DESCRIPTION/Syllabi of Curricula/Module

Short Name of the University/Country code Date (Month / Year)	DSEA Jan 2019
TITLE OF THE MODULE	**Code**
Digital Processing of Biomedical Signals	**P11**

Teacher(s)	Department
Coordinating: Eduard Grybkov, Doctor of Sciences **Others:**	Department of Computer and Information Technology (CIT)

Study cycle (BA/MA)	Level of the module (Semester number)	Type of the module (compulsary/elective)
Bachelor	5th semester (third year) for Bachelor	Elective

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

Prerequisites	
Prerequisites: the study of disciplines „Higher Mathematics“, „Theory of Probabilities and Mathematical Statistics“, „Numerical Methods“, „Mathematical Methods of Research of Operations“, „Biomedical systems, materials and technologies“	**Co-requisites (if necessary):** Programming skills

ECTS (Credits of the module)	Total student workload hours	Contact hours	Individual work hours
4	120	60	60

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

Students should be able to:

- Understand the fundamental concepts of digital signal processing, master the use of digital filters for converting sound and images.
- Master the skills testing, data collection and processing digital signals biomedical purpose, use different methods of conversion and signal analysis in a computerized medical systems.
- Master the techniques of modeling and statistical signal processing

Learning outcomes of module (course unit)	Teaching/learning methods (theory, lab, exercises)	Assessment methods (written exam, oral exam, reports)
Knowledge: - acquaintance with the basic theoretical positions of realization of methods of processing random samples and their use in specific tasks; - Familiarization with the definition of different types of models, their use, testing of hypotheses, the difference between model predictions, concepts of suitability and model constraints.	Work with the lecture notes as well as on the available fundamental subject literature	Knowledge test
Skills: - formation of theoretical knowledge and acquiring practical skills for the formalization of tasks arising in various spheres of human activity; - formation of the ability to create algorithms for statistical simulation; - development of skills in the use use different methods of conversion and signal analysis in a computerized medical systems	Lectures, practiacl work, consultation	Active attendance on lectures, individual project and presentation
Competences: Study the subject literature, exchange knowledge, working in group	Lectures, practiacl work, consultation	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. Messages and signals. Classification of signals. Signal parameters. Specific features of biomedical signals. Communication systems, communication channels.	4				4		**8**	**8**	Study exam/ complete exercise
2. Analysis and synthesis of signals, description of signals. Decomposition of an arbitrary signal in a given system of functions. Approximation questions, Bessel inequality.	4				4		**8**	**8**	Study exam/ complete exercise
3. Harmonic analysis of periodic signals. Power distribution in the spectrum of periodic oscillations. Harmonic analysis of deterministic non-periodic signals. Properties of the Fourier transform.	4				4		**8**	**8**	Study exam/ complete exercise
4. Single pulse spectrum. The energy of a non-periodic signal, Parseval's equality. True, current and instant spectra. Serial and parallel spectrum analysis methods. Correlation analysis. The relationship between the correlation function and the spectrum.	4				4		**8**	**8**	Study exam/ complete exercise
5. Description of the properties of quadripoles. Signal discretization, mathematical questions. Kotelnikov's theorems. Ageev’s theorem.	2				2		**4**	**4**	Study exam/ complete exercise
6. Discrete signal processing, a generalized digital processing algorithm. The spectrum of the sampled signal. Direct and inverse discrete Fourier transform.	2				2		**4**	**4**	Study exam/ complete exercise

Themes	Contact work hours							Time and tasks for individual work	
	Lectures	Consultations	Seminars	Practiacl work	Laboratory work	Placements	**Total contact work**	**Individual work**	**Tasks**
7. Fast Fourier Transform. Temporary windows.	4				4		**8**	**8**	Study exam/ complete exercise
8. Filter classification, filter parameters. Approximation of frequency characteristics of filters.	2				2		**4**	**4**	Study exam/ complete exercise
9. Digital filters.	2				2		**4**	**4**	Study exam/ complete exercise
10. Statistical data analysis methods.	2				2		**4**	**4**	Study exam
Total	**30**				**30**		**60**	**60**	

Assessment strategy	Weight in %	Deadlines	Assessment criteria
written exam theory	40%	during the semester / exam	Good response to the 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				
Semmlow, J.	2017	Circuits, Signals and Systems for Bioengineers: A MATLAB-based Introduction.		Academic Press. – 782 p.

Author	Year of issue	Title	No of periodical or volume	Place of printing. Printing house or internet link
Compulsory literature				
Leondes, C. T.	2005	Medical Imaging Systems Technology: Methods in cardiovascular and brain systems (Vol. 5)		World Scientific. – 408 p.
Northrop, R. B.	2016	Signals and systems analysis in biomedical engineering		CRC press. – 654 p.
Additional literature				
Малков П.Ю.	2005	Количественный анализ биологических данных: Учебное пособие		Горно-Алтайск: РИО ГАГУ, 2005. - 71 с.
Смирнов И.В., Старшов А.М.	2008	Функциональная диагностика. ЭКГ, реография, спирография		Издательство: Эксмо, 2008 . - 224 с.
Олейник В.П., Кулиш С.Н.	2004	Аппаратные методы исследований в биологии и медицине		Учеб. пособие. - Харьков: Нац. аэрокосм, ун-т "Харьк. авиац. ин-т", 2004. – 110 с.