

UČNI NAČRT PREDMETA / COURSE SYLLABUS

Predmet:	Avtomatizacija
Course title:	Automatization

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 M1 UN3

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:

- vpis v tretji letnik.

Prerequisites:

- enrollment in the third year.

Vsebina:

- *Uvod v avtomatizacijo.* Kratki zgodovinski pregled področja, pomena in koristi ter prihodnosti avtomatizacije v procesni industriji.
- *Osnove avtomatizacije.* Sistemi, procesi, signali in sistemska teorije, načela in teorije vodenja ter načrtovanje in sistemsko inženirstvo. Predstavitev tehniških procesov in sistemov ter vrste procesov.
- *Modeliranje sistemov.* Diferencialne enačbe, prenosne karakteristike, blokovna

Content (Syllabus outline):

- *Introduction to automation.* A brief historical overview of the field, the importance and benefits, and the future of automation in the process industry.
- *Basics of automation.* Systems, processes, signals and systems theories, management principles and theories, design and systems engineering. Presentation of technical processes and systems and types of processes.
- *Modeling of systems.* Differential equations, transfer characteristics, block algebra,

algebra, Laplaceova transformacija, Fourierova transformacija.

- *Analiza in sinteza sistemov.* Stabilnost sistemov, odstopke v stacionarnem stanju, korenska krivulja, sinteza v frekvenčni domeni, PID krmilniki, diskretni PID krmilniki, izvedba prenosnih karakteristik.
- *Orodja.* Orodja za načrtovanje in sistemsko analizo, programska orodja za regulatorje krmilnike in računalniške nadzorne sisteme.
- *Modeliranje in simulacija.* Vnos in simulacija linearnih dinamičnih sistemov. Simulacijska shema in prenosna funkcija. Osnovne lastnosti simulacijskih sistemov. Simulacijsko okolje MATLAB-Simulink, osnovna uporaba in analiza modelov s simulacijskim programom Simulink.
- *Sistemi vodenja.* Namen, funkcije in zgradba sistemov za vodenje. Življenjski cikel sistemov za vodenje (zahteve, specifikacija, načrtovanje, izvedba, zagon in uvajanje, obratovanje, ponovna uporaba). Organiziranost, usposabljanje in ekonomski vidiki sistemov vodenja, informacijsko-komunikacijska varnost.
- *Gradniki.* Zaznavala in merilni sistemi, pogoni in izvršni sistemi, programirljivi logični krmilniki, regulatorji in procesni računalniki, realno-časovni sistemi, naprednejši sistemi vodenja, vmesniki za signale, vmesniki človek-stroj, komunikacijska omrežja.
- *Programirljivi krmilni sistemi.* Logična in sekvenčna vezja, relejska vezja, pnevmatična krmilna vezja, programirljivi logični krmilniki, načini programiranja po standardu IEC-61131-3, programiranje z lestvičnim diagramom.
- *Povezani sistem.* Informacijska povezava sestavin v avtomatizirano rešitev: procesna nadzorna omrežja (PCN), porazdeljeni nadzorni sistemi (DCS), izvršni proizvodni sistemi (MES), sistemi za nadzor (SCADA), sistemi za upravljanje stavb.

Laplace transformation, Fourier transformation.

- *Analysis and synthesis of systems.* Stability of systems, deviation in the stationary state, root curve, synthesis in the frequency domain, PID controllers, discrete PID controllers, implementation of transfer characteristics.
- *Tools.* Design and system analysis tools, software tools for regulators, controllers and computer control systems.
- *Modeling and simulation.* Input and simulation of linear dynamic systems. Simulation scheme and transfer function. Basic properties of simulation systems. MATLAB-Simulink simulation environment, basic use and analysis of models with Simulink simulation program.
- *Management systems.* Purpose, functions and structure of management systems. Life cycle of management systems (requirements, specification, design, implementation, commissioning and deployment, operation, reuse). Organization, training and economic aspects of management systems, information and communication security.
- *Building blocks.* Sensors and measurement systems, drives and execution systems, programmable logic controllers, regulators and process computers, real-time systems, advanced control systems, signal interfaces, man-machine interfaces, communication networks.
- *Programmable control systems.* Logical and sequential circuits, relay circuits, pneumatic control circuits, programmable logic controllers, IEC-61131-3 programming methods, ladder diagram programming.
- *Connected system.* Information connection of components into an automated solution: process control networks (PCN), distributed control systems (DCS), manufacturing executive systems (MES), supervisory control systems (SCADA), building management systems.

