učinkovitega reševanja zahtevnejših problemov na tem področju. Razumevanje uporabe raziskovalnih metod z zmožnostjo poglobljene analize problemov in sistemskega razmišljanja na tem področju. Zmožnost ustvarjalnega sodelovanja pri reševanju težjih problemov v logističnih okoljih.

**Intended learning outcomes:**

- Graduated student is able to deal with research methods, procedures and processes in the field of optimization of logistics processes.
- The ability of independent scientific and research work in the field of optimization of logistics processes. The ability of efficient solving of more complicated problems in this field. Understanding the use of research methods with the ability of in-deepth analysis and system reflection of the identified problems. The ability of creative collaboration in order to deal with solving of more difficult problems in logistics environments.

**Metode poučevanja in učenja:**

**Learning and teaching methods:**

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| Predavanja: pri predavanjih študent spozna teoretične vsebine predmeta. Del predavanj se izvaja na klasični način v predavalnici, del pa v obliki e-predavanj (e-predavanja se lahko izvajajo na videokonferenčni način ali s pomočjo posebej v ta namen didaktično pripravljenih e-gradiv v virtualnem elektronskem učnem okolju).<br><br>Vaje: pri vajah študent utrdi teoretično znanje in spozna aplikativne možnosti. Del vaj se izvaja na klasični način v predavalnici, del pa v obliki e-vaj (e-vaje se lahko izvajajo na videokonferenčni način ali s pomočjo posebej v ta namen didaktično pripravljenih e-gradiv v virtualnem elektronskem učnem okolju). | Lectures: Students understand the theoretical frameworks of the course. Part of the lecture course is in a classroom while the rest is in the form of e-learning (e-lectures may be given via video-conferencing or with the help of specially designed e-material in a virtual electronic learning environment).<br><br>Tutorials: Students enhance their theoretical knowledge and are able to apply it. Part of the seminar is in a classroom while the rest is in the form of e-learning (e-tutorials may be given via video-conferencing or with the help of specially designed e-material in a virtual electronic learning environment). |

| **Načini ocenjevanja:** | Delež (v %) / Share (in %) | **Assessment methods:** |
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| • Opravljene obveznosti e-predavanj in e-vaj so pogoj za pristop k izpitu. | | • Successful completion of e-lectures and e-tutorials is a prerequisite for entering the exam. |
| • Opravljen seminar. | 30% | • Coursework. |
| • Pisni izpit. | 40% | • Written examination. |
| • Ustni izpit. | 30% | • Oral examination. |

**Reference nosilca / Course coordinator's references:**

1. NERAT, Marko, VRANČIĆ, Damir. A novel fast-filtering method for rotational speed of the bldc motor drive applied to valve actuator. IEEE/ASME transactions on mechatronics, ISSN 1083-4435, 2016, vol. 21, no. 3, str. 1479-1486, doi: 10.1109/TMECH.2015.2505321. [COBISS.SI-ID 29087783].
2. MOURA OLIVEIRA, P. B. de, VRANČIĆ, Damir, BOAVENTURA CUNHA, J., SOLTEIRO PIRES, E. J. Teaching particle swarm optimization through an open-loop system identification project. Computer applications in engineering education, ISSN 1061-3773. [Print ed.], 2014, no. 22, no. 2, str. 227-237, doi: 10.1002/cae.20549. [COBISS.SI-ID 24881447].
3. PETROVČIČ, Janko, VRANČIĆ, Damir. Reducing oscillations in a control system : patent EP 2356522 B1. München: European Patent Office, 6. jan. 2016. [COBISS.SI-ID 22631463] patentna družina: Patentna prijava WO 2010/054657A1, 2010-05-20.
4. GLAVAN, Miha, GRADIŠAR, Dejan, INVITTO, Serena, HUMAR, Iztok, JURIČIĆ, Đani, PIANESE, Cesare, VRANČIĆ, Damir. Cost optimisation of supermarket refrigeration system with hybrid model. Applied thermal engineering, ISSN 1359-4311. [Print ed.], 2016, vol. 103, str. 56-66, doi: 10.1016/j.applthermaleng.2016.03.177. [COBISS.SI-ID 29455655].
5. VRANČIĆ, Damir. Rapid prototyping environment for control systems implementation. V: STRMČNIK, Stanko (ur.), JURIČIĆ, Đani (ur.). Case studies in control : putting theory to work, (Advances in industrial control, ISSN 1430-9491). London [etc.]: Springer. 2013, str. 289-326. [COBISS.SI-ID 26893095].
6. GERKŠIČ, Samo, DOLANC, Gregor, VRANČIĆ, Damir, KOCIJAN, Juš, STRMČNIK, Stanko, BLAŽIČ, Sašo, ŠKRJANC, Igor, MARINŠEK, Zoran, BOŽIČEK, Miha, STATHAKI, Anna, KING, Robert Bruce, HADJISKI, Mincho B., BOSHNAKOV, Kosta. A PLC-based system for advanced control. V: STRMČNIK, Stanko (ur.), JURIČIĆ, Đani (ur.). Case studies in control : putting theory to work, (Advances in industrial control, ISSN 1430-9491). London [etc.]: Springer. 2013, str. 327-361. [COBISS.SI-ID 26893351].

