UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Ime predmeta:	INTRALOGISTIKA 4.0
Course title:	INTRALOGISTICS 4.0

Študijski program in stopnja Study programme and cycle	Študijska smer Study option	Letnik Year of study	Semester Semester
LOGISTIKA SISTEMOV 3. stopnja		1.	1. in 2.
SYSTEM LOGISTICS 3rd degree		1.	1. in 2.

Vrsta predmeta (obvezni ali izbirni) / Course type (compulsory or elective)	IZBIRNI ELECTIVE
Univerzitetna koda predmeta / University course code:	DR

Predavanja Lectures	Seminar Seminar	Vaje Tutorial			Klinične vaje Clinical training	Druge oblike študija Other forms of study	Samost. delo Individual work	ECTS
		AV	LV	RV				
20							160	6

Nosilec predmeta / Course coordinator:	**TONE LERHER**
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 posebnih omejitev.	No special conditions.

Vsebina (kratek pregled učnega načrta):	**Content (syllabus outline):**
− Pomen intralogistike 4.0 v logistični verigi z vidika pretočne zmogljivosti, energetske učinkovitosti, trajnosti, informacijske podpore logističnim procesom ter digitalizacije. − Sodobni trendi v logistiki 4.0 (Industrija 4.0, Skladiščenje 4.0, Internet Stvari (IoT), Digitalizacija, Robotizacija, Umetna Inteligenca, ang. Physical Internet. − Informacijski in materialni tok v intralogistiki 4.0. − Skladiščni procesi v intralogistiki 4.0. − Skladiščenje 4.0 s poudarkom na procesu Komisioniranja blaga. − Centralno in decentralno vodeni transportno sistemi v intralogistiki 4.0. − Avtomatski in avtonomni transportno-skladiščni sistemi v intralogistiki 4.0. (ang. Automated Storage and Retrieval Systems, Shuttle-Based	− The importance of intralogistics 4.0 in the logistics chain in terms of throughput capacity, energy efficiency, sustainability, information support to logistics processes and digitization. − Modern trends in logistics 4.0 (Industry 4.0, Warehousing 4.0, Internet of Things (IoT), Digitalization, Robotization, Artificial Intelligence, Physical Internet. − Information and material flow in intralogistics 4.0. − Warehouse processes in intralogistics 4.0. − Warehousing 4.0 with the emphasis on the process of Order-Picking. − Centralised and decentralised control of transport systems in intralogistics 4.0. − Automatic and autonomous transport and warehousing systems in intralogistics 4.0

Storage and Retrieval Systems and Autonomous Vehicle Storage and Retrieval Systems). - Načrtovanje in modeliranje transportno-skladiščnih sistemov v intralogistiki 4.0 s poudarkom na: maksimalni pretočni zmogljivosti, minimalnih celotnih stroških, energetski učinkovitosti in trajnosti. - Več-objektna optimizacija transportno-skladiščnih sistemov v intralogistiki 4.0.	(Automated Storage and Retrieval Systems, Shuttle-Based Storage and Retrieval Systems and Autonomous Vehicle Storage and Retrieval Systems). - Design and modelling of transport and warehousing systems in intralogistics 4.0 with the emphasis on: maximum throughput capacity, minimum total cost, energy efficiency and sustainability. - Multi-objective optimization of transport and warehousing systems in intralogistics 4.0

Temeljni literatura in viri / Reading materials:

