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| **UČNI NAČRT PREDMETA / COURSE SYLLABUS** |
| **Ime predmeta:** | SKLADIŠČNA TEHNIKA IN TEHNOLOGIJA |
| **Course title:** | WAREHOSE TECHNICS AND TECHNOLOGY |
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| **Študijski program in stopnja****Study programme and cycle** | **Študijska smer****Study option** | **Letnik****Year of study** | **Semester****Semester** |
| GOSPODARSKA IN TEHNIŠKA LOGISTIKA 1. stopnja |  | 2. | 3. |
| PROFESSIONAL HIGHER EDUCATION STUDY PROGRAMME ECONOMIC AND TECHNICAL LOGISTICS 1st degree |  | 2. | 3. |
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| **Vrsta predmeta (obvezni ali izbirni) /** **Course type (compulsory or elective)** | OBVEZNI |
| COMPULSORY |
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| **Univerzitetna koda predmeta / University course code:** | VS |
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| **Predavanja****Lectures** | **Seminar****Seminar** | **Vaje****Tutorial** | **Klinične vaje****Clinical training** | **Druge oblike študija****Other forms of study** | **Samost. delo****Individual work** |  | **ECTS** |
| 20 e-P40 a-P |  |  |  |  |  |  | 90 |  | 6 |
| **a-V** | **e-V** | **LV** |  |
| 15 | 5 | 10 |  |
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| **Nosilec predmeta / Course coordinator:** | **TONE LERHER** |
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| **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 pogojev. |  | None. |
| **Vsebina (kratek pregled učnega načrta):**  |  | **Content (syllabus outline):** |
| 1. Materialno informacijski tok ter osnovni skladiščni procesi.
2. Transportna sredstva za kontinuirani in ciklični transport v skladiščih.
3. Transportni viličarji, AGV in AMR.
4. Skladiščna tehnika za palete, kartone/zaboje in posamezne artikle.
5. Komisioniranje "komisionar-k-blagu" in "blago-h-komisionarju".
6. Tehnologije komisioniranja.
7. Vzdrževanje skladiščnih in manipulativnih sredstev.
8. Varovanje tovora v medskladiščnem transportu.
 |  | 1. Material and information flow and basic warehouse processes.
2. Material handling systems for continuous and discrete transport in warehouses.
3. Industrial trucks and vehicles.
4. Storage technique for pallets, packages/totes and individual pieces.
5. Order-picking.
6. Order-picking technologies.
7. Maintenance of storage and material handling devices.
8. Cargo securing in transport between warehouses.
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| **Temeljni literatura in viri / Reading materials:** |
| * Lerher, T. (2021). Skladiščno-komisionirni sistemi. Univerza v Mariboru, Fakulteta za strojništvo.
* Lerher, T. (2022). Avtomatska vozila in mobilni roboti v intralogistiki. Univerza v Mariboru, Fakulteta za strojništvo.
* Martin, H. (2021). Technische Transport- und Lagerlogistik, Springer Vieweg.
* Wehking, K.F. (2020). Technisches Handbuch Logistik 1, Fördertechnik, Materialfluss, Intralogistik, Springer Vieweg.
* Wehking, K. F. (2020). Technisches Handbuch Logistik 2, Fördertechnik, Materialfluss, Intralogistik, Springer Vieweg.
* Ten Hompel, M., Schmidt, T., Dregger, J. (2018). Materialflusssysteme, Förder- und Lagertechnik, Springer Vieweg.
* Ten Hompel, M., Sadowsky, V., Beck, M. (2011). Kommissionierung, Materialflusssysteme 2 - Planung und Berechnung der Kommissionierung in der Logistik, Springer-Verlag Berlin Heidelberg.
* Ten Hompel, M., Schmidt, T. (2010). Warehouse Management, Organisation und Steuerung von Lager- und Kommissioniersystemen, Springer-Verlag Berlin Heidelberg.
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| **Cilji in kompetence:** |  | **Objectives and competences:** |
| Cilji predmeta:* opredeliti pomen skladišča v intralogistiki,
* predstaviti tehnično-tehnološke rešitve za učinkovito izvajanje skladiščnih procesov s poudarkom na procesu komisioniranja,
* predstaviti primer načrtovanja in analize učinkovitosti komisionirno-skladiščnih sistemov,
* pojasniti prednosti uporabe avtomatiziranih rešitev v skladiščih,
* opredeliti pomen vzdrževanja skladiščnih in manipulativnih sredstev ter varovanja tovora v medskladiščnem transportu,
* opredeliti sistematični pristop pri reševanju izzivov skladiščnih sistemov v praksi.

