| UČNI NAČRT PREDMETA/COURSE SYLLABUS | |
|---|---|
| Predmet: | MODELIRANJE DINAMIČNIH PROCESOV V LOGISTIKI |
| Course title: | PRINCIPLES OF MODELLING DYNAMICS IN LOGISTICS |

| Študijski program in stopnja<br>Study programme and level | Študijska smer<br>Study field | Letnik<br>Academic year | Semester<br>Semester |
|---|---|---|---|
| LOGISTIKA SISTEMOV 2.stopnja | | 2. | 3. |
| SYSTEM LOGISTICS 2nd degree | | 2. | 3. |

| | |
|---|---|
| Vrsta predmeta / Course type | IZBIRNI |
| Univerzitetna koda predmeta / University course code: | MAG |

| Predavanja<br>Lectures | Seminar<br>Seminar | Vaje<br>Tutorial | Klinične vaje<br>Laboratory work | Druge oblike študija<br>Field work | Samost. delo<br>Individ. work | ECTS |
|---|---|---|---|---|---|---|
| 15 e-P<br>30 a-P | | 15 e-V<br>25 a-V | | | 65 | 5 |

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|---|---|
| Nosilec predmeta / Lecturer: | TONE LERHER |
| Jeziki / Languages: Predavanja / Lectures: | SLOVENSKI / SLOVENE |
| Vaje / Tutorial: | SLOVENSKI / SLOVENE |

| Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti: | Prerequisits: |
|---|---|
| Ni posebnih pogojev. | No special requirements. |

| Vsebina: | Content (Syllabus outline): |
|---|---|
| Opredelitev modeliranja dinamičnih procesov v logistiki. Zvezni in diskretni dinamični sistemi.<br>Modeliranje sistemov toka materiala s poudarkom na določitvi pretočne zmogljivosti sistema.<br>Modeliranje sistemov mehanike vožnje s poudarkom na odporih pri gibanju in vlečnih silah.<br>Modeliranje zavarovanja tovora v dinamičnih sistemih.<br>Simulacijsko modeliranje dinamičnih procesov (zvezne/diskretne simulacije, uporaba diskretnih numeričnih simulacij v tehniški logistiki).<br>Optimiranje dinamičnih procesov v logistiki s poudarkom na zvezni in diskretni optimizaciji z genetskimi algoritmi.<br>Več-objektna Pareto optimizacija projektnih spremenljivk v namenskih funkcijah.<br>Modeliranje oskrbovalnih verig in transportnih problemov. Učinek biča (ang. bullwhip effect) v oskrbovalnih verigah. | Definition of modeling of dynamic processes in logistics. Continuous and discrete dynamic systems.<br>Modeling of material flow systems with an emphasis on determining the throughput capacity of the system.<br>Modeling of driving system with an emphasis on movement resistance and traction forces.<br>Modeling of cargo securing in dynamic systems.<br>Simulation modeling of dynamic processes (continuous / discrete simulations, the application of discrete numerical simulations in technical logistics).<br>Optimization of dynamic processes with an emphasis on continuous and discrete optimization with genetic algorithms.<br>Multi-object Pareto optimization of project variables in objective functions.<br>Modeling supply chains and transport problems. Bullwhip effect in supply chains. |

Temeljna literatura in viri / Readings:


1. E-gradivo predmeta.
2. Lerher, T., Potrč, I. (2017) Transportni sistemi v intralogistiki. Univerza v Mariboru, Fakulteta za logistiko.
3. Lerher, T. (2016). Throughput and energy related performance calculations for shuttle based storage and retrieval systems, (Energy science, engineering and technology). New York: Nova Science Publishers, Inc., pp 93.
4. Lerher Tone (2015). Cargo securing in road transport using restraining method with top-over lashing, (Transportation issues, policies and R&D). New York: Nova Science Publishers, cop., pp 76.
5. J. Banks, J. S. Carson, B. L. Nelson, D. M. Nicol. Discrete-Event System Simulation, Pearson Education Limited, 2014.
6. A. M. Law, W. D. Kelton. Simulation modeling and analysis, McGraw-Hill, 2000.
7. D. S. Levi, X. Chen, J. Bramel. The Logic of Logistics: Theory, Algorithms, and Applications for Logistics Management, Springer-Verlag, 2013.
8. D. A. Coley. Introduction To Genetic Algorithms For Scientists And Engineers, World Scientific Publishing Co., 2003.


Cilji in kompetence:

Predmet je namenjen pridobitvi poglobljenih znanj iz modeliranja, simulacij in metod analize dinamičnih procesov v logistiki

Objectives and competences:

The subject is designed to gain the deep knowledge about modelling, simulation and analysis methods of dynamic process in logistics.

