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| | UČNI NAČRT PREDMETA/COURSE SYLLABUS |
| Predmet | Inovativna strega in montaža |
| Course title | Inovative Handling and Assembly |

| Študijski program in stopnja Study programme and level | Študijska smer Study field | Letnik Academic year | Semester Semester |
|---|---|---------------------------------------|------------------------------------|
| Tehnologije in sistemi v strojništvu/ 2. stopnja | Ni smeri študija | 2. letnik | 3. |
| Technologies and systems in mechanical engineering/ 2 nd Cycle | No study field | 2 nd year | 3 th |

Vrsta predmeta/Course type

Modularni/module

Univerzitetna koda predmeta/University course code

TSS M1 UN 1

| Predavanja Lectures | Seminar Seminar | Sem. vaje Tutorial | Lab. vaje Laboratory work | Teren. vaje Field work | Samost. delo Individ. work | ECTS |
|--------------------------------------|----------------------------------|-------------------------------------|--|---|---|-------------|
| 30 | | | 30 | | 120 | 6 |

Nosilec predmeta/Lecturer:

doc. dr. Tomaž Perme

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

slovenski/Slovenian
slovenski/Slovenian

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti: **Prerequisites:**

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| <ul style="list-style-type: none"> Vpis v drugi letnik študijskega programa. Študent mora pred izpitom pripraviti in predstaviti ter zagovarjati projektno seminarsko nalogo. | <ul style="list-style-type: none"> A prerequisite for inclusion is enrolment in the second year of study. Student has to prepare, present and defend a project seminar before the exam. |
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Vsebina:

Content (Syllabus outline):

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| <ul style="list-style-type: none"> <i>Uvod.</i> Osnovni pojmi in definicije: strega materiala in sredstev, strežni procesi, vpenjanje in pozicioniranje, vpliv strege na pretočne čase ter na prilagodljivost in učinkovitost proizvodnje, postopki spajanja, montažni procesi, vrste montaže, čas ciklusa in takt montaže, ergonomija, merila za vrednotenje uspešnosti strege in montaže. <i>Načrtovanje strežnih operacij.</i> Načrtovanje pozicioniranja in vpenjanja za različne izdelovalne procese, stroje in sisteme, načrtovanje prenosa materiala in sredstev v različnih izdelovalnih strojih in sistemih, računalniška podpora pri načrtovanju strežnih operacij. | <ul style="list-style-type: none"> <i>Introduction.</i> Basic terms and definitions: material handling, handling processes, clamping, the impact of handling on lead time, and production flexibility and efficiency, assembly technology and processes, type of assembly cycle and tact time, ergonomics, criteria for evaluating handling and assembly performance. <i>Planning handling operations.</i> Planning of positioning and clamping for various manufacturing processes, machines and systems, planning the transfer of material and resources in various manufacturing machines and systems, computer support in planning service operations. |
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| <ul style="list-style-type: none"> • <i>Napredni gradniki za strežne operacije in sisteme.</i> Prilagodljivi in računalniško vodeni vpenjalni pripomočki in naprave, sodobne naprave za hranjenje, urejanje, dodajanje, doziranje in ločevanje, sodobni manipulatorji in industrijski roboti, prilagodljiva prijemala, sodobni transportni trakovi in paletni transportni sistemi, samodejno vodena vozila in vozički. • <i>Strežne naprave in sistemi.</i> Napredne strežne naprave in sistemi za obdelovalne stroje in sisteme, stroje in postrojenja za preoblikovanje, stroje in sisteme za tlačno litje in brizganje plastike, stroje in naprave za alternativne obdelovalne tehnologije in za kontrolo kakovosti ter digitalna orodja za razvoj in vrednotenje strežnih naprav in sistemov. • <i>Načrtovanje montažnih operacij in procesov.</i> Montažna struktura izdelka, montažno usmerjena analiza izdelka, opredelitev montažnih operacije in njihovega zaporedja, določitev časov in vrste montažnih operacij, digitalna inženirska orodja za načrtovanje montažnih operacij in procesov. • <i>Načrtovanje delovnih mest in montažnih sistemov.</i> Združevanje operacij in oblikovanje delovnih mest, ročna, mehanizirana in avtomatizirana montažna mesta, povezava delovnih mest v montažni sistem, ocena zmogljivosti in stroškov montaže, digitalna inženirska orodja za načrtovanje in vrednotenje montažnih delovnih mest in sistemov. • <i>Napredni gradniki in montažni sistemi.</i> Napredni gradniki za urejanje in dodajanje ter avtomatizacijo montažnih procesov, industrijski roboti, sodelujoči roboti, mobilni roboti, strojni in robotski vid, 3D-vid, modularni montažni sistemi, prilagodljivi in preuredljivi montažni sistemi, pametni montažni sistemi, digitalna orodja za oblikovanje in vrednotenje delovanja montažnih sistemov. | <ul style="list-style-type: none"> • <i>Advanced components for handling operations and systems.</i> Flexible and computer-controlled clamping devices, modern devices for storing, ordering, feeding and separating, modern manipulators and industrial robots, flexible grippers, modern conveyor belts and pallet conveyor systems, automatically controlled vehicles and trolleys. • <i>Handling devices and systems.</i> Advanced handling devices and systems for machine tools and systems, forming machines and plants, die casting and injection molding machines and systems, machines and devices for alternative machining technologies and for quality control, and digital tools for development and evaluation of handling devices and systems. • <i>Planning of assembly operations and processes.</i> Assembly structure of the product, assembly-oriented analysis of the product, defining the assembly operations and their sequence, determination of times and types of assembly operations, digital engineering tools for planning assembly operations and processes. • <i>Design of workplaces and assembly systems.</i> Combining operations and design of assembly places; manual, mechanized and automated assembly places, connecting assembly places into an assembly system, evaluation of capacity and costs, digital engineering tools for planning and evaluating assembly places and systems. • <i>Advanced components and assembly systems.</i> Advanced ordering and feeding components and components for automated assembly processes, industrial robots, collaborative robots, mobile robots, machine vision, 3D-vision, modular assembly systems, flexible and reconfigurable assembly systems, smart assembly systems, digital tools for design and performance evaluation of assembly systems. |
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Temeljna literatura in viri/Readings:

