RTU Course "Fundamentals of Computer Simulation and Modelling"

12111 Department of Modelling and Simulation

General data

Code	DMI201
Course title	Fundamentals of Computer Simulation and Modelling
Course status in the programme	Compulsory/Courses of Limited Choice
Course level	Undergraduate Studies
Course type	Academic
Field of study	Computer Science
Responsible instructor	Gaļina Merkurjeva
Academic staff	Jana Bikovska Jurijs Merkurjevs Jelena Pečerska Raisa Smirnova Vitālijs Boļšakovs
Volume of the course: parts and credits points	1 part, 3.0 Credit Points, 4.5 ECTS credits
Language of instruction	LV, EN
Annotation	The module 'Fundamentals of System Modelling and Simulation' considers fundamental concepts of system modelling, i.e. the concept of computer modelling and standard procedure, modelling motivation and main principles, and model development and application aspects. The module discusses the essential principles of analytical modelling and types of analytical models used in practice, such as differential equations, difference equations, Boolean functions, logical expressions, finite automats, network models and Petri nets. The fundamentals and applications of system statistical modelling are considered. The structure of a computer simulation model and its main components are defined. Discrete event simulation methods for input modelling, time handling and process simulation, simulation on spreadsheets and simulation output analysis are considered. Systems dynamics approach is discussed. Main principles and methods for model testing and validation are given. Software modelling and add-on tools are reviewed.
Goals and objectives of the course in terms of competences and skills	Competences and skills demonstrated: knowledge of basic concepts of system modelling, model design and application aspects, a model taxonomy, analytical models, main principles and methods of system computer simulation; ability to define requirements to a system model and identify its most appropriate type; use simulation software to design a system simulation model in order to apply it to system analysis and optimisation.
Structure and tasks of independent studies	Labs: Design models using MATLAB and ProModel simulation software and apply them to the analysis and optimisation of complex systems, such as queueing systems, computer control systems; use the main principles and methods of system simulation in the their project.
Recommended literature	1. Sistēmu imitācijas modelēšanas tehnoloģija / Merkurjevs J., Merkurjeva G., Pečerska J., Tolujevs J. Rīga: RTU, 2008. – 120 lpp. 2. Michael Pidd. Computer Simulation in Management Science - Willey & Sons , 5th ed., 2004. – 311 p. 3. Simulation using ProModel / Ch. Harrell, B. K. Ghosh, Royce O. Bowden. - 2nd ed., 2004. - 733 p. 4. L. Frolova . Matemātiskā modelēšana ekonomikā un menedžmentā. Teorija un prakse. Izglītības soļi, Rīga, 2005.
Course prerequisites	Basic knowledge in mathematics, discrete mathematics, probability theory and mathematical statistics.

Course outline

Theme	Hours
Course introduction	2
Basic concepts of systems modelling	6
System analytical modelling	4
System statistical (computer simulation) modelling. The Monte Carlo method	2
Discrete event simulation	6
Simulation on time-based diagrams and spreadsheets	2
Visual interactive modelling and simulation	2
System dynamics	4
Model testing and validation	2
Modelling software and add-on tools	2
Laboratory: development of a model using MATLAB and ProModel software and its application to system analysis and optimisation	16

Learning outcomes and assessment

Learning outcomes	Assessment methods
Is able to interpret and use system modelling terminology.	Successfully passed e-test on system modelling basic concepts.
Is able to interpret and use analytical models of complex systems.	Successfully passed e-test on analytical modelling. Using MATLAB, demonstrated ability to apply analytical models to modelling and analysis of a control system.
Is able to interpret and use system statistical (simulation) techniques.	Successfully passed e-test on application aspects of system statistical modelling. Demonstrated ability to use simulation techniques (Course project).
Is able to develop simple simulation models and use them in order to analyse and improve system behaviour.	Using ProModel software, demonstrated ability to develop ProModel-based simulation models and apply them to system analysis and optimisation.
Is able to identify an appropriate model type for a specific problem.	Successfully passed e-test based on problem analysis and selection of an appropriate model.
Is able to describe different analytical and algorithmic models and their application aspects in system modelling, analysis and optimisation.	Demonstrated ability to identify a specific subject and provide a reasoned explanation (Course exam).

Study subject structure

Part	CP	Hours per Week			Tests		
		Lectures	Practical	Lab.	Test	Exam	Work
1.	3.0	2.0	0.0	1.0		*	