- Forger, Gary; Edwards, Charles; Ferrell, Bill; Hopper, Steve; Magliola, Dana; Schneider, Dave. (2017). Material Handling and Logistics U.S. Roadmap 2.0., Material Handling Industry of America (MHI).
- Bartholdi, John J. & Hackman, Steven T. (2017). Warehouse and distribution science, Release 0.98. The Supply Chain & Logistics Institute, H. Milton Stewart School of Industrial and Systems Engineering, Georgia Institute of Technology Atlanta, USA.
- Glock, Christoph & Grosse, Eric. (2017). Warehousing 4.0 - Technische Lösungen und Managementkonzepte für die Lagerlogistik der Zukunft. B + G Wissenschaftsverlag.
- Heinrich, Martin (2016). Transport- und Lagerlogistik: Systematik, Planung, Einsatz und Wirtschaftlichkeit. Springer Vieweg.
- Lerher, T. (2016). Throughput and Energy Related Performance Calculations for Shuttle Based Storage and Retrieval Systems. Nova Science Publishers, USA.
- Kagermann, Henning; Wahlster, Wolfgang; Helbig, Johannes. (2013). Recommendations for implementing the strategic initiative INDUSTRIE 4.0, National Academy of Science and Engineering, Germany.
- Lerher, T. & Šraml, M. (2012) Designing unit load automated storage and retrieval systems. V: MANZINI, Riccardo (editor). Warehousing in the global supply chain : advanced models, tools and applications for storage systems. London [etc.]: Springer. 2012, pp. 211-231.

Cilji in kompetence:	**Objectives and competences:**
- Podati povezana znanja sistemov intralogistike 4.0, s poudarkom na notranjem transportu, skladiščenju in komisioniranju. - Razviti sposobnost študentov za samostojno znanstveno-raziskovalno reševanje problemov načrtovanja in oblikovanja intralogistike 4.0, notranjega transporta, skladiščenja in komisioniranja.	- To provide integrated knowledge of the intralogistics 4.0 systems, with the emphasis on internal transport, warehousing and order-picking. - To develop student's capabilities of independent scientific-research solution solving for planning and designing of intralogistics 4.0, internal transport, warehousing and order-picking.

Predvideni študijski rezultati:	**Intended learning outcomes:**
Znanje in razumevanje: - Poznavanje sistemov intralogistike 4.0 v logistični verigi s poudarkom na notranjem transportu, skladiščenju in komisioniranju. - Znati znanstveno in raziskovalno predvideti in uporabiti napredne metode, modele, tehnike pri načrtovanju, oblikovanju in optimiranju sistemov intralogistike 4.0.	Knowledge and understanding: - Knowledge of intralogistics 4.0 systems in the logistics chain, with the emphasis on internal transport, warehousing and order-picking. - Knowledge of proper scientific-research anticipation and application of advanced methods, models, techniques by planning, design and optimization of intralogistics 4.0 systems. - Integration of theoretical knowledge and analytical/ numerical models in the development

− Povezovanje teoretičnih znanj in analitičnih/ numeričnih modelov pri izdelavi študij z uporabo naprednih računalniško podprtih orodij. Prenesljive/ključne spretnosti in drugi atributi: − Potrebno inženirsko znanje za načrtovanje, oblikovanje, modeliranje in optimiranje sistemov intralogistike 4.0 s poudarkom na notranjem transportu, skladiščenju in komisioniranju. − Poznavanje in uporaba naprednih računalniško podprtih orodjih za oblikovanje, modeliranje in optimiranje sistemov intralogistike 4.0	of studies by using advanced computer-aided tools. Transferable/Key Skills and other attributes: − The necessary engineering knowledge for planning, designing, modelling and optimizing intralogistics 4.0 systems, with an emphasis on internal transport, warehousing and order-picking. − The knowledge and the application of the advanced computer-aided tools for design, modelling and optimization of intralogistics 4.0 systems.

Metode poučevanja in učenja:	**Learning and teaching methods:**
− Predavanja. − Konzultacije. − Samostojno delo. − Izdelava (projektne) seminarske naloge.	− Lectures. − Consultations. − Individual work. − Seminar (project) work.

Načini ocenjevanja:	Delež (v %) / Share (in %)	**Assessment methods:**
− Raziskovalna naloga. − Izpit (teoretično in praktično znanje).	50% 50%	− Research work. − Exam (theoretical and practical knowledge).

Reference nosilca / Course coordinator's references:

1. 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.
2. 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.
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.