DESCRIPTION/Syllabi of Curricula/Module

Short Name of the University/Country code Date (Month / Year)	DSEA/P11 Jan 2019
TITLE OF THE MODULE	**Code**
Mathematical modeling in biotechnical systems	

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	1st semester (first year) for Masters	Elective

Form of delivery (theory/lab/exercises)	Duration (weeks/months)	Language(s)
Lectures, labs	15 weeks	Ukrainian / English

Prerequisites	
Prerequisites: study of subjects "Higher mathematics", "Probability theory and mathematical statistics", "Mathematical methods of operations research".	**Co-requisites (if necessary):** MS Excel (OpenOffice Calc), Programming skills

ECTS (Credits of the module)	Total student workload hours	Contact hours	Individual work hours
5	150	45	105

Aim of the module (course unit): competences foreseen by the study programme

Students should be able:

- to implement a mathematical representation of models of different types of systems, to perform iterative model development; the usage of models and the process of modeling for testing hypotheses, assessing the adequacy of models.
- to master modern technologies of mathematical modeling of objects, processes and phenomena, to develop computational models and algorithms of numerical solution of mathematical modeling problems taking into account the errors of the approximate numerical solution of professional problems.
- to perform intelligent multidimensional data analysis and their operational-analytical processing with visualization of the results of analysis in the process of solving applied problems in the field of computer sciences.
- to develop information models of the medical diagnostic process in healthcare institutions; to evaluate the effectiveness of the system of receiving, collecting, processing, transmitting and protecting medical information.
- to master the documentation of the development and implementation of models and its presentation in oral and written forms.

Learning outcomes of module (course unit)	Teaching/learning methods (theory, lab, exercises)	Assessment methods (written exam, oral exam, reports)
Knowledge: - general methods of statistical processing of a one-factor and full-factor experiment, a matrix of planning; - the least-squares method for empirical studying functional dependence of the studied quantities; - methods of statistical and correlation analysis of the regression model; - methods of approximation of functions; - methods of formation and statistical processing of factor plans; - methods of finding the conditional optimum for a full-featured experiment; - methods of digital image processing.	Working with lecture notes and basic literature on relevant topics	Knowledge test
Skills: - to develop a program for conducting an experiment and processing experimental data by means of the least-squares method or methods of approximation of functions;	Lectures, practical training, consultations	Active attendance of lectures, individual project and presentation

- to develop a program for statistical processing of plans of the first and second order; - to develop a program for calculating the conditional optimum for a full-featured experiment; - to develop a program to check the adequacy and integrity of the model received; - to model data on systems and processes, states and behavior of complex informatization objects in the process of designing information systems and technologies; - to perform digital image processing.		
Competences: study subject literature, share knowledge, work in groups	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.Statistical processing of a one-factor experiment. Tasks of regression and correlation analysis. The least-squares method. Statistical analysis of the regression model. Correlation analysis. Approximation by orthogonal polynomials.	4				8		**12**	**20**	Study exam/ complete design of laboratory work
2. Factorial plans of the first order. General facts about multi-factor experiments. Statistical processing of multifactorial experiments. Criteria for optimality of plans. A full-factor 2k type experiment. General view of the plans of the second order. Second-order orthogonal	8				16		**24**	**25**	Study exam/ complete design of laboratory work

plans. Rotational plans of the second order. Simple grid layout. Making decisions on the surface of the result.									
3. Digital image processing (including biomedical). Packed matrix images. 24-bit binary RGB pixel representation. HLS and HSV color models. Addition and measurement of noise. Binary conversion and quantization. 1D histograms. Threshold processing. Inversion.	6				12		**18**	**20**	Study exam/ complete design of laboratory work
4. Digital image processing (including biomedical). Geometric transformations of images. Functions of morphological processing.	6				12		**18**	**20**	Study exam/ complete design of laboratory work
5. Digital image processing (including biomedical). Border search methods. Segmentation.	6				12		**18**	**20**	Study exam/ complete design of laboratory work
Total	**30**			**15**			**45**	**105**	

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				
Rafael C. Gonzalez,Richard E. Woods	2017	Digital Image Processing (4th Edition)		**ISBN:** 0133356728

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
Jeff Schewe	2015	The Digital Negative: Raw Image Processing in Lightroom, Camera Raw, and Photoshop (2nd Edition)		ISBN: 0134033175
Mark Nixon	2012	Feature Extraction and Image Processing for Computer Vision, Third Edition		ISBN: 0123965497
Maria Petrou,Costas Petrou	2010	Image Processing: The Fundamentals		ISBN: 047074586X
Wilhelm Burger,Mark J. Burge	2009	Principles of Digital Image Processing: Core Algorithms (Undergraduate Topics in Computer Science)		ISBN: 1848001940
Additional literature				
Ravishankar Chityala,Sridevi Pudipeddi	2014	Image Processing and Acquisition using Python (Chapman & Hall/CRC Mathematical and Computational Imaging Sciences Series)		ISBN: 1466583754
John R. Jensen	2015	Principles of Digital Image Processing: Fundamental Techniques (Undergraduate Topics in Computer Science)		ISBN: 013405816X