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
20		AV	LV	RV			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.	– 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.
– Sodobni trendi v logistiki 4.0 (Industrija 4.0, Skladiščenje 4.0, Internet Stvari (IoT), Digitalizacija, Robotizacija, Umetna Inteligenca, ang. Physical Internet.	– Modern trends in logistics 4.0 (Industry 4.0, Warehousing 4.0, Internet of Things (IoT), Digitalization, Robotization, Artificial Intelligence, Physical Internet.
– Informacijski in materialni tok v intralogistiki 4.0.	– Information and material flow in intralogistics 4.0.
– Skladiščni procesi v intralogistiki 4.0.	– Warehouse processes in intralogistics 4.0.
– Skladiščenje 4.0 s poudarkom na procesu Komisioniranja blaga.	– Warehousing 4.0 with the emphasis on the process of Order-Picking.
– Centralno in decentralno vodeni transportno sistemi v intralogistiki 4.0.	– Centralised and decentralised control of transport systems in intralogistics 4.0.
– Avtomatski in avtonomni transportno-skladiščni sistemi v intralogistiki 4.0. (ang. Automated Storage and Retrieval Systems, Shuttle-Based	– 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:

− Sposobnost povezovanja znanja sistemov intralogistike 4.0, s poudarkom na notranjem transportu, skladiščenju in komisioniranju.
− Zmožnost za samostojno znanstvenoraziskovalno reševanje problemov načrtovanja in oblikovanja intralogistike 4.0, notranjega transporta, skladiščenja in komisioniranja.

Objectives and competences:

− Ability to integrate knowledge of intralogistics 4.0 systems, with the emphasis on internal transport, warehousing and order-picking.
− Ability for independent scientific research solution solving for planning and designing of intralogistics 4.0, internal transport, warehousing and order-picking.

Predvideni študijski rezultati:

Znanje in razumevanje:
− Samostojno definirati problem s področja intralogistike 4.0 in ga rešiti.
− Kritično ovrednotiti in uporabiti napredne metode, modele, tehnike pri načrtovanju, oblikovanju in optimiranju sistemov intralogistike 4.0.
− Uporabiti modele in metode reševanja izzivov intralogistike 4.0 tudi na ostalih področjih v gospodarstvu.

Intended learning outcomes:

Knowledge and understanding:
− Independently define the problem in the field of intralogistics 4.0 and solve it. Critically evaluate and apply advanced methods, models, techniques by planning, design and optimization of intralogistics 4.0 systems.
Apply models and methods for solving the challenges of intralogistics 4.0 in other areas of the economy, as well.

Prenesljive/ključne spretnosti in drugi atributi:	Transferable/Key Skills and other attributes:
− 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	− 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. − Raziskovalna (projektna) naloga.	− Lectures. − Consultations. − Individual work. − Research (project) work.

Načini ocenjevanja:	Delež (v %) / Share (in %)	**Assessment methods:**
− Raziskovalna (projektna) naloga.	50%	− Research (project) work.
− Pisni izpit	50%	− Written examination

Reference nosilca / Course coordinator's references:

1. KÜÇÜKYAŞAR, Melis, EKREN, Banu Y., LERHER, Tone. Cost and performance comparison for tier-captive and tier-to-tier SBS/RS warehouse configurations. International transactions in operational research, ISSN 1475-3995. [Online ed.], July 2021, vol. 28, iss. 4, str. 1847-1863. https://doi-org.ezproxy.lib.ukm.si/10.1111/itor.12864, doi: 10.1111/itor.12864. [COBISS.SI-ID 25139715], [JCR, SNIP, WoS do 9. 11. 2021: št. citatov (TC): 7, čistih citatov (CI): 6, čistih citatov na avtorja (CIAu): 2.00, Scopus do 7. 11. 2021: št. citatov (TC): 10, čistih citatov (CI): 9, čistih citatov na avtorja (CIAu): 3.00] kategorija: 1A1 (Z, A'', A', A1/2); uvrstitev: Scopus (d), SCI, SSCI, Scopus, MBP; tip dela je verificiral OSICD točke: 39.34, št. avtorjev: 3

2. LERHER, Tone, FICKO, Mirko, PALČIČ, Iztok. Throughput performance analysis of automated vehicle storage and retrieval systems with multiple-tier shuttle vehicles. Applied mathematical modelling, ISSN 0307-904X. [Print ed.], Mar. 2021, vol. 91, str. 1004-1022, ilustr., doi: 10.1016/j.apm.2020.10.032. [COBISS.SI-ID 36277251], [JCR, SNIP, WoS do 15. 11. 2021: št. citatov (TC): 3, čistih citatov (CI): 3, čistih citatov na avtorja (CIAu): 1.00, Scopus do 8. 11. 2021: 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 OSICD točke: 44.52, št. avtorjev: 3

*3. AUGUSTYN, Lorenc, LERHER, Tone. PickupSimulo - prototype of intelligent software to support warehouse managers decisions for product allocation problem. Applied sciences, ISSN 2076-3417, **2020**, vol. 10, iss. 23, str. [1]-29, ilustr. https://doi.org/10.3390/app10238683, doi: 10.3390/app10238683. [COBISS.SI-ID 41594883], [JCR, SNIP] kategorija: 1A2 (Z, A1/2); uvrstitev: SCI, Scopus, MBP; tip dela še ni verificiran točke: 45.38, št. avtorjev: 2*