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Developed in the frame of project "Erasmus+ (CBHE) BioArt "Innovative Multidisciplinary Curriculum in Artificial Implants for Bio-Engineering BSc / MSc Degrees" (586114-EPP- 1-2017- 1-ES- EPPKA2-CBHE- JP).

DESCRIPTION/Syllabi of Curricula/Module

Short Name of the University/Country code **Date (Month / Year)**	**VNTU / UA** **Sep 2019**
TITLE OF THE MODULE	**Code**
Complex image processing methods (discipline - Processing of biomedical images and reconstruction of objects)	

Teacher(s)	**Department**
Coordinating: As. Prof. Leonid Koval, Ph.D. **Others:**	Dep. for Biomedical Engineering

Study cycle **(BA/MA)**	**Level of the module** **(Semester number)**	**Type of the module** **(compulsary/elective)**
MA	1 semester	Compulsory

Form of delivery **(theory/lab/exercises)**	**Duration** **(weeks/months)**	**Language(s)**
Lectures, exercises, laboratory work	9 weeks / 2 months	Ukrainian, English

Prerequisites	
Prerequisites: Knowledge: basic knowledge of design, construction of biotechnical systems, registration of indicators of vital activity of a biological object. Skills: none Competences: none	**Co-requisites (if necessary):** none

ECTS (Credits of the module)	Total student workload hours	Contact hours	Individual work hours
2,5	75	27	48

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

Students should be able to:

- to create and improve the means, methods and technologies of biomedical engineering for research and development of bioengineering objects and systems of medical and technical purpose;
- analyze complex medical engineering and bioengineering problems and formalize them to find quantitative solutions using modern mathematical methods and information technologies;
- to study biological and technical aspects of functioning and interaction of artificial biological and biotechnical systems.

Learning outcomes of module (course unit)	Teaching/learning methods (theory, lab, exercises)	Assessment methods (written exam, oral exam, reports)
Knowledge: Obtainers have a broad knowledge of the structure and application of devices for biomedical image registration and image processing, model building for object reconstruction	Slides, lecture notes, suggested books and literature, personal reports, written papers	Written/oral exam, essays
Skills: Analyze, develop and apply models for object reconstruction, devices and software for biomedical image registration and image processing.	Lectures, working groups, individual work	Exercise and laboratory reports
Competences: Perform critical literature research on the subject, use the knowledge in practice, exchange notions, present the results	Working groups	Exercise reports 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**
Image filtering.	3						**3**	**6**	To study and understand questions: Schedule of signals, basics of its use. An analogy in the description of spatial and temporal signals. Spatial spectrum as a two-dimensional analogue of the frequency spectrum of time signals. Spatial frequency. Features of the discrete case. Limited frame. Spatial frequency filtering. Filtering ratio in the image domain and the spatial frequency domain. The convolution theorem. The ratio of perfect and real images.
Selection of diagnostic information from images.	2						**2**	**7**	To study and understand questions: Object and texture images in medicine. The role of visual assessment of information in medical research, in particular through technical means. Use of expert systems. Segmentation The case of segmenting multilayered images. Three-dimensional case. Examples of automated image processing for diagnosis.
Synthesis of images.	2						**3**	**7**	To study and understand questions: Object and texture images in medicine. The role of visual assessment of information in medical research, in particular through technical means. Use of expert systems. Segmentation The case of segmenting multilayered images. Three-dimensional case. Examples of automated image processing for diagnosis.
Pattern recognition	3						**3**	**6**	To study and understand questions: Requirements for recognition systems, expert systems, computer vision. General methodological approaches to the construction of pattern recognition systems. Semantic methods in pattern recognition. Features of setting and solving problems of pattern recognition for medical purposes. Use of neural networks. Selection of features. Types of features.
The structure of the image processing system	3						**3**	**7**	To study and understand questions: The needs of the hardware due to the specific mathematical apparatus and the tasks of the particular system.

									Tasks parallelization and architectural features. Features of building software. Application of universal and specialized software. Database support features that include graphical objects.
Practical work				2 2 1			**5**		Adaptive filtering. Building realistic images. Compression of information.
Laboratory work					3 3 3		**9**		Visualization of medical research. Reconstruction and filtering of the object. Construction of 3D image.
Course work								**15**	
Final exam									
Total	**13**			**5**	**9**		**27**	**48**	

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Assessment strategy	Weight in %	Deadlines	Assessment criteria
Practical work and related reports	20		Attendance and reports
Laboratory works attendance and exercise reports	20		Attendance and reports
Colloquium (theory control)	25		Test
Individual tasks	10		Presentations
Final exam	25		Written/oral exam

Author	Year of issue	Title	No of periodical or volume	Place of printing. Printing house or internet link
Compulsory literature				
Preim B, Bartz D.	2007	Visualization in Medicine. Theory, Algorithms, and Applications	ISBN: 978-0-123-70596-9	Morgan Kaufmann
Bankman IN (ed).	2008	Handbook of Medical Image Processing and Analysis	ISBN: 0-123-73904-7	Academic Press
Jan J.	2005	Medical Image Processing, Reconstruction and Restoration	ISBN: 0-824-75849-8	CRC Press
	2008	Image Processing: Methods and Applications	ISBN: 1-402-09085-4	Springer
Additional literature				
Umbaugh SE.	2005	Computer Imaging: Digital Image Analysis and Processing	ISBN: 0-849-32919-1	CRC Press
Bernd Jähne	2013	Digital Image Processing	ISBN: 9783662047811	Springer
В. Г. Абакумов, С. М. Злепко, З. Ю. Готра та ін.	2011	Реєстрація, обробка та контроль біомедичних сигналів: навчальний посібник	ISBN 978-966-641-445-1	ВНТУ

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