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Розроблено в рамках проекту "Erasmus+ (CBHE) BioArt "Інноваційна мультидисциплінарна освітня програма зі штучних імплантів для біоінженерії для бакалаврів та магістрів"
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 DISCIPLINE	Code
Biophysics	
TITLE OF THE MODULE	Code
Biomaterials: blood material interaction and blood purification	

Teacher(s)	Department
Coordinating: As. Prof. Dmytro Shtofel, Ph.D. Others:	Dep. for Biomedical Engineering

Study cycle (BA/MA)	Level of the module (Semester number)	Type of the module (compulsory/elective)
Bachelor	4 th (second year) for Bachelor	Compulsory

Form of delivery (theory/lab/exercises)	Duration (weeks/months)	Language(s)
Lectures, exercises, laboratory study	6 weeks / 1,5 months	Ukrainian, English

Prerequisites	
<p>Prerequisites:</p> <p>Knowledge: basic knowledge on physics, human physiology</p> <p>Skills: none</p> <p>Competences: none</p>	<p>Co-requisites (if necessary):</p> <p>none</p>

ECTS (Credits of the module)	Total student workload hours	Contact hours	Individual work hours
2	60	33	27
Aim of the module (course unit): competences foreseen by the study programme			
<p>Students should be able to:</p> <ul style="list-style-type: none"> - Apply physical, chemical, biological and mathematical methods in the analysis and modeling of the functioning of living organisms and biotechnical systems. - Use tools and methods for analysis, design, calculation and testing when developing biomedical products and services. - Conduct research and observations on the interaction of biological, natural and artificial systems (prostheses, artificial organs, etc.) 			
Learning outcomes of module (course unit)	Teaching/learning methods (theory, lab, exercises)	Assessment methods (written exam, oral exam, reports)	
<p>Knowledge: The students will obtain wide knowledge on the mechanisms of interaction of biomaterials with blood, technologies and equipment for blood purification.</p>	Slides, lecture notes, suggested books and literature, personal reports, written papers	Written/oral exam, essays	
<p>Skills: Perform the analysis of the interaction of biomaterials with blood.</p>	Lectures, working groups, individual work	Exercise and lab reports	
<p>Competences: Perform critical literature research on the subject, use the knowledge in practice, exchange notions, present the results</p>	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
Interaction of biomaterials with blood.	5						5	9	Learn the biomaterials used for blood contact and the areas of their use. Learn and understand the processes of surface modification of biomaterials, physical criteria of biocompatibility, the ways of its increasing. Learn and understand the biological response to the biomaterial input.
Cellular response of blood to foreign material.	5						5	9	Learn and understand the inner and external forces that impact the cell, the mechanisms of reception and cell response. Learn and understand the biophysical mechanisms of blood coagulation, platelet reactions, interaction of the extracellular matrix and glycocalyx, purification principles.
External blood purification	5						5	9	Learn and understand principles and extracorporeal technologies of blood purification, bionic basis of kidney functioning, Learn and understand the principles and equipment for apheresis and dialysis. Learn the materials for adsorption and membranes for blood purification. Learn the methods for assessing the efficiency of blood purification systems.
Exercises				3 3 3			9		Modeling surface effects on material when interacting with blood. Construction of the immune response scheme. Modeling of protein interaction with antigen. Calculation of the apheresis and dialysis parameters.
Laboratory units					3 3 3		9		Unit on physiological testing: study of the interaction of biomaterials and blood plasma. Unit on physiological testing: study of interaction between biomaterials and formed elements Unit on dialysis: study of the dialysis equipment.
Final exam									
Total	15			9	9		33	27	

Assessment strategy	Weight in %	Deadlines	Assessment criteria
Practical works attendance and exercise reports	15		Attendance and reports
Laboratory study and lab report	20		Attendance and reports
Colloquium (theory control)	20		Test
Individual tasks	20		Essays and 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				
Basu, Bikramjit, Dharendra S. Katti, and Ashok Kumar	2010	Advanced biomaterials: fundamentals, processing, and applications	ISBN 978-0-470-89130-8	John Wiley & Sons
Xu, Li-Chong; James W. Bauer; and Christopher A. Siedlecki	2014	Proteins, platelets, and blood coagulation at biomaterial interfaces	Colloids and Surfaces B: Biointerfaces 124: 49-68.	https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5001692/
Suzuki, Hiromichi, and Hiroyuki Hirasawa (eds.)	2010	Acute blood purification	ISBN 978-3-8055-9478-3	Karger Medical and Scientific Publishers
Dawids, Steen (ed.)	2012	Test procedures for the blood compatibility of biomaterials	ISBN 978-94-011-1640-4	Springer Science & Business Media
Sargent, John A., and Frank A. Gotch	1996	Principles and biophysics of dialysis	ISBN 978-0-585-36947-1	in "Replacement of renal function by dialysis," Springer, Dordrecht, 1996. 34-102.

Additional literature				
Campbell, Gaylon S., and John M. Norman	2012	An introduction to environmental biophysics	ISBN 978-1-4612-1626-1	Springer Science & Business Media
Bialek, William	2012	Biophysics: searching for principles	ISBN 978-0691138916	Princeton University Press
Davidovits, Paul	2012	Physics in biology and medicine (4 th edition)	ISBN 978-0123865137	Elsevier – Academic Press
Jung, Friedrich, and Steffen Braune	2016	Thrombogenicity and hemocompatibility of biomaterials	Biointerphase s 11.2: 029601.	https://www.hzg.de/imperia/md/content/gkss/zentrale_einrichtungen/bibliothek/journals/2015/jung_33637.pdf
Wester, Maarten	2018	Electrifying solutions for a miniature dialysis device	Thesis	Utrecht University https://dspace.library.uu.nl/bitstream/handle/1874/374273/Wester.pdf?sequence=1

This project has been funded with support from the European Commission. This publication / communication reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein.