

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	SKLADIŠČNI SISTEMI IN SKLADIŠČNO POSLOVANJE
Course title:	WAREHOUSE SYSTEMS AND WAREHOUSE OPERATION

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
LOGISTIKA SISTEMOV 1. stopnja		2.	4.
SYSTEM LOGISTICS 1 st degree		2.	4.

Vrsta predmeta / Course type: OBVEZNI

Univerzitetna koda predmeta / University course code: UN

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje Laboratory work	Druge oblike študija Field work	Samost. delo Individ. work	ECTS
e-P 15 a-P 30		e-V 9 a-V 15	6		105	6

Nosilec predmeta / Lecturer: TONE LERHER

Jeziki / Predavanja / Lectures: SLOVENSKI / SLOVENE
 Languages: Vaje / Tutorial: SLOVENSKI / SLOVENE

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:
Ni pogojev.

Prerequisites:
None.

Vsebina:

Razvoj in pomen skladiščnih sistemov v transportno-skladiščni logistični funkciji.
 Materialni tok – skladišče kot sistem čakalne vrste (zalogska in pretočna zmogljivost).
 Operacije skladiščenja – sprejem, naročila, komisioniranje, kontrola, pakiranje, odprema.
 Upravljanje skladiščnih sistemov – sprejem in odprema, zaloge, lastnosti, oskrba trga.
 Skladiščna in manipulativna oprema: oprema za uskladiščenje, transporterji, sortirna oprema.
 Vrste viličarjev – glede na principe delovanja, pogone, zmogljivosti, nosilnosti.
 Transportni vozički – klasični, avtonomni, zložljivi, montažni – namenski vozički, induktivno vodeni itd.
 Transportno skladiščne enote – palete, zaboji.
 Varovanje tovora, varno manipuliranje in varno upravljanje s transportnimi sredstvi.
 Skladiščne strategije kot podpora skladiščnim procesom (sistem za upravljanje in naročanje transporta, vpeljava ABC sistema pri uskladiščenju blaga).
 Komisioniranje – načini, sredstva, cone.
 Oblikovanje skladiščnih sistemov – regalni skladiščni sistemi, konstrukcija skladišč, optimiranje oblike.
 Potreba in vpeljava zunanjega logističnega servisa -

Content (Syllabus outline):

Development and importance of warehouse systems in the transport-warehouse logistics function.
 Material flow – warehouse as a queuing system (warehouse volume and throughput capacity).
 Warehouse operations – receiving, process customer orders, order-picking, checking, packing, put away.
 Warehouse management systems – receiving and shipping, stock locator system, features, market supply.
 Storage and handling equipment – storage equipment, transporters, sorting equipment etc.
 Types of forklifts – due to their working principles, drive motors, carrying capacity, bearing strength.
 Transportation handcarts – classical, autonomous, folding, assembling – special handcarts, inductive guided etc.
 Transport unit loads – pallets, boxes etc.
 Protection of goods and safety manipulating and safety managing with transport devices.
 Warehouse strategies as a support to the warehousing processes (the system for managing-ordering of transport, the application of ABC system with the storage of goods).
 Order picking – types, equipment, zones.
 Design of warehouse systems – storage rack systems, construction of the warehouse, shape optimisation.

"outsourcing".

Need for implementing external logistics service - "outsourcing".

Temeljni literatura in viri / Readings:

- E-gradivo predmeta.
- Glock, Christoph & Grosse, Eric. (2017). Warehousing 4.0: Technische Lösungen und Managementkonzepte für die Lagerlogistik der Zukunft, B + G Wissenschaftsverlag.
- Lerher, T., Potrč, I. (2017) Transportni sistemi v intralogistiki. Univerza v Mariboru, Fakulteta za logistiko.
- 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.
- Kay B.M. (2016) Lecture Notes for Production system design, North Carolina State University, USA.
- Gudehus, T. (2012) Logistik 1: Grundlagen, Verfahren und Strategien, Springer Verlag, Berlin.
- Arnold, D. (2002) Handbuch Logistik, Berlin, Springer Verlag, ISBN: 3-540-41996-9, COBISS.SI-ID: 24234757.

