Course Syllabus

Course from study programme for the cycle: 2023/2024

I. General Information

Course name	Computer modeling and simulations
Programme	Informatics
Level of studies (BA, BSc, MA, MSc, long-cycle MA)	BA
Form of studies (full-time, part-time)	full-time
Discipline	Informatics
Language of instruction	English

Course coordinator	dr hab. Aliaksandr Chychuryn prof. KUL

Type of class *(use only the types mentioned below)*	Number of teaching hours	Semester	ECTS Points
lecture	30	III	5
tutorial			
classes	30	III	
laboratory classes			
workshops			
seminar			
introductory seminar			
foreign language classes			
practical placement			
field work			
diploma laboratory			
translation classes			
study visit			

Course pre-requisites	1. Knowledge of basis for computing; 2. Programming skills; 3. The ability to search for information on the Internet; 4. Knowledge of basis for mathematical analysis and algebra in the first year in education of computer science

II. Course Objectives

1. The student understands what is computer modeling and simulation;
2. The student knows the basic rules for applying the capabilities of Mathematica and Matlab;
3. The student knows the basic capabilities of the environment WebMathematica

III. Course learning outcomes with reference to programme learning outcomes

Symbol	Description of course learning outcome	Reference to programme learning outcome
KNOWLEDGE		
W_01	define the concepts of modeling and simulation	K_W01
W_02	analyze approaches to solving of differential and algebraic equations in the Mathematica / Matlab program	K_W01
W_03	formulate the differences between various methods of visualization and animation programs available	K_W01, K_W11
W_04	select online sources of knowledge, which can be traced to ready-made examples of models in various fields prepared in Mathematica code (WebMathematica 3.3)	K_W01, K_W06
W_05	know basic applications of programs MatLab, Scilab and WolframAlpha	K_W05
SKILLS		
U_01	can use different data collections available in Mathematica and Matlab programs	K_U06, K_U11
U_02	can create visualizations of known models	K_U06, K_U11
U_03	is able to create simulations of known models	K_U06
U_04	can use MatLab, Scilab and WolframAlpha programs	K_U03
U_05	can solve simple models using the MatLab, Scilab and Mathematica programs, containing differential equations with initial conditions	K_U17
SOCIAL COMPETENCIES		
K_01	formulate opinions about selected models	K_K01

IV. Course Content

1. Introduction to the modeling and simulation.
Concept of modeling. Kinds of computer simulations. Examples of the models.
Mathematical models and numerical methods. Differential equations and mathematical models.
Modeling with the Mathematica/MatLab system.
2. First Steps with Mathematica/MatLab. Numbers. Types of Numbers. Exact and Approximate Results. Numerical Precision. Arbitrary-Precision Numbers.
Algebraic Calculations. Symbolic Computation. Transforming Algebraic Expressions. Linear Algebra. Solving Linear Systems.
Numerical Methods in Mathematica/MatLab. The Uncertainties of Numerical Mathematics.
Numerical Equation Solving. Numerical Solution of Polynomial Equations. Numerical Root Finding.
Numerical Solution of Differential Equations.
Symbolic calculations. Series and Limits. Differentiation. Integration. Indefinite Integrals. Definite Integrals. Differential Equations.
3. Visualization and graphics in Mathematica/MatLab.
Graphics for Functions (2D, 3D). Basic Graphics Primitives. Basic Graphics Options.
Graphics for 2D Data. The numerical Data. Basic Image transformation. View and Animation. Basic Manipulation.
4. Programming in Mathematica/MatLab. Wolfram Language.
Simple Programming. Modeling and simulation with Mathematica/MatLab (simple examples).

5. Web- Mathematica. WolframAlpha. Demonstration Projects in the Mathematica codes.

V. Didactic methods used and forms of assessment of learning outcomes

Symbol	Didactic methods *(choose from the list)*	Forms of assessment *(choose from the list)*	Documentation type *(choose from the list)*
KNOWLEDGE			
W_01	conventional lecture, problem lecture, seminar lecture, multimedia presentation, e-learning	Test / Exam	Written test / Completed and graded test
W_02	conventional lecture, problem lecture, seminar lecture, multimedia presentation, e-learning	Test / Exam	Written test / Completed and graded test
W_03	conventional lecture, problem lecture, seminar lecture, multimedia presentation, e-learning	Test / Exam	Written test / Completed and graded test
W_04	conventional lecture, problem lecture, seminar lecture, multimedia presentation, e-learning	Test / Exam	Written test / Completed and graded test
W_05	conventional lecture, problem lecture, seminar lecture, multimedia presentation, e-learning	Test / Exam	Written test / Completed and graded test
SKILLS			
U_01	Practical exercises, discussion design thinking	Test / Presentation	Protocol / Test / Assessing written text
U_02	Practical exercises, discussion design thinking	Test / Presentation	Protocol / Test / Assessing written text
U_03	Practical exercises, discussion design thinking	Test / Presentation	Protocol / Test / Assessing written text
U_04	Practical exercises, discussion design thinking	Test / Presentation	Protocol / Test / Assessing written text
U_05	Practical exercises, discussion design thinking	Test / Presentation	Protocol / Test / Assessing written text
SOCIAL COMPETENCIES			
K_01	Discussion design thinking	Test / Presentation	Written test / Completed and graded test

VI. Grading criteria, weighting factors...

Assessment of classes: 1 test (80%), 1 demonstration project (20%)

Oral exam

VII. Student workload

Form of activity	Number of hours
Number of contact hours (with the teacher)	**90**
Number of hours of individual student work	**70**

VIII. Literatura

Basic literature
1. Edwards C. Henry, Penney David E., Calvis David T. Differential Equations and Boundary Value Problems: Computing and Modeling. - Pearson Prentice Hall. 2016. - 800 p. 2. Giordano Frank R., Fox William P., Horton Steven B. A First Course in Mathematical Modeling. - Brooks/Cole, Boston. 2014. - 676 p. 3. Wagon S. Mathematica in Action: Problem Solving Through Visualization and Computation, Third Edition. - New York: Springer-Verlag, 2010. - 680 p. 4. Pratap Rudra, MatLab 7 for scientists and engineers. Warszawa: PWN, 2010.
Additional literature
1. Stormy Attaway, Matlab: A Practical Introduction to Programming and Problem Solving, Butterworth-Heinemann. 2018. – 626 p. 2. Ruskeepää, Heikki. Mathematica Navigator: Mathematics, Statistics, and Graphics. - Burlington, San Diego, London: Elsevier, - 3rd ed. 2009. - 1112 p. OTHER LEARNING RESOURCES www.wolframalpha.com www.demonstrations.wolfram.com www.wolfram.com/learningcenter/tutorialcollection https://www.mathworks.com/products/matlab.html?s_tid=hp_products_matlab www.virtualregion.kul.pl