INTELIGENTNI STREŽNI IN MONTAŽNI SISTEMI

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	INTELIGENTNI STREŽNI IN MONTAŽNI SISTEMI
Course title:	INTELLIGENT HANDLING AND ASSEMBLY SYSTEMS
Članica nosilka/UL Member:	UL FS

Študijski programi in stopnja	Študijska smer	Letnik	Semestri	Izbirnost
Strojništvo, tretja stopnja, doktorski	Proizvodno inženirske znanosti, kibernetika in mehatronika (smer)		Celoletni	izbirni

Univerzitetna koda predmeta/University course code:	0033472
Koda učne enote na članici/UL Member course code:	7317

Predavanja /Lectures	Seminar /Seminar	Vaje /Tutorials	Klinične vaje /Clinical tutorials	Druge oblike študija /Other forms of study	Samostojno delo /Individual student work	ECTS
90					160	10

Nosilec predmeta/Lecturer:	Niko Herakovič

Izvajalci predavanj:	Niko Herakovič
Izvajalci seminarjev:	
Izvajalci vaj:	
Izvajalci kliničnih vaj:	
Izvajalci drugih oblik:	
Izvajalci praktičnega usposabljanja:	

Vrsta predmeta/Course type:	Izbirni predmet /Elective course	

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

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	Prerequisites:
Veljajo splošni pogoji za doktorski študij.	General prerequisites for the third level studies.

Vsebina:	Content (Syllabus outline):
Strežni in montažni (SiM) procesi in sistemi (pregled tehnologij, naloge in osnovni koncepti SiM procesov in sistemov, načrtovanje in ovrednotenje SiM sistemov).	Handling and assembly (H&A) processes and systems (a review of technologies, tasks and basic concepts of (H&A) processes and systems, planning and evaluation of(H&A)systems).
Montažne operacije, zaporedje montažnih operacij kot osnova za opredelitev montažnega procesa.	Assembly operations, sequence of assembly operations as a basis for defining the assembly process.
Predstavitev sestavljenca in montažnih operacij v fazi razvoja in konstruiranja ter kreiranje podatkovne baze za računalniško podprto projektiranje montažnih postrojev. Načrtovanje izdelkov in simultano inženirstvo.	Presentation of assemled part and assembly operations in the development and design and the creation of a database for computer-aided design of assemly systems. The design of products and simultaneous engineering.
Avtomatizirani strežni in montažni (SiM)sistemi:	Automated handling and assembly systems:
• Fleksibilna avtomatizacija strege in montaže. • Modularna zasnova SiM sistemov.	• Flexible automation of handling and assembly. • The modular design of the (H&A).
Robotizirani strežni in montažni (SiM) sistemi:	Robotized handling and assembly systems:
• Roboti v stregi in montaži. • Robotizirane montažne celice. • Robotizirane montažne linije. • Fleksibilna prijemala v robotiziranih SiM sistemih.	• Robots in handling and assembly. • Robotic assembly cells. • Robotic assembly line. • Flexible grippers in robotized (H&A) systems.
Oblikovanje izdelkov za avtomatizirano in robotizirano strego in montažo in sočasni razvoj izdelkov ter SiM sistemov.	Product design for automated and robotised handling and assembly and simultaneous development of products and (H&A)systems.
Senzorika in aktorika v SiM sistemih:	Sensors and actuators in (H&A)