Temeljni literatura in viri / Readings:

Temeljna literatura/Basic literature

- PODRŽAJ Primož. *Linearna teorija krmiljenja sistemov*. Ljubljana: Fakulteta za strojništvo, 2014. ISBN - 978-961-6536-49-3
- PODRŽAJ Primož *Zbirka rešenih nalog s področja linearne teorije krmiljenja sistemov*. Ljubljana: Fakulteta za strojništvo, 2016. ISBN - 978-961-6536-74-5

Priporočljiva literatura/Recommended literature

- MUŠIČ, G. (2014). *Avtomatika*, učbenik za visokošolski strokovni študij. Ljubljana: Založba FE in FRI, 2014.
- STRMČNIK, S. in drugi (1998). *Celostni pristop k računalniškemu vodenju procesov*. Ljubljana: Založba FE in FRI, 1998.
- ZUPANČIČ, B. (2011). *Avtomatsko vodenje sistemov*, Učno gradivo, Ljubljana: Založba FE in FRI.
- OGATA Katsuhiko. *Modern control engineering*, Boston [etc.] : Prentice Hall, cop. 2010. ISBN - 978-0-13-615673-4
- DORF Richard C. in Robert H. BISHOP. *Modern control systems*, Harlow [etc.] : Pearson, cop. 2017. ISBN - 978-1-292-15
- KLJAJIČ Miroljub, *Teorija sistemov*, Kranj : Moderna organizacija, 1994. ISBN - 86-81049-82-8Kuo, B. C., Golnaraghi, F. *Automatic Control Systems*. New York: John Wiley & Sons, Inc. 2013
- JOHN, K.-H. in M., TIEGELKAMP, *IEC 61131-3: Programming Industrial Automation Systems, Second editon*. Berlin: Springer.2010

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,
- sposobnost uporabe pridobljenega teoretičnega znanja v praksi,
- sposobnost obvladovanja razvoja in napredka,
- razumevanje raznolikosti in globalnega ter socialnega vpliva tehnologij na okolje,
- avtonomnost v strokovnem delu,
- 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,

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,
- 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,
- autonomy in professional work,
- 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,

- sposobnost stalne uporabe informacijske in komunikacijske tehnologije na svojem strokovnem področju.

- 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:

Znanje in razumevanje:

Študent/študentka:

- pozna in razume zgodovino in osnove avtomatizacije ter njeno uporabo v procesni industriji,
- pozna potek in metode načrtovanja ter osnovne gradnike in rešitve avtomatizacije v procesni industriji,
- zna uporabiti pridobljeno teoretično znanje za načrtovanje osnovnih avtomatiziranih sistemov in rešitev za procesno industrijo,
- zna poiskati in uporabiti ustrezno strokovno literaturo ter oceniti primernost razpoložljivih tehnologij in rešitev glede na potrebe in zahteve za avtomatizacijo v procesni industriji,
- pozna osnove modeliranja in simulacije v programskem okolju MATLAB-Simulink ter programiranja programirljivih logičnih krmilnikov (PLK) za uporabo v procesni industriji.

Intended learning outcomes:

Knowledge and understanding:

Student:

- knows and understands the history and basics of automation and its application in the process industry,
- knows the process and methods of design and the basic building blocks and solutions of automation in the process industry,
- can apply the acquired theoretical knowledge to design basic automated systems and solutions for the process industry,
- can find and use appropriate professional literature and evaluate the suitability of available technologies and solutions with respect to the needs and requirements of automation in the process industry,
- knows the basics of modeling and simulation in the MATLAB-Simulink programming environment and programmable logic controllers (PLCs) for use in the process industry.

Metode poučevanja in učenja:

- *predavanja z aktivnim sodelovanjem študentov* (razlaga, primeri iz prakse, vprašanja in diskusija, razvijanje ustvarjalnosti),
- *vaje* z industrijsko opremo in 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.*

Learning and teaching methods:

- *lectures* with active participation of students (explanation, examples from practice, questions and discussion, development of creativity),
- *tutorials* with industrial equipment and concrete examples from practice,
- *seminar (project) task* (definition of the task, 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:
<p data-bbox="193 311 683 385">Način (pisni izpit, ustno izpraševanje, naloge, projekt):</p> <ul data-bbox="244 432 691 506" style="list-style-type: none"> <li data-bbox="244 432 691 465">• seminarska (projektna) naloga <li data-bbox="244 468 691 506">• pisni (ustni) izpit <p data-bbox="193 510 552 544">Ocenjevalna lestvica: ECTS.</p>	<p data-bbox="732 432 887 465">40 % ocene</p> <p data-bbox="732 468 887 501">60 % ocene</p>	<p data-bbox="943 311 1433 385">Type (examination, oral, coursework, project):</p> <ul data-bbox="994 432 1425 506" style="list-style-type: none"> <li data-bbox="994 432 1425 465">• seminar (project) assignment <li data-bbox="994 468 1425 506">• written (oral) exam <p data-bbox="943 510 1206 544">Grading scale: ECTS.</p>