Temeljna literatura/Basic literature

- BOOTHROYD, Geoffrey. *Assembly Automation and Product Design*. Boca Raton [etc.]: Taylor & Francis, 2005. ISBN - 1-57444-643-6
- BALIČ, Jože. *Inteligentni obdelovalni sistemi*. Maribor: Univerza v Mariboru, Fakulteta za strojništvo, 2004. ISBN 86-435-0579-X
- ČUŠ, Franc in drugi avtorji. *Vpenjalne priprave za procese odrezavanja*. Maribor: Fakulteta za strojništvo, 2004. ISBN - 86-435-0608-7

Priporočljiva literatura/Recommended literature

- NOF, Shimon Y., Wilbert W. WILHELM in Hans-Jürgen WARNECKE. *Industrial Assembly*. London [etc.]: Chapman & Hall, 1997. ISBN - 0-412-55770-3
- DROZDA, Tom. *Tool and manufacturing engineers handbook. Vol. 9, Material and part handling in manufacturing : a reference book for manufacturing engineers, managers, and technicians*. Dearborn: Society of Manufacturing Engineers, cop., 1998. ISBN - 0-87263-489-2
- BALANTIČ, Zvone, Andrej POLAJNAR in Simona JEVŠNIK. *Ergonomija v teoriji in praksi*. Ljubljana: Nacionalni inštitut za javno zdravje, 2016. ISBN - 978-961-6911-91-7

Cilji in kompetence:

Učna enota prispeva predvsem k razvoju naslednjih splošnih in specifičnih kompetenc:

- sposobnost samostojnega in ustvarjalnega raziskovalno-razvojnega dela na področju strojništva,
- sposobnost samostojnega spremljanja in kritične presoje najnovejših dosežkov s področja strojništva in širše,
- sposobnost aktivnega pisnega in ustnega sporazumevanja na visoki strokovni kot tudi na poljudni ravni, odvisno od ciljnega občinstva,
- sposobnost timskega dela s strokovnjaki z različnih področij,
- sposobnost učinkovite uporabe informacijsko-komunikacijske tehnologije,
- sposobnost prevzeti odgovornost za lasten poklicni in osebni razvoj,
- sposobnost delovanja v sozvočju s poklicno, okoljsko, socialno in etično odgovornostjo.
- poznavanje in razumevanje naprednih strežnih in montažnih procesov, gradnikov in in sistemov,
- obvladovanje izbranih metod in orodij za načrtovanje in vrednotenje na področju strege in montaže,
- sposobnost reševanja konkretnih problemov s področja strege in montaže z uporabo naprednih inženirskih orodij v digitalnem okolju.

