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 (Engineering) **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 Bachelors	Elective

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

Prerequisites	
Prerequisites: study of the disciplines „Higher mathematics“, „Probability theory and mathematical statistics“, „Numerical methods“, „Mathematical methods of the 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 program

Students should be able:

- to understand the fundamental concepts of digital signal processing, master the use of digital filters for converting sound and images.
- to master the skills to collect and process digital biomedical signals, use different methods of signal conversion and analysis in computerized medical systems.
- to model and statistically process signals.

Learning outcomes of module (course unit)	Teaching/learning methods (theory, lab, exercises)	Assessment methods (written exam, oral exam, reports)
Knowledge: - familarization with the basic theoretical provisions of the implemention of methods of processing random samples and their use for 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 limitations.	Work with lecture notes and available fundamental subject literature	Knowledge test
Skills: - formation of theoretical knowledge and acquisition of practical skills for formalization of tasks arising in various spheres of human activity; -formation of the ability to create algorithms for statistical modeling; - development of skills of using different methods of signal conversion and analysis in computerized medical systems	Lectures, labs, consultations	Active lecture attendance, individual projects and presentations
Competences: Studying subject literature, sharing knowledge, working in a group	Lectures, labs, consultations	Individual projects and presentations

Themes	Contact work hours							Time and tasks for individual work	
	Lectures	Consultations	Seminars	Practical 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**	Control work / individual task
2. Analysis and synthesis of signals, description of signals. Decomposition of an arbitrary signal in a given system of functions. Approximate questions, Bessel inequality.	4				4		**8**	**8**	Control work / individual task
3. Harmonic analysis of periodic signals. Power distribution in the spectrum of periodic oscillations. Harmonic analysis of deterministic non-periodic signals. Fourier transformation properties.	4				4		**8**	**8**	Control work / individual task
4. Single pulse spectrum. The energy of a non-periodic signal, Parseval's equality. Current and instant spectra. Sequential and parallel methods of spectrum analysis. Correlation analysis. Relationship between correlation function and spectrum.	4				4		**8**	**8**	Control work / individual task
5. Description of the properties of quadripoles. Signal discretization, mathematical questions. Kotelnikov's theorems. Ageev's theorem.	2				2		**4**	**4**	Control work / individual task
6. Discrete signal processing, an algorithm of generalized digital processing. The sampled signal spectrum. Direct and inverse conversion. Fourier transformation.	2				2		**4**	**4**	Control work / individual task
7. Fast Fourier transformation. Temporary windows.	4				4		**8**	**8**	Control work / individual task

Themes	Contact work hours							Time and tasks for individual work	
	Lectures	Consultations	Seminars	Practical work	Laboratory work	Placements	**Total contact work**	**Individual work**	**Tasks**
8. Filter classification, filter parameters. Approximation of frequency characteristics of filters.	2				2		**4**	**4**	Control work / individual task
9. Digital filters.	2				2		**4**	**4**	Control work / individual task
10. Statistical methods of data analysis.	2				2		**4**	**4**	Control work / individual task
Total	**30**				**30**		**60**	**60**	

Assessment strategy	Weight in %	Deadlines	Assessment criteria
Exam	40%	during the semester / exam	Good response to the questions
Practical computer exam	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.
Leondes, C. T.	2005	Medical Imaging Systems Technology: Methods in cardiovascular and brain systems (Vol. 5)		World Scientific. – 408 p.

Author	Year of issue	Title	No of periodical or volume	Place of printing. Printing house or internet link
Compulsory literature				
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.