DISCIPLINE SHEET

1. Data about the programme

1.1.	**"CAROL DAVILA" UNIVERSITY OF MEDICINE AND PHARMACY**
1.2.	**FACULTY OF MEDICINE**
1.3.	**DEPARTMENT I – FUNCTIONAL SCIENCES**
1.4.	**DISCIPLINE: BIOPHYSICS**
1.5.	**DOMAIN OF STUDY: HEALTH – Sectorally regulated within the European Union**
1.6.	**STUDY CYCLE: LICENCE**
1.7.	**STUDY PROGRAME: MEDICINE – ENGLISH MODULE**

2. 2. Data about discipline

2.1.	**Name of the discipline in the educational plan: Biophysics**				
2.2.	**Discipline code: DF I 2 S1M**				
2.3.	**Discipline type (FD/SD/CD): FD**				
2.4.	**Discipline regimen (MD/OPD/): MD**				
2.5.	**The holder of the course activities: Assoc. Prof. Dr. Octavian Călinescu, Lecturer Dr. Ramona Mădălina Babeș**				
2.6.	**The holder of the seminar activities : Assoc. Prof. Dr. Octavian Călinescu, Lecturer Dr. Ramona Babeș, Assistant Prof. Dr. Violeta Călin, Assistant Prof. Dr. Maria Minodora Iordache, Assistant Prof. Dr. Laura Călugăru**				
2.7. Year of study	**I**	**2.8. Semester**	**I**	**2.9. Type of evaluation (E/C)**	**E**

3. **Total estimated time (hours/semester of didactic activity an self preparation/study**

I. Academic training (teaching, practical application, assessment)						
3.1. Nr hours/week	**4**	**From which:**	**3.2. lecture**	**2**	**3.3. seminary/ laboratory**	**2**
3.4. Total hours of educational plan	**56**	**From which:**	**3.5. lecture**	**28**	**3.6. seminary/ laboratory**	**28**
Evaluation (nr. of hours) : 2						
II. Self preparation/study						
Time allocation						**hours**
Study of course materials, textbooks, books, study of the recommended minimal bibliography						36
Additional research in the library, research through the internet						4
Performing specific activities for preparing projects, laboratories, elaborating reviews or other tasks						4
Specific preparation activities for projects, laboratory work, assignments, and reports						24
Tutoring						2
Other activities						0
3.7. Total individual study hours						70
3.9. Total hours per semester (3.4.+ 3.7.)	128					

3.10. Number of credits	5

4. Preconditions (where applicable)

4.1. of curriculum	None applicable
4.2. of competences	None applicable

5. Conditions (where applicable)

5.1. to conduct the lecture	Requires a lecture hall with computer assisted videoprojection and whiteboard with markers
5.2. to conduct the seminar / laboratory	Requires laboratory rooms with dedicated laboratory instruments, videoprojection, whiteboard with markers

6. Learning outcomes

Knowledge	Skills	Responsibility and autonomy
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	Creating abilities to handle specific laboratory equipment	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
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	Development of the capacity to handle and interpret statistically the experimental data obtained in the lab	Development of preclinical medical thinking
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	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 a constructive attitude regarding scientific research, understanding the reason for continuous research in the medical field
	Learning to efficiently use sources of information as well as resources of communication and assisted professional formation	

7. Course objectives (aligned with the learning outcomes)

7.1. General 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 objective	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. Contents

8.1. Lecture	**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 published 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		

Recent bibliography:

1. Călinescu, O., Babeş, R., Iftime, A., Băran, I., Ionescu, D., Ganea, C. ***Medical Biophysics For 1st Year Medical Students***. Presa Universitară Clujeană, Cluj-Napoca **2024**, ISBN: 978-606-37-2235-6 (ebook), 978-606-37-2234-9 (print).
2. Russell K. Hobbie, Bradley J. Roth. ***Intermediate Physics for Medicine and Biology***. 5th Edition, Springer **2015**, ISBN: 978-3-319-12681-4.
3. Kane Suzanne Amador, ***Introduction to Physics in Modern Medicine***, 3rd Edition, Taylor & Francis Ltd. **2020**, ISBN-13: 9781138036031.

