SUBJECT OUTLINE

1. Programme of study description

1.1.	**THE "CAROL DAVILA" UNIVERSITY OF MEDICINE AND PHARMACY**
1.2.	**THE FACULTY OF MEDICINE / DEPARTMENT I – FUNCTIONAL SCIENCES**
1.3.	**DISCIPLINE: BIOPHYSICS**
1.4.	**DOMAIN OF STUDY: Healthcare – regulated sector within the EU**
1.5.	**CYCLE OF STUDIES: BACHELOR'S DEGREE**
1.6.	**PROGRAMME OF STUDY: MEDICINE**

2. Subject description

2.1.	**Name of the subject/compulsory subject/elective subject within the discipline: Biophysics**
2.2.	**Location of the discipline: Bd. Eroii Sanitari, nr. 8, sector 5, București**
2.3.	**Course tenured coordinator: Assoc. Prof. Dr. Octavian Călinescu, Assoc. Prof. Dr. Adrian Iftime, Lecturer Dr. Ramona Babeș**
2.4.	**Practicals/clinical rotations tenured coordinator: Assoc. Prof. Dr. Octavian Călinescu, Assoc. Prof. Dr. Adrian Iftime, Lecturer Dr. Ramona Babeș, Assistant Prof. Dr. Violeta Călin, Assistant Prof. Dr. Maria Minodora Iordache, Assistant Prof. Dr. Ioana Teodora Tofolean**

2.5. Year of study	I	**2.6. Semester**	I	**2.7. Type of assessment**	written and oral	**2.8. Subject classification**	Mandatory

3. Total estimated time (hours/semester of didactic activity) – teaching module

Number of hours per week	5	**Out of which: course**	2	**Clinical rotation**	3
Total number of hours from curriculum	70	**Out of which: course**	28	**Clinical rotation**	42
Distribution of allotted time					**Hours**
Study from textbooks, courses, bibliography, and student notes					
Additional library study, study on specialized online platforms and field study					
Preparing seminars / laboratories, assignments, reports, portfolios and essays					
Tutoring					
Examinations					
Other activities					
Total hours of individual study					
Number of credit points	5 credits				

4. Prerequisites (where applicable)

4.1. of curriculum	none applicable
4.2. of competencies	none applicable

5. Requirements (where applicable)

5.1. for delivering the course	Requires a lecture hall with computer assisted videoprojection and whiteboard with markers
5.2. for delivering the clinical rotation	Requires laboratory rooms with dedicated laboratory instruments

6. Acquired specific competencies

Professional competencies (expressed through knowledge and skills)	• Knowledge of physics principles that govern biological structures and phenomena, from a medical perspective: thermodynamic states of a living

	organism, transport phenomena în living organisms (from basics of molecular transport through cell membranes up to body-wide transport through hemodynamics); genesis and propagation of cells' electric action potentials; the study of sensory systems (visual and auditory) from a biophysical point of view; understanding of the mechanics of muscle contraction; elements of human psychophysics. • Knowledge of the techniques used in medical investigation, in diagnosis, imaging and treatment: using electromagnetic non-ionizing and ionizing radiation, knowledge of ultrasounds, of corpuscular ionizing radiation, dosimetry. • Knowledge of the biological effects of physical factors from the environment: the effects of electromagnetic waves in the UV, visible and the IR domains, effects of electrical and magnetic fields, effects of direct, alternative and pulsed electrical current. • Creating abilities to handle specific laboratory equipment. • Development of the capacity to handle and interpret statistically the experimental data obtained in the lab.
Transversal competencies (of role, of professional and personal development)	• Identification of the objectives that are to be achieved, of the available resources, of the conditions needed to finalize them, of the working steps and working time. • Development of the ability to work in a team, identification of roles and responsibilities in a team and applying techniques of interacting and efficient work in the team. • Development of preclinical medical thinking. • Development of a positive attitude regarding scientific research, understanding the reason for continuous research in the medical field. • Creating the abilities to handle specific lab equipment and efficiently using sources of information as well as resources of communication and assisted professional formation.

