UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	Osnove modeliranja in simulacije dogodkovnih in zveznih sistemov
Course title:	Fundamentals of Modelling and Simulation of Discrete and Continuous Systems

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Informatika v sodobni družbi, magistrski študijski program druge stopnje	-	Prvi ali drugi	Drugi ali četrti
Informatics in Contemporary Society, second cycle Masters Study Programme	-	First or second	Second or fourth

Vrsta predmeta / Course type

Izbirni / Elective

Univerzitetna koda predmeta / University course code:

1-ISD-MAG-IP-OMSDZS-2016-10-01

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje work	Druge oblike študija	Samost. delo Individ. work	ECTS
30	-	15	-	30	75	5

Nosilec predmeta / Lecturer:

Jeziki / Languages:	Predavanja / Lectures:	Slovenski, angleški / Slovene, English
	Vaje / Tutorial:	Slovenski, angleški / Slovene, English

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	**Prerequisits:**
Študent/študentka mora pred pristopom k izpitu pripraviti in zagovarjati empirično seminarsko nalogo.	The student is obliged to prepare and defend his/her assignments before the admission to the examination.

Vsebina:	**Content (Syllabus outline):**
• *Uvod v predmet.* Namen študija predmeta, povezanost predmeta z drugimi predmeti, vsebina študija predmeta, študijska literatura. Simulacija sistemov in reševanje poslovnih in organizacijskih problemov. • *Diskretna dogodkovno orientirana simulacija.* Stohastične spremenljivke in verjetnostna funkcija. Verjetnostne porazdelitve in generiranje	• *Introduction to the course.* The purpose of the study object, integration with other subjects, study the course content, textbooks. Simulation systems and solving business and organizational problems. • *Discrete event- oriented simulation* Stochastic variables and probability function. Probability distribution and generatig random variables.

slučajne spremenljivke. Enakomerna, eksponentna in empirična porazdelitev.
Modeli strežbe.
Porazdelitve časov med prihodi in časov strežbe
Disciplina vrste.
Generiranje časov med prihodi in časov strežbe.

- *Zvezna simulacija in sistemska dinamika.* Diferenčne in diferencialne enačbe v simulaciji.
Vzročno posledični diagrami in referenčni odziv sistema.
Oblikovanje dinamične hipoteze.
Razvoj modelov sistemske dinamike.
Zbiranje podatkov, izračun statistike in analiza rezultatov.
- *Testiranje in validacija modelov.*
- *Načrtovanje eksperimentov.*
- *Pregled simulacijskih jezikov:* GPSS, AnyLogic.
- *Simulacijski primeri:*
Kreativno Jedro: Simulacije in drugi projekti.
- *Modeliranje kompleksnih sistemov:*
- Metode iz projekta Kreativno Jedro: Simulacije.

Uniform, exponential and empirical distribution.
Service models.
Distribution of time between arrivals and times of comfort and convenience.
Queue discipline .
Generating times between arrivals and times of comfort and convenience.

- *Continuous simulation and system dynamics.*
Difference and differential equations in simulation.
Cause and effect diagram and reference system response.
Creating a dynamic hypothesis.
Development of system dynamics models.
Data collection , calculation and statistical analysis results.
- *Testing and validation of models.*
- *Design of Experiments.*
- *Review of simulation languages:* GPSS, AnyLogic.
- *Simulation examples:* Creative Core: Simulations and other projects.
- *Modelling complex systems.*
- Automated model building (methods developed in Creative Core: Simulations).

Temeljni literatura in viri / Readings:

- Banks, J., Carson, J. S., Nelson, B. L., Nicol, D. M. (2009) Discrete-Event System Simulation, Prentice Hall.
- Borschchev A. (2013) The Big Book of Simulation Modeling. Multimethod Modeling with AnyLogic 6, AnyLogic North America.
- Grigoryev, I., Borschchev A. (2012) AnyLogic 6 in Three Days: A Quick Course in Simulation Modeling.
- Sterman, J. D. (2000) Business Dynamics: Systems Thinking and Modeling for a Complex World, Irwin/McGraw-Hill.
- Law, A., Kelton, W. D. (1999) Simulation Modeling and Analysis. McGraw-Hill.
- Severance, F. L. (2001) System Modeling and Simulation: An Introduction, John Wiley & Sons, Chichester.
- Kljajić M. (1994) Teorija sistemov, Fakulteta za organizacijske vede.
- Prašnikar J., Debeljak, Ž. (1998) Ekonomski modeli za poslovno odločanje, Gospodarski vestnik.

