UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	Strega in montaža
Course title:	Handling and Assembly

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Tehnologije in sistemi – prva stopnja	Tehnologije in sistemi	tretji	peti
Technologies and systems – 1st cycle	Technologies and systems	third	fifth

Vrsta predmeta / Course type	modularni/modular
Univerzitetna koda predmeta / University course code:	TS M4 UN2

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Laboratorijske vaje work	Druge oblike študija	Samost. delo Individ. work	ECTS
45		15	15		100	6

Nosilec predmeta / Lecturer:	doc. dr. Tomaž Perme

Jeziki / Languages:	**Predavanja / Lectures:**	slovenski/slovenian angleški/english
	Vaje / Tutorial:	slovenski/slovenian angleški/english

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	**Prerequisits:**
• vpis v tretji letnik.	• enrollment in the third year.

Vsebina:	**Content (Syllabus outline):**
• *Uvod*. Kratek pregled zgodovine, umestitev in vloga strege in montaže v proizvodnji, osnovna opredelitev strege in montaže. • *Osnove strege materiala in sredstev*. Osnovni pojmi in opredelitev strežnih procesov, vpliv strege na pretočne čase ter zmogljivost in prilagodljivost proizvodnih sistemov. • *Strežni pripomočki in sistemi*. Naprave za hranjenje, urejanje, dodajanje, doziranje in ločevanje, manipulatorji, roboti, prijemala,	• *Introduction.* A brief overview of the history, place and role of handling and assembly in production, basic definition of handling and assembly. • *Basics concepts of material handling and resource* management. Basic concepts and definition of handling processes, the impact of handling on flow times and the capacity and adaptability of production systems. • *Handling tools and systems*. Devices for feeding, arranging, adding, dosing and separating, manipulators, robots, grippers,

transportni trakovi, paletni transportni sistemi, samodejno vodeni vozički.

- *Vpenjalni pripomočki in naprave*. Osnove pozicioniranja in vpenjanja, pomen in vpliv pozicioniranja in vpenjanja na kakovost in učinkovitost proizvodnje, pozicionirni in vpenjalni elementi in sistemi, pozicioniranje in vpenjanja pri različnih postopkih in sistemih izdelave.
- *Ravnanje z orodji ter s strežnimi pripomočki in napravami*. Hranjenje, priprava in vzdrževanje pripomočkov in naprav, oskrba delovnih mest z orodji ter strežnimi pripomočki in napravami, sistem hitre menjave orodij in pripomočkov.
- *Načrtovanje in optimizacija strege*. Izhodišča za načrtovanje strežnih pripomočkov in sistemov, ocena produktivnosti, učinkovitosti in gospodarnosti proizvodnje glede na različne strežne pripomočke in sisteme, metode in postopki načrtovanja in vodenja strege in toka materiala, računalniška podpora načrtovanju in optimizaciji strege.
- *Osnove montaže*. Izdelek za montažo, postopki spajanja, vrste montaže, montažni procesi, čas ciklusa in takt montaže, merila za vrednotenje uspešnosti montaže.
- *Načrtovanje montaže*. Izhodišča za načrtovanje montaže, montažna struktura izdelka, montažne operacije in njihovo zaporedje, montažno usmerjena ABC-analiza, čas in vrsta montažnih operacij, oblikovanje delovnih mest, povezava delovnih mest v montažni sistem, ocena zmogljivosti in stroškov montaže.
- *Ročna montaža*. Organiziranje ročne montaže, ergonomija, pripomočki za ročno montažo, postopki in metode načrtovanja ročne montaže, standardi dela v montaži, sodobne tehnologije v ročni montaži.
- *Montažne naprave*. Naprave za mehanizacijo montažnih operacij, naprave za privijanje, vtiskovanje, kovičenje, lepljenje, lotanje in doziranje, delilne mize, urejevalne naprave, manipulatorji in montažni roboti, prijemala.

conveyor belts, pallet transport systems, automatically guided trolleys.