7. Subject learning objectives (based on the scale of acquired specific competencies)

7.1. General learning objective	Identification of physical aspects of medical structures and biological phenomena; techniques used in medical exploration and biological effects of physical factors from the environment.	
7.2. Specific learning objectives	The Biophysics lecture aims to present students with: physical aspects of medical structures and biological phenomena; techniques used in medical exploration and biological effects of physical factors from the environment (at the fundamental level of interaction between physical factors and biological systems) and aims the formation of a specific overall way of thinking of future doctors by establishing a correct base of medical thinking. The Biophysics practical sessions aim to promote the understanding of physical phenomena that are the working basis of equipment in the Biophysics lab, creating the abilities to handle the equipment, developing the ability to handle and interpret the obtained experimental data, critical analysis of scientific literature regarding the usage of clinical investigation equipment.	

8. Content

8.1. Course	**Teaching methods**	**Observations**
Lecture 1: Notions of biological thermodynamics	Lectures are taught in amphitheaters and halls which are technically equipped for this purpose: laptop, video projector. All lectures have an electronic support and are brought up to date from the point of view of the information, according to treatises, specialty journals and books edited by the teaching staff of the discipline. At the level of the discipline a library exists, along with the possibility of online access in order to obtain the necessary information.	The educational materials, according to the curriculum, are presented interactively using multimedia means, Powerpoint presentations, teaching videos.
Lecture 2: Water in biological systems		
Lecture 3: Biophysics of disperse systems		
Lecture 4: Membrane transport phenomena		
Lecture 5: Bioelectric phenomena		
Lecture 6: Biophysics of muscle contraction		
Lecture 7: Elements of the biophysics of the visual analyzer		
Lecture 8: Elements of the biophysics of auditive reception		
Lecture 9: Elements of phychophysics		
Lecture 10: Blood circulation and notions of hemodynamics		
Lecture 11: Elements of photobiology		
Lecture 12: Elements of radiobiology		
Lecture 13: Effects of physical factors used in therapy		
Lecture 14 : Elements of medical imaging		
8.2. Clinical rotation	**Teaching methods**	**Observations**
LP1. Introductive seminar (including work security). Elements of biomechanics.	Frontal teaching with the entire group; interactive method, systematic presentation, conversation, problematization, debate.	During the seminars some fundamental physics notions will be recapped – these are necessary for understanding the physical principles underlying the function of the equipment in the Biophysics lab and the knowledge necessary for handling experimental data. The seminars are interactive and the students are encouraged to actively take part in them. During the practical activities, the students are presented with the physical principle that represents the basis of functioning of the device, including its
LP2. Seminar. Notions of bioelectricity.		
LP3. Electrical recordings of biological systems: Electrical basis of electrocardiography; practical determinations.		
LP4. Applications of geometrical optics: Study of lenses. Geometric defects of sight and their correction.		
LP5. Applications of geometrical optics: Optical microscopy. Determination of the diameter of red blood cells.		
LP6. Ionizing radiation: Radiodosimetry: activity of a radioactive source; natural background of radiation. Protection screens against ionizing radiation.		
LP7. Electrical recordings of biological systems: Determination of the cardiac pulse and the oxygen concentration in the peripheral blood (pulse oximetry).		
LP8. Measurement of arterial blood pressure – biophysical principles, units		

of measurement, determination using the sphyngomanometer.		mode of usage, the description of its component parts and the measurement to be done. Multimedia means and teaching movies are used. After obtaining the experimental data, students process them statistically and interpret them. A discussion of the experimental results is done, including their interpretation from the perspective of the biophysical mechanisms involved. Multiple choice exercises and applications of calculations regarding the topic of the practical activity are discussed. Medical applications correlated with the determined biophysical parameter are presented.
LP9. Imaging: Elements of acoustics; introduction to ecography; telemetric measurement of the distances from the body's surface to echogenic surfaces.		
LP10. Determination of the concentration through physical methods: Spectroscopy. Identification of a substance through spectroscopic methods. The spectrophotometric method for determining the concentration of a solution.		
LP11. Determination of the concentration through physical methods: The refractometric method for determining the concentration of a solution.		
LP12. Determination of the concentration through physical methods: The polarimetric method for determining the concentration of a solution.		
LP13. Surface tension and viscosity of biological fluids. Determination of the relative viscosity.		
LP14. Evaluation of the acquired knowledge: Practical exam.		

