

**UČNI NAČRT PREDMETA / COURSE SYLLABUS**

<b>Predmet:</b>	Modeliranje in simulacija logističnih sistemov
<b>Course title:</b>	Modelling and Simulation of Logistics Systems

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Informacijska družba, doktorski študijski program tretje stopnje	-	Prvi	Prvi
Information Society, third cycle Doctoral Study Programme	-	First	First

**Vrsta predmeta / Course type**

Izbirni/ Optional

**Univerzitetna koda predmeta / University course code:**

1-ID-DR-IP-MSLS-2016-06-21

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje work	Druge oblike študija	Samost. delo Individ. work	ECTS
10	30	/	/	/	410	15

**Jeziki / Languages:****Predavanja / Lectures:** Slovenski / Slovenian, Angleški / English**Vaje / Tutorial:** Slovenski / Slovenian, Angleški / English**Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:**

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**Prerequisites:**

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**Vsebina:**

Predmet je usmerjen k sodobnim znanjem in raziskavam za namene razvoja simulacijskih modelov sistemov v sodobni družbi z uporabo informacijske tehnologije. Predvideni so naslednji tematski sklopi:

- Namen študija predmeta, vsebina študija predmeta, študijska literatura.
- Simulacija sistemov in reševanje družbenih in organizacijskih problemov.
- Oris simulacijskih metodologij.
- Simulacijski primeri: Kreativno Jedro: Simulacije in drugi projekti.
- Razvoj zasnove modela za izbrani projekt.
- Izbira najbolj primerne orodja in metodologije za izbrani projekt.

**Content (Syllabus outline):**

The course is geared towards advanced knowledge and research for development of simulation models of systems in modern society through the use of information technology. Course contains the following themes:

- The purpose of the study, content of course, textbooks.
- Simulation of systems and solving social and organizational problems.
- Outline of simulation methodologies.
- Simulation examples: Creative Core: Simulations and other projects.
- Development of the model design for the selected project.
- Selection of the most appropriate tools and methodologies for the selected project.

- Zbiranje in priprava podatkov.
- Verifikacija in validacija modelov.
- Diskretna oz. dogodkovno orientirana simulacija; pregled orodij.
- Stohastične spremenljivke in verjetnostna funkcija.
- Verjetnostne porazdelitve in generiranje slučajne spremenljivke.
- Modeli strežbe, Porazdelitve časov med prihodi in časov strežbe.
- Modeliranje z agenti; pregled orodij.
- Arhitekture agentnih modelov.
- Zvezna simulacija in sistemska dinamika; pregled orodij.
- Diferenčne in diferencialne enačbe v simulaciji.
- Vzročno posledični diagrami in referenčni odziv sistema.
- Oblikovanje dinamične hipoteze.
- Razvoj modelov sistemske dinamike.
- Zbiranje podatkov, analiza ter predstavitev rezultatov.
- Načrtovanje eksperimentov.
- Optimizacija modelov in sistemov.
- Projektno delo.

- Collection and preparation of data.
- Verification and validation of models.
- Discrete / event-oriented simulation; overview of the tools.
- Stochastic variables and probability function.
- Probability distribution and generation of random variables.
- Service models, Distributions times between arrivals and time facilities.
- Modelling of agents; overview of the tools.
- Architectures of agent-based models.
- Continuous simulation and system dynamics; overview of the tools.
- Differential and differential equations in the simulation.
- Cause-effect diagrams and reference system response.
- Creation of dynamic hypotheses.
- Development of system dynamics models.
- Data collection, analysis and presentation of results.
- Design of Experiments.
- Optimization models and systems.
- Project work.

### **Temeljni literatura in viri / Readings:**

- Banks, J., Carson, J. S., Nelson, B. L., Nicol, D. M. (2009) Discrete-Event System Simulation, Prentice Hall.
- Grigoryev, I. (2014) AnyLogic 7 in Three Days: A Quick Course in Simulation Modeling, AnyLogic North America
- Borschchev A. (2013) The Big Book of Simulation Modeling. Multimethod Modeling with AnyLogic 6, AnyLogic North America
- Railsback, S.F., Grimm V. (2011) Agent-Based and Individual-Based Modeling: A Practical Introduction, Princeton University Press.
- Gilbert, N. (2007) Agent-Based Models (Quantitative Applications in the Social Sciences), SAGE Publications.
- Gilbert, N., Troitzsch, K. (2005) Simulation for the Social Scientist, Open University Press.
- Miller J.H., Page, S.E. (2007) Complex Adaptive Systems: An Introduction to Computational Models of Social Life, Princeton University Press.
- 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.