- *Clamping aids and devices*. Fundamentals of positioning and clamping, importance and impact of positioning and clamping on production quality and efficiency, positioning and clamping elements and systems, positioning and clamping in various manufacturing processes and systems.
- *Handling of tools and handling aids and devices.* Storage, preparation and maintenance of tools and devices, provision of workplaces with tools and service tools and devices, system for rapid replacement of tools and devices.
- *Planning and optimisation of handling.* Starting points for planning handling equipment and systems, evaluation of productivity, efficiency and economy of production in relation to various handling equipment and systems, methods and procedures for planning and managing the flow of services and materials, computer support for planning and optimisation of handling.
- Basics of assembly. Assembly product, joining procedures, types of assembly, assembly processes, cycle time and assembly cycle time, criteria for evaluating assembly performance.
- *Assembly planning.* Starting points for assembly planning, assembly structure of the product, assembly operations and their sequence, assembly-oriented ABC analysis, time and type of assembly operations, design of jobs, connection of jobs in the assembly system, assessment of assembly capacity and costs.
- *Manual assembly.* Organizing manual assembly, ergonomics, tools for manual assembly, procedures and methods of planning manual assembly, work standards in assembly, modern technologies in manual assembly.
- *Assembly devices*. Devices for mechanisation of assembly operations, devices for screwing, pressing, riveting, gluing, soldering

- *Montažni sistemi*. Enopostajni, krožni in linijski montažni avtomati, montažne celice, montažne linije, paletni montažni sistemi, prilagodljivi montažni sistemi, značilne postavitve montažnih sistemov, merila za izbiro montažnih naprav in sistemov.
- *Oblikovanje izdelka za strego in montažo*. Metode in orodja za oblikovanje izdelka za strego in montažo, računalniška podpora oblikovanju izdelkov za strego in montažo.
- *Kakovost in optimizacija strege in montaže*. Analiza FMEA, sistemi za nadzor montažnih procesov in testiranje izdelkov, stabilnost in sposobnost procesov, statistični nadzor procesov, šest sigma, razpoložljivost in zanesljivost strežnih in montažnih sistemov, vzdrževanje, analiza pretočnih časov, modeliranje in simulacija toka materiala, računalniško podprta orodja za načrtovanje in preverjanje montažnih sistemov v digitalnem okolju.

and dosing, dividing tables, editing devices, manipulators and assembly robots, grippers.
- *Assembly systems*. Single-station, circular and linear assembly machines, assembly cells, assembly lines, pallet assembly systems, flexible assembly systems, typical layouts of assembly systems, criteria for selecting assembly devices and systems.
- *Product design for handling and assembly.* Methods and tools for designing products for service and assembly, computer support for designing products for service and assembly.
- *Quality and optimisation of service and assembly.* FMEA analysis, assembly process control systems and product testing, process stability and capability, statistical process control, six sigma, availability and reliability of handling and assembly systems, maintenance, flow time analysis, material flow modeling and simulation, computer-aided design tools and verification of assembly systems in a digital environment.

Temeljni literatura in viri / Readings:

- Ammer, D., Bullinger, H. J. (1986). *Systematische Montageplanung : Handbuch fűr die Praxis*. München, Wien: C. Hanser, cop.
- Lotter, B., Schilling. W. (1994). *Mnuelle Montage : Planung, Rationalisierung, Wirtschaftlichkeit*, Düsseldorf: VDI
- Boothroyd, G. (2005). *Assembly Automation and Product Design.* Boca Raton: CRC Press.
- Nof, S., Wilhelm, W., Warnecke, H. (1997). *Industrial Assembly.* London: Chapman & Hall.
- Drozda, T. (1998). *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.
- Balantič, Z., Polajnar, A., Jevšnik, S. (2016). Ergonomija v teoriji in praksi, Ljubljana : Nacionalni inštitut za javno zdravje

Cilji in kompetence:

