Syllabus
«Methods and visual technologies of simulation modelling»

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Expected learning outcomes
As a result of studying the discipline, the student
must know:

- definition of the model structure, input and output variables, model parameters, functional dependencies describing the relationship between variables and parameters, restrictions on changes in values;
- formulation of the target function (quality criteria) of the system, selection of the degree of detailing of the model description and development of the scheme of the conceptual model;
- analysis of possible methods of solving the given problem, including a review of literary sources, advantages and disadvantages of the specified methods, a clear justification of the chosen method of solving a specific problem;
- basics of building models of mass service systems;
- theoretical foundations of Petri nets and simulation software based on Petri nets.

***must be able to*:**

- use modern instrumental and computing tools for system research, which is provided by knowledge of system modelling methods;
- develop simulation models of the system to solve the tasks and master the methods of processing and analysis of the obtained results;
- to have mathematical and simulation modelling methods, regardless of which software modelling tools are used;

The scope of the discipline: 4 ECTS credits (16 hours of lectures, 32 hours of practice).

Purpose: theoretical and practical training of future masters in the field of methods and visual technologies of simulation modelling; formation of students' practical skills in building models of systems of different classes, researching these models and processing the obtained research results using simulation modelling tools.

The content of the discipline

Topic 1. Methods of designing simulation models. Conceptual model development**.**
Topic 2. Software implementation of the simulation model. Programming automation**.**
Topic 3. Simulation modelling software**.**
Topic 4. Simulation modelling of computer systems and networks**.**
Topic 5. Making decisions based on simulation results. Consideration of examples**.**
Topic 6. Introduction to the theory of Petri nets. Basic theoretical provisions, properties. Types of networks, structures. Rules for the operation of transitions**.**
Topic 7. Coloured Petri nets. Modelling in the CPN Tools environment. Algorithm for building and adjusting the model in the CPN Tools environment. Examples**.**
Topic 8. Building a mass service system model M|M|1 in CPN Tools. Consideration of examples**.**
Topic 9. Simulation modelling of the data transfer protocol in the CPN Tools environment. Examples**.**

Evaluation criteria of laboratory works / practices / individual works / reports / projects

Maximum number of points a student with high quality independently completed the entire amount of work, answers all questions related to the completed work, and makes additional calculations offered by the teacher. The teacher has no complaints about the implementation

- know and be able to use one or more simulation systems and programming languages;
- solve standard tasks of professional activity based on developed simulation models;
- reasonably draw conclusions based on the results of simulation modelling.

Prerequisites

"Higher mathematics", "Fundamentals of programming", "System analysis", "Fundamentals of discrete mathematics", "Probability theory and mathematical statistics", "Theory of algorithms"**.**

Consequences

The knowledge gained as a result of mastering the discipline will help in building simulation models of complex systems and processes of various nature for their further use in solving tasks of machine learning and big data processing. All this is necessary for a graduate who has mastered the master's program to solve various tasks of practical and research activities.

Technical support

Laboratory work on the discipline is conducted in computer classes using languages and software environments: R Studio, R, Python, CPN Tools**.**

Deadline Policy

Works that are submitted late without good reason will be assigned a lower grade**.**

Academic Integrity Policy

Presupposes independent performance of laboratory work. Debiting during credit (including using mobile devices) is prohibited. If plagiarism or plagiarism is detected, the work will not be counted.

and requirements for the performance of the work.

Approximately 70%-99% of the maximum number of points – a student completed all tasks with sufficient quality, but in the process of work he made some mistakes, which, after being pointed out by the teacher, he corrected himself. He answers some questions incorrectly. Additional calculations proposed by the teacher are done with some effort. Not all requirements for performance of work are met.

Approximately 40%-69% of the maximum number of points – a student independently completed all the work, but the quality of the implementation is insufficient (calculation errors, not all work requirements are met). The answers to questions about the performance of work are not quite clear. There are mistakes in the answers.

Approximately 1%-39% of the maximum number of points – a student did not complete all the work independently, while the quality of the implementation was insufficient (errors in calculations, does not comply with the requirements for the design of the work). He does not answer questions about the performance of work clearly. There are gross mistakes in the answers.

0 points – a student did not complete the entire amount of work, or did it with gross errors. He has problems with calculations, does not know the theoretical material, the software implementation does not meet the requirements.