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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-P  40 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. | | | | | | | | |
| **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. | | | | | | | | | | | | | | | | | | | | |
| **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. | | | | | | | | |
| **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. | | | | | | | | |
| **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. |