4. 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.
5. Nölting, B., ***Methods in Modern Biophysics***, 3rd Edition, Springer **2013,** ISBN13: 978-3662053683
6. Philip Nelson, ***Biological Physics: Energy, Information, Life***. Chiliagon Science **2020**, ISBN-10: 057868702X.
7. Ehsan Samei, Donald J. Peck, ***Hendee's Physics for Medical Imaging***, 5th Edition, Wiley-Blackwell **2019**, ISBN: 978-0-470-55220-9.
8. Hall EJ, Giaccia AJ. ***Radiobiology for the radiologist***, 8th Edition. Lippincott Williams & Wilkins **2018**, ISBN: 978-1-49-633541-8.
9. Neil Campbell, Lisa Urry, Michael Cain, Steven Wasserman, Peter Minorsky, Jane Reece, Rebecca Orr. ***Biology: A Global Approach***, Pearson **2020**, ISBN-10: 1292341637.
10. Alberts, B. *et al.*, ***Molecular Biology of the Cell***, 6th Edition, Garland Science **2020**, ISBN: 978-0-393-87094-7.
11. Jeremy P.T. Ward, Roger W.A. Linden. ***Physiology at a glance***. 4th Edition, Wiley-Blackwell **2017**, ISBN: 978-1-119-24731-9.
12. 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.

8.2. Laboratory / practical lesson	**Teaching methods**	**Observations**
LP1. Introductive seminar (including work security). Elements of biological thermodynamics.	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 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
LP2. Seminar. Notions of bioelectricity.		
LP3. Electrical recordings of biological systems: Electrical basis of electrocardiography (EKG1)		
LP4. Applications of geometrical optics: Study of lenses.		
LP5. Applications of geometrical optics Geometric defects of sight and their correction.		
LP6. Applications of geometrical optics: Optical microscopy. Determination of the diameter of red blood cells.		
LP7. Ionizing radiation: Radiodosimetry: determination of natural background of ionizing radiation.		
LP8. Introduction to spectroscopy. Electromagnetic spectrum, recording of absorption spectra. Identification of a substance through spectroscopic methods.		
LP9. The spectrophotometric method for determining the concentration of a solution.		
LP10. Determination of the concentration through other physical methods: The refractometric method.		
LP11. Measurement of arterial blood pressure – biophysical principles, units of measurement, determination using the sphyngomanometer.		
LP12. Elements of acoustics; introduction to ecography; echographic measurements.		

LP13. The recording of electrocardiogram. Scalar measurements on electrocardiogram. Electrical artifacts (EKG2)		calculations regarding the topic of the practical activity are discussed. Medical applications correlated with the determined biophysical parameter are presented.
LP14. Evaluation of the acquired knowledge: Practical exam.		

Recent 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. Evaluation

Activity type	9.1. Evaluation criteria	9.2. Evaluation methods	9.3. Percentage in the final grade
9.4. Lecture	- 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 and if they have attended at least 50% of the lectures.	Written exam – multiple choice - The written exam consists of solving a **multiple choice test** made up of 30 questions from the exam bibliography, each worth 0.3 points. The answers are of the grouped complement type. 1 point is given by default. The grade awarded (Grade ES) is between 1 and 10. The questions are the same for all students in a series, and the exam takes place at the same time for all the students of a series. - 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 27 questions correctly.	80%

9.5. Seminary/ practical activity	- The laboratory colloquium consists of solving a list of 7 questions, which also contains performing one measurement of those studied during the practical activities. The measurement is graded with a maximum of 2 points. The other questions are from the bibliography of the practical activities and are graded with 1 or 2 points. The questions address the studied practical activities, the biophysical principles of the methods and the way the devices function, to recognize the devices, 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. A model of the questions (sample questionnaire) is posted during the semester and available to the students.	At the practical exam (**EP**) each question is graded with a number of points. The maximum possible number of points for one form is 9 (nine). 1 point is awarded by default. After grading the written answers of the student (and checking the student's method of work on the experimental device, if needed), the grade of the practical exam is calculated, by rounding up to the nearest integer grade (for example, a student that scores 9.5 points is awarded a grade of 10). The grade of the practical exam (Grade EP) is an integer. The practical exam can take at most 100 minutes for one student. - In order for the exam to be passed, the minimum obtained grade has to be 5, the exam is eliminatory.	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		
9.5.1. Individual project (if applicable	-	-	-

9.6. Minimum performance standard

- In order for the student to pass the practical laboratory exam (which is eliminatory) with 5, the student must score at least 3,5 points from the questionnaire (1 point is awarded by default).
- 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 filling: **17.09.2025**	**Signature of the lecture tenured coordinator** **Assoc. Prof. Dr. Octavian Călinescu** **Lecturer Dr. Ramona Babeș**	**Signature of the seminar tenured coordinator** **Assoc. Prof. Dr. Octavian Călinescu** **Lecturer Dr. Ramona Babeș** **Assistant Prof. Dr. Violeta Călin** **Assistant Prof. Dr. Maria Minodora Iordache** **Assistant Prof. Dr. Laura Călugăru**

Date of approval in the Council of the Department:

Signature of the Head of the Department