- Dotični in brezdotični senzorji v SiM sistemih. - Strojni vid v SiM sitemih. - Inteligentni senzorji in aktuatorji v SiM sistemih.	systems: - Tactile and non-tactile sensors in the (H&A) system. - Machine vision in the (H&A) sitemi. - Intelligent sensors and actuators in the (H&A) system.
Opredelitev inteligentnih strežnih in montažnih (SiM) sistemov: - Vrste inteligentnih naprav in sistemov. - Koncepti inteligentnih SiM. - Obvladovanje variantnosti izdelka v procesu strege in montaže.	The definition of intelligent handling and assembly systems: - Types of intelligent devices and systems. - Concepts of intelligent (H&A)systems. - The mastering of product variants in the process of assembly and handling.
Inteligentni strežni in montažni (SiM) sistemi: - Strojna in programska oprema v SiM sistemih. - Umetna inteligenca v SiM sistemih.	Intelligent handling and assembly (H&A) systems: - Hardware and software in the (H&A) system. - Artificial Intelligence in the (H&A) system.
Načrtovanje strežnih in montažnih sistemov: - Računalniško podprto načrtovanje SiM sistemov z uporabo metod simulacije v procesu načrtovanja in analize. - Modeliranje, simulacija in optimizacija SiM sistemov in naprav. - Sredstva in integracija skladiščenja ter proizvodnje.	Planning of handling and assembly systems: - Computer-aided design of H&A systems with using the methods of simulation in the process of planning and analysis. - Modeling, simulation and optimization of H&A systems and equipment. - Resources and integration of storage and production.
»Low cost« inteligentni strežni in montažni sistemi: - Strežni in montažni sistemi v malih in srednje velikih podjetjih. - Vloga enostavne avtomatizacije v sinhronih proizvodnih sistemih. - Enostavna avtomatizacija v stregi in montaži. - Enostavna avtomatizacija v pretoku polproizvodov, proizvodov in sestavljancev in v skladiščenju končnih proizvodov. - Pokayoke in uporaba enostavnih senzorjev v procesu strege in montaže. - Zagotavljanje in kontrola kakovosti v procesu strege in montaže.	Low-cost intelligent hanling and assembly systems: - Handling and assembly systems in small and medium-sized enterprises. - The role of simple automation in a synchronous production systems. - Simple automation in handling and assembly. - Simple automation in the flow of semi-products, products and assembled parts and in the storage of finished products. - Pokayoke and use of simple sensors in the process of assembly and handling.

	• Quality assurance and control in the process of handling and assembly.

Temeljna literatura in viri/Readings:

[1] Boothroyd, G.: Assembly Automation and Product Design, Second edition, CRC Press, 2005.

[2] Herakovič, N., Noe, D.: Strežni in montažni procesi ter sistemi, Učno gradivo, FS, 2009 (v nastajanju).

[3] Takeda, H.: LCIA – Low Cost Intelligent Automation – produktivitätsvorteile durch

    Einfachautomatisierung, Mi-Fachverlag, 2006.

[4] Gemeinschaftsausschuss CIM: Rechnerintegrierte Konstruktion und Produktion, Band 8: Flexible Montage, VDI verlag, 1992.

[5] Intelligent Assembly Systems, 1995, World Scientific, Edditors: M.H. Lee and J.J. Rowland.

[6] S.Y. Nof, W.E. Wilhelm, H.-J. Warnecke, Industrial Assembly, Chapman & Hall, London, 1997.

[7] P.K. Wright, D.A. Bourne, Manufacturing Intelligence, Addison-Wessley, 1988.

[8] H.K. Rampersad, Integrated and Simultaneous Design for Robotic Assembly, John Wiley & Sons, Inc. New York, NY, USA, 1994.

Cilji in kompetence:	**Objectives and competences:**
Cilji:	**Goals**:
• Nadgraditi znanja, potrebna za izbiro, snovanje in integracijo inteligentnih strežnih in montažnih procesov sistemov v proizvodnem procesu.	• The principal goal is to upgrade the skills needed for the selection, design and integration of intelligent handling and assembly processes and systems in the production process.
• Naučiti študente analize in snovanja strežnih in montažnih procesov ter sistemov in jim prikazati vlogo in pomen različnih inteligentnih sistemov v stregi in montaži.	• To teach students to analyse and design of handling and assembly processes and systems and to demonstrate the role and importance of the various intelligent systems in handling and assembly.
Kompetence:	**Competences**:
• Študent osvoji znanja s področja strežnih in montažnih procesov in sistemov ter pridobi sposobnost odločanja in izbire tehnologij pri njihovem snovanju.	• The student acquires the knowledge in the field of handling and assembly processes and systems and the ability to obtain a decision and selection of technologies in their conception.
• Znanje in sposobnost izbire ustreznih montažnih postopkov z vidika stopnje avtomatizacije in inteligence ter s tehnoloških in ekonomskih vidikov.	• Knowledge and the ability of the selection of appropriate assembly procedures in the light of of automation and intelligence assembly

• Razumevanje delovanja inteligentnega strežnega in montažnega sistema in sposobnost sodelovanja pri njegovem načrtovanju in upravljanju.	level, and technological and economic considerations. • To understand the operation of intelligent handling and assembly system and the ability to participate in its planning and management.