Bibliography for course and clinical rotation

Lecture Bibliography:

1. Russell K. Hobbie, Bradley J. Roth. ***Intermediate Physics for Medicine and Biology***. 5th Edition, Springer **2015**, ISBN: 978-3-319-12681-4.
2. Kane Suzanne Amador, ***Introduction to Physics in Modern Medicine***, 3rd Edition, Taylor & Francis Ltd. **2020**, ISBN-13: 9781138036031.
3. Nordlund, T.M., Hoffmann, P.M., ***Quantitative Understanding of Biosystems: An Introduction to Biophysics, Second Edition (Foundations of Biochemistry and Biophysics)***. CRC Press **2019**, ISBN-13: 978-1138633414.
4. Nölting, B., ***Methods in Modern Biophysics***, 3rd Edition, Springer **2013,** ISBN13: 978-3662053683
5. Philip Nelson, ***Biological Physics: Energy, Information, Life***. Chiliagon Science **2020**, ISBN-10: 057868702X.
6. Ehsan Samei, Donald J. Peck, ***Hendee's Physics for Medical Imaging***, 5th Edition, Wiley-Blackwell **2019**, ISBN: 978-0-470-55220-9.
7. Hall EJ, Giaccia AJ. ***Radiobiology for the radiologist***, 8th Edition. Lippincott Williams & Wilkins **2018**, ISBN: 978-1-49-633541-8.
8. Neil Campbell, Lisa Urry, Michael Cain, Steven Wasserman, Peter Minorsky, Jane Reece, Rebecca Orr. ***Biology: A Global Approach***, Pearson **2020**, ISBN-10: 1292341637.
9. Alberts, B. *et al.*, ***Molecular Biology of the Cell***, 6th Edition, Garland Science **2020**, ISBN: 978-0-393-87094-7.
10. Jeremy P.T. Ward, Roger W.A. Linden. ***Physiology at a glance***. 4th Edition, Wiley-Blackwell **2017**, ISBN: 978-1-119-24731-9.
11. Parke, W.C. ***Biophysics: A Student's Guide to the Physics of the Life Sciences and Medicine***, **1st**

edition, Springer **2020**, ISBN-13: 978-3030441456.

Laboratory bibliography:

1. Băran, I., Ionescu D., Iftime A., Mocanu, M.-M., Călinescu, O., Omer S., Babeș, R.M., Iordache, M.M., Nisiparu L., Tofolean, I.T., Onu M., Sulică D., Vinersan J. ***Biophysics. Practical Sessions and Seminars*** Editor: Babeș, R.M.. Ed. Universitară Carol Davila, București **2018**, ISBN: 978-606-011-051-4.
2. M.S. Meah, E. Kebede-Westhead, ***Essential Laboratory Skills for Biosciences***. Wiley-Blackwell **2012**, ISBN: 978-0-470-68647-8.
3. Bunch, A.D., ***The Introductory Physics Workbook***. CreateSpace Independent Publishing Platform **2017**, ISBN-13: 978-1545284391.
4. Stroobandt, R.X., Barold, S.S., Sinnaeve, A.F., ***ECG from Basics to Essentials: Step by Step***. Wiley-Blackwell **2015**, ISBN-13: 978-1119066415.