Cilji in kompetence:

Cilji:
- seznaniti slušatelje s področjem uporabe dogodkovne simulacije in sistemske dinamike pri reševanju organizacijskih problemov
- spoznati metode in tehnike modeliranja po principih dogodkovne simulacije in sistemske dinamike
- obvladati kvantitativni pristop k izgradnji dogodkovnih modelov in modelov sistemske dinamike
- obravnavati osnove simulacijskih jezikov
- osvojiti postopke priprave eksperimenta in interpretacijo rezultatov
- izvedba celovitega projekta s področja dogodkovne simulacije in sistemske dinamike na akademskem primeru

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

Splošne kompetence:
- poznavanje pomena kakovosti in prizadevanje za kakovost strokovnega dela skozi avtonomnost, samoiniciativnost, (samo)kritičnost, (samo)refleksivnost in (samo)evalviranje v strokovnem delu
- prepoznavanje in ocenitev aktualnih in nastajajočih tehnologij ter ocenitev njihove uporabnosti za reševanje potreb uporabnikov
- usposobljenost za samoučenje s ciljem obvladovanja najnovejših relevantnih spletnih in mobilnih tehnologij
- sposobnost varnega in namenskega koriščenja najzahtevnejših spletnih storitev
- zmožnost za prepoznavanje in izkoriščanje priložnosti, ki jih ponuja spletna tehnologija

Predmetnospecifične kompetence:
Po opravljenem izpitu iz predmeta bo student/ka pridobil/a kompetence:
- poznavanje in obvladanje simulacijskih metod in orodij, v domeni zveznih kakor tudi dogodkovnih modelov

Objectives and competences:

Objectives:
- the main objective of the course is to introduce the application of discrete simulation and system dynamics at solving of the organizational problems
- understand the methods and techniques of modeling by the principles of discrete event simulation and system dynamics
- learn the quantitative approach to the discrete event models building and system dynamics models
- learn the basics of simulation languages
- study the experimental design approaches and interpretation of the results
- conduct of the complete project in the field of discrete event simulation and system dynamics in an academic case

The instructional unit contributes to the development of the following general and subject-specific competences:

General competences:
- familiarity with the importance of quality, striving to maintain the quality of professional work through practicing autonomous behaviour, showing initiative, as well as through (self-) criticism, (self-)reflection and (self-) evaluation
- identification and evaluation of current and emerging technologies, and assessment of their usability in terms of fulfilling user requirements
- ability to self-educate with the aim to master relevant state-of-the-art web and mobile technologies
- ability to safely and purposefully use the most complex web services
- ability to recognize and seize opportunities offered by the web technology

Subject-specific competences:
Upon completion of this course the student will have competences:
- knowledge and ability to use simulation

- celovito načrtovanje in obvladovanje dogodkovnih in zveznih procesov - izgradnja dogodkovnih simulacijskih modelov - izgradnja modelov sistemske dinamike - povezovanje simulacijskih modelov s podatkovnimi bazami in produkcijskimi informacijskimi sistemi - harmonizacija delovnih procesov - odprava ozkih grl v delovnih procesih - analiza strukture in odziva sistema s pomočjo sistemske dinamike	- methods and tools, both discrete and continuous - complete design and control of discrete and continuous processes - building of discrete event simulation models - building of system dynamics models - connection of the simulation models with databases and production information systems - harmonization of production processes - elimination of bottle-necks in production processes - analysis of structure and response of the system by the aid of system dynamics

Predvideni študijski rezultati:

Intended learning outcomes:

Znanje in razumevanje: *Študent/študentka pridobi znanja za:* - kvantitativno modeliranje organizacijskih problemov na področju proizvodnje, logistike in sistemov strežbe - analizo vhodnih podatkov, priprava in statistična obdelava - definicijo kriterijev in dinamično testiranje hipoteze pri izboru rešitve - optimizacija procesov z uporabo simulacijskih orodij	Knowledge and understanding: *The student has the knowledge of:* - quantitative modeling of organizational problems in manufacturing, logistics, and service systems - input data analysis, preparation and statistical processing - definition of criterions and dynamical hypothesis testing at the solution selection - process optimization using simulation tools

Metode poučevanja in učenja:

Learning and teaching methods:

predavanja z aktivno udeležbo študentov (razlaga, diskusija, vprašanja, primeri, reševanje problemov) *laboratorijske vaje* (uporaba simulacijskih orodij) - individualne in skupinske *konzultacije* (diskusija, dodatna razlaga, obravnava specifičnih vprašanj)	*lectures* with active students' involvement (explanation, discussion, questions, examples, problem solving) *laboratory work* (usage of simulation tools) - individual and group *consultations* (discussions, supplementary explanations, treatment of specific questions)

Načini ocenjevanja:	Delež (v %) / Weight (in %)	Assessment:
Način (pisni izpit, ustno izpraševanje, naloge, projekt): • pisni/ustni izpit • empirična seminarska naloga s poročili eksperimentalnih vaj ter predstavitev naloge	 50 50	Type (examination, oral, coursework, project): • written/oral examination • empirical student assignment with the reports from experimental exercises together with the presentation of the assignment