FACULTY OF STOMATOLOGY
STUDY PROGRAM 0911.1 STOMATOLOGY
DEPARTMENT OF HUMAN PHYSIOLOGY AND BIOPHYSICS

APPROVED
at the meeting of the Commission for Quality Assurance and Evaluation of the Curriculum Stomatology Faculty
Protocol No. 6 from 28.06.2022
Chairman, PhD, associate professor
Stepco Elena _____

APPROVED
at the Council meeting of the Stomatology Faculty
Protocol No. 1 from 06.09.2022
Dean of Stomatology Faculty,
doctor of medicine, conf. univ.
Oleg Solomon _____

APPROVED
at the meeting of the chair of Human Physiology and Biophysics
Protocol No. 31 from 06.06.2022
Head of chair, PHD, professor
Victor Vovc _____

SYLLABUS
DISCIPLINE **BIOPHYSICS IN STOMATOLOGY**

Integrated studies

Tipe of course: **Compulsory**

Syllabus developed by the team of authors:
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Chisinau, 2022

I. INTRODUCTION

II. General presentation of the discipline: place and role of the discipline in the formation of the specific competences of the professional / specialty training program

Biophysics in dentistry is the fundamental medical-biological science, the study of which at the university level will allow the future dentist to study the physical aspects of biological structures and phenomena in the light of nanotechnologies, as well as physiological and mathematical concepts and theories. Creating skills for applying and reading information on medical devices, developing critical thinking in addressing the problems of the structure and functioning of medical devices, including those related to the activity of the dentist. Taught in the first year of university studies, biophysics in dentistry provides the basis for the scientific study of living matter with the help of nanotechnologies, modern techniques, and the creation of scientific conceptions of medicine for students. Given its broad spectrum of methods and objectives, biophysics evolves in close connection with physiology, biochemistry, bio-cibernetics, biomathematics, molecular biology, and system biology - a young discipline born at the border between biology and engineering sciences.

Good knowledge of Physics, Mathematics, Chemistry and Biology in the pre-university studies is required for the good knowledge of the subject.

III. Mission of the curriculum (aim) in professional training

The course of "Biophysics in dentistry" aims to train the students of the General Medicine faculty with a set of skills necessary for the acquisition of the specialized courses as well as the further training of a specialist. The content units of the course "Biophysics in dentistry" are structured to provide the students with skills training in several fundamental directions: a) physical analysis skills of composition, structure and development of the living matter; b) skills to use physical methods of exploration of the biological structures and the physical principles of operation of apparatus and equipment used in medicine; c) skills to analyze the influence of physical factors (such as the temperature, the electromagnetic radiation of different types, the composition and environmental parameters) on the biological systems.

IV. Language of the discipline: English.

V. Beneficiaries students of the 1st year, Stomatology faculty.

II. MANAGEMENT OF THE DISCIPLINE

Code of discipline		**F.01.O.004**	
Name of the discipline		**Biophysics in Stomatology**	
Persons in charge of the discipline		**Chetrus Petru, Gubceac Natalia**	
Year	**I**	Semester/Semesters	**I**

Total number of hours, including:			**120**
Lectures	**30**	Practical/laboratory hours	**15**
Seminars	**15**	Self-training	**60**
Form of assessment	**E**	Number of credits	**4**

III. TRAINING AIMS WITHIN THE DISCIPLINE

At the end of the discipline study the student will be able to:

- ***at the level of knowledge and understanding:***

– at the level of knowledge and understanding:
– to distinguish the notions and physical laws that describe the structure and development of the biological systems;
– to expand the approaches used to describe the physical phenomena and the processes to elucidate the nature of the processes in the living organisms and their elements;
– to report on the similarity of the laws of the physical systems in the biological systems;
– to interpret the achievements of the contemporary physics that can be used in the medicine;
– to explain the essence of the physical phenomena and their relationship with processes in the biological organisms;
– to illustrate the analogies between the known physical systems and the biological systems;
– to exemplify the application of the contemporary physics achievements in medical practice.

- ***at the application level:***

– to use the physical facilities for study characteristic of the physical processes and the biological organisms;
– to operate with the physical quantities and their units of measurement that also characterize the biological systems;
– to model the functioning of the biological organisms based on analogy with the physical systems;
– to practice the evaluation of the activity of the living organism based on its physical parameters;
– to simulate the experiments that elucidate the action of the physical factors on the vital functions of the biological organism;
– to perform the measurements of the physical factors parameters affecting living organisms;
– to solve problems related to the parameters of the physical factors that influence the biological systems.