Objectives and competences:

The learning unit mainly contributes to the development of the following general and specific competences:

- ability of independent and creative research and development work in the field of mechanical engineering,
- ability to independently perceive and critically assess the latest achievements in the field of mechanical engineering and beyond,
- ability to actively communicate in writing and orally at a high professional as well as at a popular level, depending on the target audience,
- ability to work in teams with experts from different fields,
- ability to effectively use information and communication technology,
- ability to take responsibility for one's own professional and personal development,
- ability to work according to professional, environmental, social and ethical responsibility.
- knowledge and understanding of advanced handling and assembly processes, components and systems,
- mastery of selected methods and tools for planning and evaluation in the field of handling and assembly,
- ability to solve problems in the field of handling and assembly using advanced engineering tools in the digital environment.

Predvideni študijski rezultati:

Študent/študentka:

- pozna procese, gradnike in sisteme napredne strege in montaže,
- pozna metode, postopke in orodja za načrtovanje in vrednotenje naprednih strežnih in montažnih procesov in sistemov,
- razume namen, vlogo in uporabo strežnih in montažnih sistemov v praksi ter njihov vpliv na učinkovitost sodobne proizvodnje,

Intended learning outcomes:

Students:

- know the processes, building blocks and systems of advanced handling and assembly,
- know the methods, procedures and tools for design and evaluation of advanced handling and assembly processes and systems,
- understand the purpose, role and use of handling and assembly systems in practice

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| <ul style="list-style-type: none"> • razvije znanja in sposobnosti za razvoj in vrednotenje strežnih in montažnih sistemov • se usposobi za uporabo naprednih inženirskih orodij za načrtovanje in vrednotenje strežnih in montažnih sistemov v digitalnem okolju, • zna kritično presojati in analizirati ter predvidevati uporabo novih dognanj in rešitev na področju strege in montaže. | <p>and their impact on the efficiency of modern production,</p> <ul style="list-style-type: none"> • develop knowledge and skills for the development and evaluation of handling and assembly systems, • develop skills in the use of advanced engineering tools for the design and evaluation of handling and assembly systems in the digital environment, • are able to critically assess and analyse, and anticipate the use of new findings and solutions in the field of handling and assembly. |
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Metode poučevanja in učenja:

Learning and teaching methods:

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| <ul style="list-style-type: none"> • <i>predavanja</i> z aktivno udeležbo študentov (razlaga, diskusija, vprašanja, primeri, reševanje problemov), • <i>avditorne vaje</i>: reševanje problemov, študije primerov, kritično presojanje, diskusija, refleksija izkušenj, vrednotenje, projektno delo, timsko delo, • <i>laboratorijske vaje</i>: praktično reševanje več tipičnih problemov v laboratoriju (na računalniku), • <i>seminar</i>: priprava, predstavitev in uspešen zagovor projektne/raziskovalne naloge, (reševanje problemov, študije primera, kritično presojanje, diskusija, refleksija izkušenj, vrednotenje, projektno delo, timsko delo). | <ul style="list-style-type: none"> • <i>lectures</i> with active student participation (explanation, discussion, questions, examples, problem solving), • <i>tutorial</i>: problem solving, case studies, methods of critical thinking, discussion, reflection of experience, evaluation, project work, team work, • <i>laboratory work</i>: practical solving of several typical problems in laboratory (on a computer), • <i>seminar tutorial</i>: presentation and defence of project/research work (problem solving, studies, critical thinking, discussion, reflection of experience, evaluation, project work, team work). |
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Načini ocenjevanja:

Delež (v %)

Weight (in %)

Assessment:

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| <p>Načini:</p> <ul style="list-style-type: none"> • pisni izpit • projektno seminarsko delo <p>Ocenjevalna lestvica: ECTS.</p> | <p>60 %</p> <p>40 %</p> | <p>Types:</p> <ul style="list-style-type: none"> • written exam • project seminar <p>Grading scheme: ECTS.</p> |
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