9. Corroboration of the subject content with the expectations of the representatives of the epistemic community, professional associations, and major employers in the field of the programme of study

The mandatory Biophysics lecture, including the Biophysics Practical Sessions, contribute to the formation of students as future medical doctors (MD), consisting of an adequate framework of teaching-learning of the mechanisms and biophysical principles that lie at the basis of common medical procedures, emphasizing the accelerated progress of medical technologies in the last years. As an interdisciplinary subject, it forms an overall way of thinking for the students, encouraging them to research and find out the new information in the field. The theoretical and practical landmarks included in the curriculum of Biophysics are necessary for the future doctors in order for them to become good proffesionists. The contents of the lectures and of the practical activities are continously updated, improved and completed in accordance with the new scientific discoveries in the field and correlated with the university curricula of other similar specialty centers, national and international.

10. Assessment

Type of activity	Assessment criteria	Assessment methods	Assessment weighting within the final grade
Course	- The following will be graded: the exactness, accuracy and integrity of the knowledge; logical coherency; the degree of assimilation of the specialty terms; the capacity to operate with principles taught at the lecture. - The students can only attend the written exam in the exam session if they have obtained a passing grade (5) at the laboratory colloquium. At the half of the semester a control test out of the subjects taught at the lecture up until that date is taken. The control test contains 15 multiple choice questions, each questions being worth 0.6 p. The grade at the control test is between 1 and 10. The obtained grade does	Written exam – multiple choice - The written exam consists of solving a **multiple choice test** made up of 30 questions, each worth 0.3 points. The answers are of the grouped complement type. 1 point is given by default. The grade awarded is between 1 and 10. - The exam is considered to be passed if the student has correctly solved a minimum of 12 questions (the equivalent of 5). - In order to obtain a grade of 10 the student must answer at least 28 questions correctly.	80%

	not condition entry into the written exam in the exam session.		
Clinical rotation	- The laboratory colloquium consists of performing one experiment of those studied during the practical activities. - For a grade of 5, the student must: recognize, know what he is measuring and how to use the equipment. - For a grade of 10, the student must: know the biophysical principle of the method and the way the device functions, recognize the device, know how to use the device, know how to mathematically determine a certain physical quantity that is not determined directly by the experiment, be capable of interpreting the obtained results.	Oral examination – practical laboratory exam - The students will be graded from 1 to 10 (grade NP). - In order for the exam to be passed, the minimum obtained grade has to be 5, the exam is eliminatory. - A grade (from 4 to 10) is given for *the activity* of the student at the practical activities, depending on how he works and on the grade obtained at the control test (grade NA). - The grade of the practical exam (grade EP) is calculated as an average of the grades NP and NA.	20%
	The final grade is calculated according to the following formula : $Grade_{final} = 0{,}8 \times Grade_{ES} + 0{,}2 \times Grade_{EP}$ Where ES – written exam, EP – practical exam		

Minimum performance standard

- In order for the student to pass the practical laboratory exam (which is eliminatory) with 5, the student must: recognize, know what he is measuring and knows how to use the lab equipment, he has to know the meaning of a certain biophysical parameter that is determined.
- The written exam during the exam session is passed if the student has correctly solved a minimum of 12 out of 30 questions (the equivalent of the grade 5 out of 10), which assumes that the student has to be able to recognize and characterize the physical phenomenon that lies at the basis of a certain biological process, he knows fundamental notions in biological thermodynamics, bioelectricity, geometrical optics, wave optics, fluid mechanics, radiobiology, psychophysics. In order for the student to be able to attend the written exam he needs to have passed the practical laboratory exam.

Date of filing	Signature of the course tenured coordinator	Signature of the seminar tenured coordinator
05.10.2022	**Assoc. Prof. Dr. Octavian Călinescu**	**Assoc. Prof. Dr. Octavian Călinescu**
	Assoc. Prof. Dr. Adrian Iftime	**Assoc. Prof. Dr. Adrian Iftime**
	Lecturer Dr. Ramona Babeș	**Lecturer Dr. Ramona Babeș**
		Assistant Prof. Dr. Violeta Călin
		Assistant Prof. Dr. Maria Minodora Iordache
		Assistant Prof. Dr. Ioana Teodora Tofolean

Date of approval in the Council of the Department:	Signature of the Head of the Department