- **at the integration level:**

– to generalize the basic conclusions regarding the physical phenomena and the processes in the living organism;

- to use the theoretical and practical knowledge obtained in studying of the biophysics course by correlating them with the field of activity;
- to estimate the role of physical and physicochemical processes that ensure the vital activity of the human organism;
- to give assumptions about the importance and the place of biophysics in the system of medical-biological sciences.

IV. PROVISIONAL TERMS AND CONDITIONS

In order to achieve the curriculum, the student of the 1st year must meet the following requirements:

- knowledge of the language of instruction;
- proven skills in biology, chemistry, physics at upper secondary level;
- skills in the field of information technologies (using the Internet, documenting with computer, using graphics software);
- communication skills and teamwork.

V. THEMES AND ESTIMATE ALLOCATION OF HOURS

Lectures, practical hours/ laboratory hours/seminars and self-training

No. d/o	THEME	Number of hours			
		Lectures	Practical hours	Seminars	Self-training
1.	Introduction. Biophysics. Biophysical systems used in dentistry studies.	2			2
2.	Description of multi-electron atom by using Bohr's model. Quantum numbers.	2			2
3.	Interatomic and intermolecular forces of interaction in molecular biophysics. Phase transformations. Properties of dental materials.	2			2
4.	Water. Structure and properties of the water molecule. Dissociation of the water molecules.	2			2
5.	Biophysics of the dispersed systems. Electrical properties of the solutions. Electrical properties of the solutions Electrical properties of the solutions and materials used in dentistry.	2			2
6.	Introduction to the fluids biomechanics. Fluids dynamics. Viscosity.	2			2
7.	Simple diffusion. Diffusion through membranes. Molecular transport phenomena.	2			2
8.	Bioelectric phenomena. Membrane potential.	2			2

No. d/o	THEME	Number of hours			
		Lectures	Practical hours	Seminars	Self-training
	Electromiography in dentistry.				
9.	Electromagnetic radiation. Photons interaction with the substance.	2			2
10.	Thermal radiation. Thermal radiation laws:Kirschoff's Stefan-Boltsman, Wien.	2			2
11.	Luminescence, photoluminescence. Stoke's law for luminescence. Using of fluorescence in dental diagnosis.	2			2
12.	X-radiation. X-rays diffraction.Radiography and radioscopy in dentistry.	2			2
13.	Magnetic properties of the substabces. Nuclear magnetic resonance (NMR).	2			2
14.	Modern methods of medical imaging.	2			2
15.	Evaluation, the 1st	2			
16.	Structure of matter. Methods of errors calculation.			2	2
17.	Determination of viscosity of biological liquids.		2		2
18.	Ultrasound effects. Techniques and methods used in medicine.			2	2
19.	Determination of the coefficient of surface tension to liquid-air interface.		2		2
20.	Cell osmotic phenomena		1	1	2
21.	Determination of ion mobility by electrophoretic method.		2		2
22.	Evaluation, the 2nd			2	
23.	Emission and absorption spectra. Spectral analysis.			2	2
24.	Laser radiation. Determination of wavelength and energy of laser radiation.		2		3
25.	Determination of the concentration of solutions by the polarimetrical method.		2		3
26.	Stud Studying of colored solutions by photo-colorimetric method		2		3
27.	Determination of a biological dose with installation B-4.		2		3
28.	Evaluation, the 3rd			2	

No. d/o	THEME	Number of hours			
		Lectures	Practical hours	Seminars	Self-training
29.	Detection of nuclear radiation.			2	3
30.	Impedance dispersion of biological tissues.			2	3
Total		**30**	**15**	**15**	**60**

VI. PRACTICAL TOOLS PURCHASED AT THE END OF THE COURSE

VII. OBJECTIVES AND CONTENT UNITS

Objectives	Content units
Fluid biophysics	
• To define the notions of atom, viscosity, superficial tension,ultrasound, osmosis and ion mobility; • to know the SI units and medical practice for the above specified quantities; • to know the water disintegration formula as well as all water properties; • to determine the coefficient of viscosity, the surface tension coefficient, the mobility of the ions by the methods specific to each; • to apply the new studied concepts to medical practice.	1. Determination of the viscosity of the liquids.
	2. Ultrasonic effects. Techniques and methods used in medicine.
	3. Determination of the surface tension coefficient at the liquid-air interface
	4. Cell osmotic phenomena.
	5. Determination of ion mobility by electrophoretic method.
	6. Water. Structure of the water molecule.
	7. Fluid biophysics. Statics and Fluid Dynamics. Hemodynamics.
	8. Structure of matter. Bohr's atom. Quantum numbers.
Electromagnetic radiation	
• To define the concepts of solution, emission spectra and absorption spectra, laser,impedance,polarimetry;	1. Emission and absorption spectra. Spectral analysis.
	2. Laser radiation. Determination of wavelength and quantum energy.