Predvideni študijski rezultati:	**Intended learning outcomes:**
- Študent osvoji znanja s področja strežnih in montažnih procesov in sistemov ter pridobi sposobnost odločanja in izbire tehnologij pri njihovem snovanju. - Znanje in sposobnost izbire ustreznih montažnih postopkov z vidika stopnje avtomatizacije in inteligence ter s tehnoloških in ekonomskih vidikov. - Razumevanje delovanja inteligentnega strežnega in montažnega sistema in sposobnost sodelovanja pri njegovem načrtovanju in upravljanju.	Knowledge and understanding: - The student acquires the knowledge in the field of handling and assembly processes and systems and the ability to obtain a decision and selection of technologies in their conception. - Knowledge and the ability of the selection of appropriate assembly procedures in the light of of automation and intelligence assembly level, and technological and economic considerations. - To understand the operation of intelligent handling and assembly system and the ability to participate in its planning and management.

Metode poučevanja in učenja:	**Learning and teaching methods:**
Predavanja, laboratorijske vaje, seminarsko delo, e-izobraževanje, konzultacije. Seminarsko delo v čim večji meri navezujoče se na področje doktorskega raziskovanja. Študij z uporabo priporočene literature.	Lectures, laboratory practice & seminar work, e-education, consulting. The seminar work is related, as much as possible, to the student's doctoral research field. Study on a recommended literature basis.

Načini ocenjevanja:	**Delež/ Weight**	**Assessment:**
Ustni izpit, poročilo o seminarskem delu. Pogoj za opravljanje ustnega izpita je uspešno izdelano in pozitivno ocenjeno seminarsko delo. Način (ustno izpraševanje, naloge, projektni seminar) • Naloge (30%) • Projektni seminar (40%) • Ustno izpraševanje (30%)		Oral exam, report on seminar work. The condition for admission to oral exam is successful completion of seminar work, rewarded with a passing grade. Method (written exam, oral examination, assignments, project): • assignments (30%) • project seminar (40%) • oral examination (30%)

Reference nosilca/Lecturer's references:

prof. dr. Niko HERAKOVIČ

HERAKOVIČ, Niko, METLIKOVIČ, Peter, DEBEVEC, Mihael. Motivational lean game to support decision between push and pull production strategy. International journal of simulation modelling, ISSN 1726-4529, Dec. 2014, vol. 13, nr. 4, str. 433-446.

HERAKOVIČ, Niko. Računalniški in strojni vid v robotizirani montaži = Computer and machine vision in robot-based assembly. Strojniški vestnik, ISSN 0039-2480, 2007, letn. 53, št. 12, str. 858-873.

HERAKOVIČ, Niko, ŠIMIC, Marko, TRDIČ, Francelj, SKVARČ, Jure. A machine-vision system for automated quality control of welded rings. Machine vision and applications, ISSN 0932-8092, 2011, vol. 22, no. 6, str. 967-981.

DEBEVEC, Mihael, ŠIMIC, Marko, HERAKOVIČ, Niko. Virtual factory as an advanced approach for production process optimization. International journal of simulation modelling, ISSN 1726-4529, Mar. 2014, vol. 13, no. 1, str. 66-78.

PIPAN, Miha, KOS, Andrej, HERAKOVIČ, Niko. Adaptive algorithm for the quality control of braided sleeving : Miha Pipan, Andrej Kos, and Niko Herakovic. Advances in mechanical engineering, ISSN 1687-8132. [Printed ed.], 2014, str. 1-8.