Cilji in kompetence:

Študenti pri tem predmetu:

- se seznanijo s skladiščnimi sistemi in skladiščnim poslovanjem s poudarkom na sodobnih transportno-skladiščnih sistemih, avtomatizaciji in robotizaciji skladiščnih procesov,
- se usposobijo za povezavo znanj teoretičnih in numeričnih modelov načrtovanja in optimiranja transportno-skladiščnih sistemov,
- se usposobijo za samostojno in kreativno reševanje problemov načrtovanja skladiščnih sistemov.

Objectives and competences:

In the framework of this subject, the students will:

- get to know with warehouse systems and warehouse activity with the emphasis on modern transport-warehousing systems, automation and robotisation by warehouse process,
- To get integrated knowledge of the theoretical and numerical models for the design and optimization of transport-warehousing systems,
- to get knowledge for solving independent and creative solutions of designing warehouse systems.

Predvideni študijski rezultati:

Znanje in razumevanje:

- povezovati uporabo različnih znanj za reševanje problemov skladiščenja in izbire opreme,
- aplikacija algoritmov optimiranja skladiščnih sistemov na realne probleme skladiščenja,
- poznavanje pojma tehniške logistike,
- poznavanje osnovnih konceptov logistične verige, principov delovanja sistemov transporta, projektnih zahtev in sledenje tovora v logističnem sistemu,
- povezovanje različnih znanj in postopkov ter pomena uporabe strokovne literature in računalniških sistemov za reševanje logističnih problemov.

Intended learning outcomes:

Knowledge and Understanding

- combined use of different fundamental skills for solution of warehousing and equipment selection,
- application of algorithms for storage systems optimization applied on real practical problems,
- knowledge of technical logistics conception,
- knowledge of fundamental principles of logistics – supply chain, operation principles of transport systems, projects demands and tracking the freight in the logistics system,
- connection of different knowledge and procedures and importance of professional literature and computer systems for efficient solutions of logistics problems.

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

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 tutorial is in a classroom while the rest is in the form of e-tutorials (e-

na videokonferenčni način ali s pomočjo posebej v ta namen didaktično pripravljenih e-gradiv v virtualnem elektronskem učnem okolju).

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:
<ul style="list-style-type: none"> ▪ Opravljene obveznosti e-predavanj in e-vaj so pogoj za pristop k izpitu . ▪ Pisni izpit. ▪ Ustni izpit. 	<p style="text-align: center;">50%</p> <p style="text-align: center;">50%</p>	<ul style="list-style-type: none"> ▪ Successful completion of e-lectures and e-tutorials is a prerequisite for entering the exam. ▪ Written exam. ▪ Oral exam.

Reference nosilca / Lecturer's references:

1. Lerher, T. (2018). Aisle changing shuttle carriers in autonomous vehicle storage and retrieval systems. International Journal of Production Research, Vol. 56, Iss. 11, 3859-3879, doi: 10.1080/00207543.2018.1467060.
2. Ekren, B.Y., Akpunar, A., Sari, Z., Lerher, T. (2018). A tool for time, variance and energy related performance estimations in a shuttle-based storage and retrieval system. Applied mathematical modelling, Vol. 63, 109-127, <https://doi.org/10.1016/j.apm.2018.06.037>.
3. Lerher, T. (2018). Warehousing 4.0 by using shuttle-based storage and retrieval systems. FME Transactions, Vol. 46, Iss. 3, 381-385 doi: 10.5937/fmet1803381L.
4. 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.
5. 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.
6. 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.
7. Lerher, T., EDL, M., Rosi, B. (2013) Energy efficiency model for the mini-load automated storage and retrieval systems. The international journal of advanced manufacturing technology, Vol. 70, No. 1/4, 97-115, doi: 10.1007/s00170-013-5253-x.