**Cilji in kompetence:**

Seznanimi slušatelje z metodami in tehnologijami na področju modeliranja in simulacije sistemov, spoznati metodologije dogodkovne simulacije, agentnega modeliranja in systemske dinamike za modeliranje sistemov, osvojiti postopke priprave simulacijskega eksperimenta in interpretacije rezultatov, izvedba celovitega projekta s področja modeliranja in simulacije na primeru.

*Učna enota prispeva k razvoju naslednjih splošnih in predmetnospecifičnih kompetenc:*

- sposobnost identificiranja danega raziskovalnega problema, njegove analize ter možnih rešitev
- ustvarjanje novega znanja, ki pomeni relevanten prispevek k razvoju znanosti
- sposobnost obvladavanja standardnih metod, postopkov in procesov raziskovalnega dela na različnih znanstvenih področjih
- sposobnost za reševanje konkretnih raziskovalnih problemov na posameznih področjih družbenih in ostalih ved
- razvoj veščin in spretnosti v uporabi znanja na raziskovalnem področju doktorske disertacije
- sposobnost pridobivanja, selekcije, ocenjevanja in umeščanja novih znanj in možnost interpretacije v kontekstu družboslovja in ostalih ved
- sposobnost oblikovanja in implementacije izvirnih znanstvenih rešitev danih družbenih problemov

**Objectives and competences:**

To acquaint students with the methods and technologies in the field of modeling and simulation systems, to familiarize with the methodologies of discrete event simulation, agent-based modeling and system dynamics modeling systems, learn the process of preparing simulation experiments, interpret the results, the implementation of a comprehensive case based project in the field of modeling and simulation.

*Learning unit contributes to the development of the following general and subject-specific competences:*

- the ability to identify, analyze and construct solution for a given research problem
- the creation of new knowledge and contribution to the development of science
- mastery of standard methods, approaches and processes of scientific research in various scientific fields
- skills and abilities for solving concrete research problems in various fields of social and other sciences
- development of skills and abilities in usage of knowledge in doctoral research
- the ability to extract, select, evaluate and insert new knowledges and the competence of interpretation in the context of social and other sciences
- ability of designing and implementing novel scientific solutions for given social problems

**Predvideni študijski rezultati:**

Znanje in razumevanje:

*Študent/študentka pridobi znanja za*

- kvantitativno modeliranje družbenih in organizacijskih problemov,
- zbiranje in analizo podatkov o modeliranem sistemu,
- definicijo kriterijev in dinamično testiranje hipoteze pri izboru rešitve,
- modeliranje po metodologiji systemske dinamike, agentnega

**Intended learning outcomes:**

Knowledge and understanding:

*The student has the knowledge of:*

- quantitative modelling of social and organizational problems,
- collecting and analysing data about the modelled system,
- definition of criteria and dynamic testing of hypothesis,
- modelling methodology for system dynamics, agent-based modelling

modeliranja in dogodkovnih sistemov,

- verifikacijo in validacijo modela,
- zbiranje in čiščenje podatkov za potrebe modeliranja in priprave scenarijev,
- optimizacijo procesov z uporabo simulacijskih orodij.

and discrete event systems,

- verification and validation of the model,
- collection and cleaning of data for modelling and scenario preparation,
- optimization of processes using simulation tools.

**Metode poučevanja in učenja:**

- *Predavanja* z aktivno udeležbo študentov; kratka razlaga, diskusija, razprava na primerih, reševanje problematike.
- *Seminarsko delo v obliki priprave projektne naloge*: predlog raziskovalnega projekta, utemeljitev raziskave, poročanje o rezultatih in podajanje predloga rešitev.
- *Individualno delo* študentov; samostojni študij znanstvene in strokovne literature in rezultatov raziskav.

**Learning and teaching methods:**

- *Lectures* with active students' involvement (explanation, discussion, questions, examples, problem solving).
- *Seminar work*: preparation of project paper: a proposal for a research project, justification of research, reporting results and proposing solutions.
- Individual and group consultations (discussions, supplementary explanations, treatment of specific questions).

Delež (v %) /  
Weight (in %)

**Načini ocenjevanja:**

**Assessment:**

<p>Način (pisni izpit, ustno izpraševanje, naloge, projekt):</p> <ul style="list-style-type: none"> <li>• Projektna naloga</li> </ul>	<p>100</p>	<p>Type (examination, oral, coursework, project):</p> <ul style="list-style-type: none"> <li>• Project paper</li> </ul>
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