COURSE DESCRIPTION CARD - SYLLABUS

Course name
Simulation techniques [S2EiT1E-TIT>SC]

Course

Field of study
Electronics and Telecommunications

Year/Semester
1/1

Area of study (specialization)
Information and Communication Technologies

Profile of study
general academic

Level of study
second-cycle

Course offered in
English

Form of study
full-time

Requirements
compulsory

Number of hours

Lecture
15

Laboratory classes
0

Other
0

Tutorials
15

Projects/seminars
0

Number of credit points

3,00

Coordinators

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Lecturers

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Prerequisites

Student starting this course should have knowledge in probability theory, stochastic processes and statistics. Moreover, basic knowledge of telecommunication systems, and knowledge and skills in object-oriented programming (in languages such as: C++ or C#) are needed. Students should be also aware of their limitations and skills and the need to continue their education. Student should be able to acquire knowledge from additional sources and be prepared for work on mulit-stage project.

Course objective

The aim of this course is to teach a student about basic techniques of computer-aided simulations. Main focus of this course is put on the event-driven simulation techniques and their implementation using object-oriented programming and the analysis of simulation results. The course also teaches the methods of generation of pseudorandom sequences, methods of their verification (testing) and statistical analysis of the data collected during simulation experiments.

Course-related learning outcomes

Knowledge:
1. A student knows the basic rules of discrete-event computer simulation of systems, including the knowledge on how to design the simulation experiment using an object-oriented approach.
2. A student has knowledge in generation of pseudorandom number sequences for selected distributions and about methods of validation of the generators - statistical tests.
3. A student has knowledge about simulation time management techniques and basic data structures that can be used for this purpose.
4. A student knows the basic procedures used to collect and process the simulation results using statistical tools.

Skills:
1. A student is able to select the most appropriate method of modeling and simulation for a clearly stated problem.
2. A student has skills required to develop a relatively advanced simulation tool using object-oriented programming language.
3. A student is able to process and analyse the data collected in simulation results using statistical tools.

Social competences:
1. A student is aware of the limitations of his/her current knowledge and skills.
2. Understands the societal impact of computer simulations and their interdisciplinary nature.

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

The knowledge acquired in the lectures is verified in form of a written or oral exam. The written exam comprises 5-8 open-ended questions that are graded (with points) differently. The written exam is passed if at least 45% of the total score is obtained. The oral exam relies on student's answer to at least three questions about topics indicated to students during the lectures, with the evaluation taking into account the overal understanding of the problem and the completeness of the answer. The oral exam is passed if more than 50% of the answers are evaluated as sufficient.
The abilities acquired during the tutorials are verified with development of a project that is an implementation of a computer-aided simulation for a stated problem. The simulation project is broken into several stages, with each stage discussed and evaluated individually. The final grade depends on the evaluation of the stages as well as the discussion on the full integrated project and the results. Each element should be passed with sufficient grade in order to complete the tutorial.

Programme content

The course introduces the following topics:
- Basic information about purpose and types of computer-aided simulation.
- Methods of discrete-event simulation.
- Data structures used in simulations.
- Generation of pseudorandom sequences.
- Collecting and analysis of simulation results using statistical processing.

Course topics

Lectures comprise the following topics:
- Basic information about purpose and types of computer-aided simulation.
- Methods of discrete-event simulation.
- Simulation time management and data structures used for this purpose (lists and heaps).
- Generation of pseudorandom sequences and validation of the generated sets (statistical testing).
- Collecting and analysis of simulation results including basic data structures, statistical processing and obtaining statistical independence of results.
In tutorials the following topics are taught:
- Design of a simulation experiment - identification and implementation (using object-oriented programming) of events and significant entities.
- Implementation of selected discrete-event simulation methods.
- Efficient implementation of reliable pseudorandom number generators.
- Development of data structures used in simulation to collect results.

- Statistical processing of results: removing of transient phase impact, calculation of confidence intervals.

Teaching methods

Lecture: multimedia presentation supported with additional exercises/examples solved on a board.
Tutorials: project development - a student develops a simulation tool for a given problem using object-oriented programming. The development process is divided into several stages, with each stage encompassing different aspect of simulation. The final stage is the integration of the tool, simulation and collecting and processing of the results.

Bibliography

Basic:
J. Tyszer, "Object-oriented computer simulation of discrete-event systems", Kluwer Academic Publishers, 1999

Additional:
Averill M. Law, "Simulation modeling and analysis", McGraw-Hill Education, 2015
J. Banks et al., "Discrete-event system simulation", Pearson Prentice Hall, 2001

Breakdown of average student's workload

	Hours	ECTS
Total workload	62	3,00
Classes requiring direct contact with the teacher	31	2,00
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	31	1,00