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

- sposobnost evidentiranja problema in njegove analize ter predvidevanja operativnih rešitev v tehnološkem smislu ali v procesu organizacije in vodenja,
- sposobnost obvladovanja standardnih razvojnih metod, postopkov in procesov,

Objectives and competences:

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

- the ability to grasp and analyse a problem, as well as foresee operational solutions in the technological sense or in the process of organisation and management,
- the ability to master standard development methods, procedures and processes,

• sposobnost uporabe pridobljenega teoretičnega znanja v praksi, • sposobnost obvladovanja razvoja in napredka, • razumevanje raznolikosti in globalnega ter socialnega vpliva tehnologij na okolje, • sposobnost razumevanja in uporabe sodobnih teorij s področja tehniških, tehnoloških in naravoslovnih ved, • sposobnost matematičnega razumevanja tehniških problemov in uporaba matematike pri reševanju le-teh, • sposobnost interdisciplinarnega povezovanja znanja, • sposobnost reševanja konkretnih delovnih problemov na področju tehnologij in sistemov z uporabo standardnih strokovnih metod in postopkov, • razvoj strokovnih veščin in spretnosti na področju tehnologij in sistemov, • sposobnost stalne uporabe informacijske in komunikacijske tehnologije na svojem strokovnem področju.	• the ability to use acquired theoretical knowledge in practice, • the ability to manage development and progress, • understanding of the diversity and global and social impact of technologies on the environment, • the ability to understand and apply modern theories in the fields of technical, technological and natural sciences, • the ability to understand technical problems mathematically and solve them with the help of mathematics, • the ability to integrate knowledge in an interdisciplinary manner, • the ability to solve specific work problems in the field of technologies and systems using standard professional methods and procedures, • development of professional skills and abilities in the field of technologies and systems, • the ability to continuously use information and communication technology in one's professional field.

Predvideni študijski rezultati:	**Intended learning outcomes:**
Znanje in razumevanje: *Študent/študentka:* • razume pomen in vlogo ter osnovne pojme in teoretične osnove strege in montaže, • pozna potek in metode načrtovanja ter osnovne gradnike in rešitve strežnih in montažnih sistemov, • zna uporabiti pridobljeno teoretično znanje za organiziranje in načrtovanje strežnih in montažnih sistemov v praksi, • zna poiskati in uporabiti ustrezno strokovno literaturo ter oceniti primernost razpoložljivih tehnologij in rešitev glede na potrebe in zahteve za strego in montažo.	Knowledge and understanding: *Student:* • understands the importance and role, as well as the basic concepts and theoretical foundations of handling and assembly, • knows the process and methods of planning and the basic building blocks and solutions of handling and assembly systems, • knows how to use the acquired theoretical knowledge to organise and plan handling and assembly systems in practice, • knows how to find and use relevant professional literature and assess the suitability of available technologies and solutions in relation to handling and assembly needs and requirements.

Metode poučevanja in učenja:	**Learning and teaching methods:**
• *predavanja z aktivnim sodelovanjem študentov* (razlaga, primeri iz prakse, vprašanja in diskusija, razvijanje ustvarjalnosti), • *vaje* na konkretnih primerih iz prakse, • *seminarska (projektna) naloga* (opredelitev naloge, zbiranje in pregled literature, zasnova ali opis ustrezne oziroma izbrane rešitve), • *strokovne ekskurzije in ogledi primerov iz prakse.*	• *lectures with active participation of students* (explanation, examples from practice, questions and discussion, development of creativity), • *tutorials* on concrete examples from practice, • *seminar (project) assignment* (definition of the assignment, collection and review of literature, design or description of the appropriate or selected solution), • *professional excursions and visits of examples from practice.*

Načini ocenjevanja:	Delež (v %) / Weight (in %)	**Assessment:**
Način (pisni izpit, ustno izpraševanje, naloge, projekt): • seminarska naloga • pisni (ustni) izpit Ocenjevalna lestvica: ECTS.	 40 % ocene 60 % ocene 	Type (examination, oral, coursework, project): • seminar assignment • written (verbal) exam Grading scale: ECTS.