

UČNI NAČRT PREDMETA / COURSE SYLLABUS

Predmet:	Modeliranje in simulacije v telekomunikacijskih omrežjih
Course title:	Modelling and Simulations in Telecommunication's Networks

Študijski program in stopnja Study programme and level	Modul Module	Letnik Academic year	Semester Semester
Informacijske in komunikacijske tehnologije, 2. stopnja	Komunikacijske tehnologije	1	2
Information and Communication Technologies, 2 nd cycle	Communication Technologies	1	2

Vrsta predmeta / Course type Izbirni / Elective

Univerzitetna koda predmeta / University course code: IKT2-636

Predavanja Lectures	Seminar Seminar	Sem. vaje Tutorial	Lab. vaje Laboratory work	Druge oblike	Samost. delo Individ. work	ECTS
15	15			15	105	5

**Navedena porazdelitev ur velja, če je vpisanih vsaj 15 študentov. Drugače se obseg izvedbe kontaktnih ur sorazmerno zmanjša in prenese v samostojno delo. / This distribution of hours is valid if at least 15 students are enrolled. Otherwise the contact hours are linearly reduced and transferred to individual work.*

Nosilec predmeta / Lecturer: Prof. dr. Aleš Švigelj

Jeziki / Predavanja / Lectures: slovenščina, angleščina / Slovenian, English
Languages: Vaje / Tutorial:

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:

Zaključen študijski program prve stopnje s področja naravoslovja, tehnike ali računalništva.

Prerequisites:

Student must complete first-cycle study programmes in natural sciences, technical disciplines or computer science.

Vsebina:

Uvod: pregled konceptov računalniške simulacije
 Pregled statističnih porazdelitev
 naključne porazdelitve
 naključni procesi
 Modeliranje telekomunikacijskih omrežij:
 analitičen pristop
 pristop z diskretno-dogodkovnim modelom
 hibridni pristop
 prednosti in pomanjkljivosti posameznih pristopov
 Dogodkovno orientirana simulacijska orodja:
 principi delovanja
 prednosti in pomanjkljivosti simulacij
 Statistična analiza rezultatov simulacije:

Content (Syllabus outline):

Introduction:
 overview of computer simulation concepts
 Probability and stochastic processes:
 review of statistical distributions
 stochastic processes
 Modelling of telecommunication networks:
 analytic approach
 discrete-event approach
 hybrid approach
 advantages and limitations of approaches
 Discrete event simulators:
 main concepts
 advantages and limitations of simulations
 Statistical analysis of simulation results:

verifikacija simulacijskega modela
ovrednotenje simulacijskega modela
Simulacijska orodja:
OPNET
MATLAB

verification of simulation model
validation of simulation model
Simulation tools:
OPNET
MATLAB

Temeljna literatura in viri / Readings:

Izbrana poglavja iz naslednjih knjig: / Selected chapters from the following books:

- J. Banks, J. Carson, B. L. Nelson, D. Nicol, *Discrete-Event System Simulation*, Prentice Hall; fifth edition, 2009. ISBN 978-0136062127
- J. F. Hayes, V. J. T., G. Babu, *Modeling and Analysis of Telecommunications Networks*, John Willey & Sons, 2004. ISBN 978-0471348450
- B. D. Hahn, D. T. Valentine, *Essential MATLAB for Engineers and Scientists*, Fifth edition, Elsevier, 2013. ISBN 978-0123943989
- *Modelling concepts*, OPNET user manual, 2016

Cilji in kompetence:

Cilj predmeta je seznaniti študente s koncepti, metodami in praktičnimi aspekti pri razvoju in analizi simulacijskih modelov in računalniških simulacijah telekomunikacijskih sistemov. Posebno pozornost bomo namenili praktičnim znanjem s področja diskretnih dogodkovnih simulatorjev.

Kompetence študenta bodo po uspešno opravljenem predmetu obsegale sposobnost modeliranja in simulacij v telekomunikacijskih omrežjih.

Objectives and competences:

The aim of the course is to introduce students to the concepts, techniques and practical aspects of the development and analysis of simulation models and computer simulations of telecommunication models. In particular the course will be concerned in its practical aspects with discrete event simulation.

The competencies of the students completing this course successfully will include the ability to perform modelling and simulations in telecommunication's networks.

Predvideni študijski rezultati:

Študenti bodo z uspešno opravljenimi obveznostmi tega predmeta pridobili:

- znanje o modeliranju telekomunikacijskih sistemov
- znanje o načrtovanju simulacijskih modelov
- znanje o analizi in ovrednotenju simulacijskih rezultatov

Intended learning outcomes:

Students successfully completing this course will acquire:

- knowledge of modeling of telecommunication systems
- knowledge of design of simulation models
- knowledge of analysis and evaluation of simulation results

Metode poučevanja in učenja:

Predavanja, seminar, konzultacije, individualno delo

Learning and teaching methods:

Lectures, seminar, consultancy, individual work

Načini ocenjevanja:

Seminarska naloga
Ustni zagovor seminarske naloge

Delež (v %) /

Weight (in %)

Assessment:

Seminar work
Oral defense of seminar work

Reference nosilca / Lecturer's references:

- A. Švigelj, R. Serbec, K. Alič. "Network-traffic modeling for load prediction: A user-centric approach", *IEEE Network*, vol. 29, no. 4, pp. 88 - 96, 2015.

- K. Alič, E. Pertovt, A. Švigelj, "Bearing-opportunistic network coding", *International Journal of Computers, Communications & Control*, vol. 10, no. 2, pp. 154-164, 2015.
- T. Javornik, A. Švigelj, A. Hrovat, M. Mohorčič, K. Alič. Distributed REM-assisted radio resource management in LTE-A networks. *Wireless personal communications*, Vol. 92:107–126, 2017.
- A. Volkov, J. Žganec Gros, M. Žganec, T. Javornik, A. Švigelj, Modulated acquisition of spatial distortion maps, *Sensors*, vol. 13, no. 8, pp. 11069-11084, 2013.
- A. Švigelj, M. Mohorčič, G. Kandus, A. Kos, M. Pustišek, J. Bešter, Routing in ISL networks considering empirical IP traffic, *IEEE Journal on Selected Areas in Communications*, vol. 22, pp. 261-272, 2004.