Predvideni študijski rezultati:

*Študent/študentka:*

- razume osnove dinamike zveznih in diskretnih sistemov in jih je sposoben matematično in numerično modelirati dinamične sisteme,
- osvoji poglobljena znanja na področjih analize in modeliranja, simulacij in analize dinamičnih procesov v logistiki,
- usposobi se za reševanje zgoraj navedenih problemov stroke,
- zna uporabljati računalniška orodja za modeliranje in simulacijo dinamičnih procesov v logistiki.

Intended learning outcomes:

*Students*

- master the basic knowledge of continuous and discrete systems and can perform the mathematical and numerical modeling of dynamical systems,
- to gain the deep knowledge about the analysis, modelling and simulation of dynamic processes in logistics,
- to qualify for solving problems in this field,
- to know how to use computer tools for modelling and simulation of dynamical processes in logistics.

Metode poučevanja in učenja:

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).

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).

Learning and teaching methods:

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).

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 %) / Weight (in %) | Assessment: |
|---|---|---|
| • Opravljene domače naloge in projektna naloga,<br>• ustni izpit (teoretično in praktično znanje).<br><br>Opravljene obveznosti e-predavanj in e-vaj so pogoj za pristop k izpitu. | 40%<br>60% | • Completed home works and seminar (project) work,<br>• oral exam (theoretical and practical knowledge).<br>Successful completion of e-lectures and e-tutorials is a prerequisite for entering the exam. |

Reference nosilca / Lecturer's references:


1. Borovinšek, Matej., Ekren, Y. B., Burinskiene, A., Aurelija, Lerher, T. (2017). Multi-objective optimisation model of shuttle-based storage and retrieval system. Transport, ISSN 1648-4142. [Print ed.], 2017, Vol. 32, No. 2, 120-137, doi: 10.3846/16484142.2016.1186732.
2. Lerher, T., Borovinšek, M., Ficko, M., Palčič, I. (2017). Parametric study of throughput performance in SBS/RS based on simulation. International journal of simulation modelling, Vol. 16, No. 1, 96-107, doi: 10.2507/IJSIMM16(1)8.372.
3. Rosi, B., Grasic, L., Dukic, G., Opetuk, T., Lerher, T. (2016). Simulation-based performance analysis of automated single-tray vertical lift module. International journal of simulation modelling, Vol. 15, No. 1, 97-108. doi: 10.2507/IJSIMM15(1)8.328.
4. Lerher, T., Ekren, B. Y., Sari, Z., Rosi. B. (2016). Method for evaluating the throughput performance of shuttle based storage and retrieval systems. Technical Gazette, Vol. 23, No. 3, 715-723.
5. Lerher, T. (2016). Throughput and energy related performance calculations for shuttle based storage and retrieval systems, (Energy science, engineering and technology). New York: Nova Science Publishers, Inc., cop., pp 93.
6. Dukic, G., Opetuk, T., Lerher, T. (2015). A throughput model for a dual-tray Vertical Lift Module with a human order-picker. International journal of production economics, Vol.170, Part C, 874-881. doi:10.1016/j.ijpe.2015.04.009.
7. Lerher, T., Ekren, B. Y., Sari, Z., Rosi. B. (2015). Simulation Analysis of Shuttle Based Storage and Retrieval Systems. International Journal of Simulation Modelling, Vol. 14, No. 1, 48-59. doi: 10.2507/IJSIMM14(1)5.281
8. Lerher, T. (2015). Travel time model for double-deep shuttle-based storage and retrieval systems. International Journal of Production Research, Vol. 54, Issue 9, 2519-2540. doi: 10.1080/00207543.2015.1061717.
9. Lerher, T. (2013). Modern automation in warehousing by using the shuttle-based technology. V: ARENT, Doug (ur.), FREEBUSH, Monica (ur.). Automation systems of the 21st century : new technologies, applications and impacts on the environment & industrial processes, (Engineering tools, techniques and tables). New York: Nova Publishers, Inc., pp 51-86.
10. Lerher, T., Borovinšek, M., Šraml, M. (2013). A multi objective model for optimization of automated warehouses. V: CHEUNG, Jinghua (ur.), SONG, Huan (ur.). Logistics : perspectives, approaches and challenges. New York: Nova Publishers. Inc., pp. 87-110.
11. Lerher, T., Šraml, M. (2012). Designing unit load automated storage and retrieval systems. V: MANZINI, Riccardo (ur.). Warehousing in the global supply chain : advanced models, tools and applications for storage systems. London [etc.]: Springer., pp 211-231, doi: 10.1007/978-1-4471-2274-6_9.


Opomba:
Navedene sestavine so obvezna sestavina učnega načrta predmeta kot ga določajo Merila za akreditacijo visokošolskih zavodov in študijskih programov v 7. členu (Ur. l. RS, št. 101/2004).