Kompetence, ki jih študentje osvojijo: * spoznati in razumeti delovanje različnih skladiščnih sistemov v praksi,
* se usposobiti za načrtovanje in analizo učinkovitosti komisionirno-skladiščnih sistemov,
* se usposobiti za izbiro in implementacijo različne skladiščne tehnike in tehnologije,
* se usposobiti za izbiro ustreznega transportnega sredstva pri procesih prevzema, uskladiščenja, komisioniranja in odpreme.
* se usposobiti za izdelavo projektnega plana skladišča ter analizirati materialne tokove, kapaciteto in pretočno zmogljivost skladišča,
* se usposobiti za učinkovito izvajanje procesa vzdrževanja skladiščnih in manipulativnih sredstev,
* se usposobiti za izbiro metod pri načrtovanju varovanja tovora v medskladiščnem transportu.
 |  | Objectives:* define the meaning of the warehouse in intralogistics,
* present technical-technological solutions for an efficient implementation of storage processes with a focus on the order-picking process,
* present an example of planning and analysing the efficiency of order-picking and storage systems,
* explain the advantages of using automated solutions in warehouses,
* define the importance of maintaining storage and handling devices and cargo securing in transport between warehouses,
* define a systematic approach to solving storage system challenges in practice.

Competences that students acquire: * learn about and understand how different storage systems work in practice,
* gain the ability to plan and to analyse the efficiency of order-picking and storage systems,
* gain the ability to select and to implement different storage techniques and technologies,
* gain the ability to select the appropriate means of transportation in the processes of receiving, storing, order-picking, and shipping,
* gain the ability to develop a project plan for a warehouse and to analyse material flows, storage volume, and throughput performance of the warehouse,
* gain the ability to effectively implement the process of maintaining storage and handling devices.
* gain the ability to select methods of planning cargo securing in transport between warehouses.
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| **Predvideni študijski rezultati:** |  | **Intended learning outcomes:** |
| Študent je ob zaključku predmeta zmožen:* uporabiti ustrezno skladiščno tehniko in tehnologijo pri načrtovanju skladišča,
* načrtovati, analizirati in ovrednotiti uporabo izbrane transportno skladiščne tehnike za učinkovito poslovanje skladišča,
* načrtovati prostorsko razvrstitev "layout" skladišča,
* uporabiti osnovne modele in tehnična priporočila (VDI, FEM) pri načrtovanju skladišč,
* uporabiti metode za učinkovito izvajanje procesa vzdrževanja skladiščnih in manipulativnih sredstev,
* zagotoviti varnost tovora v medskladiščnem transportu z uporabo metod proti zdrsu in prevračanju tovora.
 |  | At the end of the course, the student is able to: * use appropriate storage techniques and technologies in warehouse planning,
* plan, analyse and evaluate the use of the selected transport and storage technology for the efficient operation of the warehouse,
* plan the layout of the warehouse,
* use basic models and technical guidelines (VDI, FEM) for the design of warehouses,
* use methods to effectively implement the process of maintaining storage and handling devices,
* ensure the safety of cargo in transport between warehouses by using methods to prevent the cargo from slipping and tipping.
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| **Metode poučevanja in učenja:** |  | **Learning and teaching methods:** |
| 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 laboratoriju, 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). Tutorials: Students enhance their theoretical knowledge and are able to apply it. Part of the seminar is in a laboratory 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:** |
| * Opravljene obveznosti e-predavanj in e-vaj so pogoj za pristop k izpitu.
* Pisni izpit.
* Ustni izpit.
* Poročilo o laboratorijskih vajah.
 | 40%50%10% | * Successful completion of e-lectures and e-tutorials is a prerequisite for entering the exam.
* Written examination.
* Oral exam.
* Laboratory exercise report.
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| **Reference nosilca / Course coordinator's references:**  |
| 1. Jerman, Boris; Ekren, Banu Y., KÜÇÜKYAŞAR, Melis, Lerher, Tone. (2021). Simulation-based performance analysis for a novel AVS/RS technology with movable lifts. Applied sciences. vol. 11, iss. 5, pp 1-14, DOI: [10.3390/app11052283](https://dx.doi.org/10.3390/app11052283).
2. Lorenc, Augustyn; Lerher, Tone. (2020). PickupSimulo - prototype of intelligent software to support warehouse managers decisions for product allocation problem. Applied sciences. vol. 10, iss. 23, pp 1-29, DOI: [10.3390/app10238683](https://dx.doi.org/10.3390/app10238683).
3. Rajković, Miloš; Zrnić, N. Đ.; Kosanić, N; Borovinšek, M.; Lerher, T. (2019). A multi-objective optimization model for minimizing investment expenses, cycle times and CO2 footprint of an automated storage and retrieval systems. Transport, Vol. 34, iss. 2, 275-286, doi: 10.3846/transport.2019.9686.
4. Lerher, Tone. (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.
5. Ekren, Banu Y., Akpunar, Anil, Sari, Zaki, Lerher, Tone. (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.
6. 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.
7. 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.
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