Co-funded by the Erasmus+ Programme of the European Union

DESCRIPTION/Syllabi of Curricula/Module

Short Name of the University/Country code Date (Month / Year)	DSEA/P11 Sept 2020
TITLE OF THE MODULE	**Code**
Mathematical modeling in biotechnical systems	**2.2.5**

Teacher(s)	Department
Coordinating: Liudmyla Vasylieva, PhD **Others:**	Department of Computer and Information Technology (CIT)

Study cycle (BA/MA)	Level of the module (Semester number)	Type of the module (compulsary/elective)
MA	2st semester (first year) for Masters	Elective

Form of delivery (theory/lab/exercises)	Duration (weeks/months)	Language(s)
Lectures, exercises	18 weeks	Ukrainian / English

Prerequisites	
Prerequisites: study of the cycle of bachelor's degree disciplines in the specialty 122 "Computer Science"	**Co-requisites (if necessary):**

ECTS (Credits of the module)	Total student workload hours	Contact hours	Individual work hours
5,5	165	72	93

Aim of the module (course unit): competences foreseen by the study programme
The goal of the discipline is the formation of cognitive, affective, and psychomotor competencies in the field of application of mathematical modeling methods in biotechnical systems in professional activities, the development of object models, and the implementation of algorithms using modern programming languages and existing software. Students should be able: - to use system analysis to obtain information about activities in various subject areas (technical, organizational, technical, and medical purpose) and use knowledge of the patterns of random phenomena, their properties and operations on them, models of random processes, and modern software environments for solving problems of statistical data processing and building predictive models. - reasonably choose and improve numerical methods and the possibility of their adaptation when performing modeling tasks and studying systems of various nature. - to perform modeling and research of technical, organizational, and technical systems, products, and systems for medical purposes; use operations research methods.

Learning outcomes of module (course unit)	Teaching/learning methods (theory, lab, exercises)	Assessment methods (written exam, oral exam, reports)
Knowledge: - knowledge of the basics of methodology for modeling biological, technical and biotechnical systems; possession of a systematic approach to their modeling; - the ability to create and research mathematical models of technical and biological components of biotechnical systems, to take into account their mutual influence; - ability for mathematical and logical thinking, formulation and research of mathematical models, substantiation of the choice of methods and approaches for solving theoretical and applied problems in the field of computer science, interpretation of the results obtained in various subject areas (technical, medical, etc.); - the ability to process the results obtained, analyze, comprehend and present them, substantiate the proposed solutions at the modern scientific and technical level; - the ability to use, develop	Working with lecture notes and basic literature on relevant topics	Knowledge test

and research mathematical methods and algorithms for data processing.		
Skills: - be able to plan and implement computer experiments with models using modern information technologies; - to apply the acquired modeling skills in the process of analysis and synthesis of biotechnical systems and their components; - control the results of one's own efforts in the educational process and correct (with the help of a teacher) these efforts to eliminate gaps in the assimilation of educational material or the formation of skills; - independently carry out the search, systematization, generalization of educational material, develop options for solving problems, and choose the most rational of them.	Lectures, practical training, consultations	Active attendance of lectures, individual project and presentation
Competences: - critically comprehend lecture and non-selective educational material, argue based on theoretical material, apply the studied methods of finding optimal solutions in relevant practical problems; solve problems using software packages when using computers, implement high-performance computing based on modern services and technologies; - be able to present the results of modeling and in the process of discussion with other students to justify their conclusions. - the ability to communicate with representatives of other professional groups of different levels (with experts from other fields of knowledge and activities).	Lectures, practical training, consultations	Individual project and presentation

Themes	Contact work hours	Time and tasks for individual work

	Lectures	Consultations	Seminars	Practiacl work	Laboratory work	Placements	**Total contact work**	**Individual work**	**Tasks**
1. The concept and characteristics of systems. Biotechnical systems and their features. Essence and general principles of systems modeling. Mathematical modeling. Basic requirements for mathematical models and their characteristics.	8			6			**14**	**18**	Study exam/ complete design of practiacl work
2. Fundamentals of construction and identification of objects and parameters of mathematical models based on experimental dependencies, fundamentals of correlation, and regression analysis. Statistical modeling of biotechnical systems.	6			6			**14**	**19**	Study exam/ complete design of practiacl work
3. Linear models. Statistical criteria. Checking the model for adequacy. Statistical significance of the parameters.	6			8			**14**	**18**	Study exam/ complete design of practiacl work
4. Non-linear models. Collinearity and multicollinearity. Types of the forecast.	8			8			**16**	**18**	Study exam/ complete design of practiacl work
5. Dynamic data. Time series analysis. Row smoothing methods.	8			8			**16**	**20**	Study exam/ complete design of practiacl work
Total	**36**			**36**			**72**	**93**	

Assessment strategy	**Weight in %**	**Deadlines**	**Assessment criteria**
Written theory exam	40%	during the semester / exam	good response to questions
Practical exam on a computer	60%	during the semester / exam	the work is done completely without mistakes or minor errors

Author	Year of issue	Title	No of periodical or volume	Place of printing. Printing house or internet link
Compulsory literature				
В.А. Устюжанин, И.В. Яковлева	2014	Моделирование биотехнических систем		Старый Оскол: ТНТ – 215 с.
Montgomery, Douglas C.	2017	Design and analysis of experiments.		John wiley & sons
Wu, Cf Jeff; Hamada, Michael S.	2011	Experiments: planning, analysis, and optimization		John Wiley & Sons
Fedorov, V. V.	2013	Theory of optimal experiments.		Elsevier
Гліненко Л.К., Сухоносов О.Г.	1999	Основи моделювання технічних систем		Львів: "Ніка-ПЛЮС". – 204 с.
Филатова Н.Н.	2008	Моделирование биотехнических систем		Тверь: ТГТУ – 144 с.
О. Э. Соловьева, В. С. Мархасин, Л. Б. Кацнельсон, Т. Б. Сульман, А. Д. Васильева, А. Г. Курсанов	2013	Математическое моделирование живых систем		Екатеринбург : Изд-во Урал, ун-та. — 328 с.
Additional literature				
В.А.Павлиш, Л.К. Гліненко	2013	Основи інформаційних технологій і систем		Львів: Видавництво львівської політехніки. - 500 с.
J.Enderle, J.Bronzino.	2012	Introduction to Biomedical Engineering		Elsevier Inc.
Khoo M.C.K.	2015	Physiological Control Systems. AnaLysis, Simulation and Estimation		John Wiley & Son, Inc.