7. RAUBAR, Edvin, VRANČIĆ, Damir. Anti-sway system for ship-to-shore cranes. Strojniški vestnik, ISSN 0039-2480, maj 2012, vol. 58, no. 5, str. 338-344, SI 66, ilustr., doi: 10.5545/sv-jme.2010.127. [COBISS.SI-ID 25941543].
8. VRANČIĆ, Damir. Magnitude optimum techniques for PID controllers. V: PANDA, Rames C. (ur.). Introduction to PID colntrollers : theory, tuning and application to frontiers areas. Rijeka: InTech. cop. 2012, str. 75-102. [COBISS.SI-ID 25734695]
9. KRAMBERGER, Tomaž, DRAGAN, Dejan, PRAH, Klemen. A heuristic approach to reduce carbon dioxide emissions. Proceedings of the Institution of Civil Engineers - Transport, ISSN 0965-092X. [Print ed.], Okt. 2014, vol. 167, iss. 5, str. 296-305. http://www.icevirtuallibrary.com/content/article/10.1680/tran.11.00053, doi: 10.1680/tran.11.00053. [COBISS.SI-ID 512554557].
10. DRAGAN, Dejan, KRAMBERGER, Tomaž, TOPOLŠEK, Darja. Efficiency and travel agencies : Bayesian structural equation model. V: KRAMBERGER, Tomaž (ur.), POTOČAN, Vojko (ur.), IPAVEC, Vesna Mia (ur.). Sustainable logistics and strategic transportation planning, (Advances in logistics, operations, and management science book series (Print), ISSN 2327-350X). Hershey: IGI Global. cop. 2016, str. 211-235, ilustr. http://www.igi-global.com/book/sustainable-logistics-strategic-transportation-planning/141939, doi: 10.4018/978-1-5225-0001-8.ch010. [COBISS.SI-ID 512762173].
11. DRAGAN, Dejan, KRAMBERGER, Tomaž, PRAH, Klemen. Transport optimization and estimation of reduced CO2 emissions. V: KRAMBERGER, Tomaž (ur.), POTOČAN, Vojko (ur.), IPAVEC, Vesna Mia (ur.). Sustainable logistics and strategic transportation planning, (Advances in logistics, operations, and management science book series (Print), ISSN 2327-350X). Hershey: IGI Global. cop. 2016, str. 405-436, ilustr. http://www.igi-global.com/book/sustainable-logistics-strategic-transportation-planning/141939, doi: 10.4018/978-1-5225-0001-8.ch019. [COBISS.SI-ID 512762429].
12. DRAGAN, Dejan, ROSI, Bojan, AVŽNER, Toni. Synergies between an observed port and a logistic company : application of the discounted cash-flow model and the Monte Carlo simulation. Logistics & sustainable transport, ISSN 2232-4968. [Spletna izd.], May 2017, vol. 8, no. 1, str. 1-18, ilustr. https://doi.org/10.1515/jlst-2017-0001, doi: 10.1515/jlst-2017-0001. [COBISS.SI-ID 512846141].
13. TOPOLŠEK, Darja, DRAGAN, Dejan. Relationships between the motorcyclists' behavioural perception and their actual behaviour. Transport, ISSN 1648-3480. [Online ed.]. http://www.tandfonline.com/doi/abs/10.3846/16484142.2016.1141371, doi: 10.3846/16484142.2016.1141371. [COBISS.SI-ID 512755261].
14. TOPOLŠEK, Darja, DRAGAN, Dejan. Behavioural comparison of driverswhen driving a motorcycle or a car : a structural equation modelling study. Promet, ISSN 0353-5320. [Print ed.], 2015, vol. 27, no. 6, str. 457-466, ilustr. http://www.fpz.unizg.hr/traffic/index.php/PROMTT/issue/view/163. [COBISS.SI-ID 512739133].
15. INTIHAR, Marko, KRAMBERGER, Tomaž, DRAGAN, Dejan. Container throughput forecasting using dynamic factor analysis and ARIMAX model. Promet, ISSN 0353-5320. [Print ed.], 2017, vol. 29, no. 5, str. 529-542, ilustr. [COBISS.SI-ID 512879421].
16. TOPOLŠEK, Darja, DRAGAN, Dejan. Integration of travel agencies with other supply chain members : impact on efficiency. Logistics & sustainable transport, ISSN 2232-4968. [Spletna izd.], Oct. 2016, vol. 7, no. 1, str. 1-17. https://www.degruyter.com/downloadpdf/j/jlst.2016.7.issue-1/jlst-2016-0001/jlst-2016-0001.xml, doi: 10.1515/jlst-2016-0001. [COBISS.SI-ID 512794173].