Objectives	Content units
• to know how to express the concentration of solutions; • to determine the energy of a laser quantum; • to determine the concentration of solutions by polarimetric method and photocolorimetric method; • to apply the new studied concepts to medical practice.	3. Dispersion of impedance of biological tissues. 4. Determination of solution concentration by polarimetric method. 5. Studying colored solutions by photocolorimetric method. 6. Detection of nuclear radiation. Protection against ionizing radiation.
Lectures	
• To define the concepts of dispersion systems, electromagnetic radiation, thermal radiation, luminescence; • To know the types of transport through membranes; • To explain the phenomena of interaction of electromagnetic radiation with matter and its effects; • To explain the difference between X-ray, computed tomography and magnetic resonance.	1. Molecular biophysics. Connecting forces. Phase transformations. 2. Biophysics of dispersed systems. Electrical properties of solutions. 3. Molecular transport phenomena. Diffusion through membranes. 4. Electromagnetic radiance. Interaction of the photon with the substance. 5. Thermal radiance. The laws of Kirchhoff, Stefan-Boltzmann, Wien. 6. Luminescence. Photoluminescence. Stokes' law. 7. Radiation X. X-Ray Diffraction. Radiography, radioscopy. 8. Magnetic properties of the substance. Nuclear magnetic resonance.

VIII. PROFESSIONAL (SPECIFIC (SC)) AND TRANSVERSAL (TC) COMPETENCES AND STUDY FINALITIES

✓ Professional (specific) (SC) competences

- PC1. Strong knowledge of the features of structure, development and functioning of the human body in various physiological and pathological conditions.
- PC2: Conducting of various practical work and procedures for carrying out professional activities specific to the specialty of dentistry based on the knowledge of fundamental sciences;

✓ Transversal competences (TC)

- TC1. Applcation of professional standards of assessment, acting according to professional ethics, as well as the provisions of the legislation in force. Promotion of logical reasoning, practical applicability, assessment and self-assessment in decision-making;

✓ Study finalities

Note. Discipline finatities (are deduced from the professional competences and the formative valences of the informational content of the discipline).

- Knowledge, understanding and correct use of the terminology of the Biophysics.
- Knowledge and understanding of atomic and the molecular structure of the substance and its relationship to the physio -chemical properties of the substance used in dentistry.
- Measurement and estimation of physical quantities, which characterize the properties of the substance.
- Solving problems related to the study of physical systems that model the biological systems.
- Analysis and comparison of different physical methods of study of the biological systems in dentistry.
- Performing various practical exercises, including the ones applied in dentistry, related to the study of physical and biological systems.

IX. STUDENT'S SELF-TRAINING

No.	Expected product	Implementation strategies	Assessment criteria	Implementation terms
1.	Working with information sources	Reading the lecture or the material in the manual carefully; To get acquainted with the list of additional information sources on the topic; Select the source of additional information on the topic; Reading the text entirely, carefully and writing the essential content; Formulate conclusions about the importance of the topic / subject.	• Ability to extract the essentials; interpretative skills;	During the semester
2.	Working with the notebook of Practical Lesson	Until the presentation of the practical notebook, it is necessary to study the material for each paper, to prepare the notebook according to the	Presentation of the report, with the conclusions and the error calculation.	During the semester

		unique requirements. After the experiment, it is necessary to calculate the errors, interpret them and formulate the conclusions.		
3.	Preparation of presentations, posters and papers	Selection of the research theme, setting the plan and the deadline. Determining the components of the PowerPoint presentation, poster or report - theme, purpose, results, conclusions, practical applications, bibliography.	The volume of work, the degree of penetration in the essence of the project theme, the level of scientific argumentation, the quality of the conclusions, the elements of creativity, the formation of the personal attitude, the coherence of the exposure and the scientific correctness, the presentation,	During the semester

X. METHODOLOGICAL SUGGESTIONS FOR TEACHING-LEARNING-ASSESSMENT

✓ *Teaching and learning methods used*

Lecture lessons are held for students of the General Medicine II faculty. Seminar and laboratory lessons are held in groups. Laboratory work is performed individually by each student and ends with the teacher's assessment of the report. Seminars are used to listen to and discuss the papers prepared by the students. The assessment of the students' knowledge and skills in the Biophysics discipline takes place in the form of three evaluations/tests according to the USMF curriculum. A grade for the average assessment is made up of the current grades of each student in performing the laboratory work and the individual work of each student.

✓ ***Applied*** *(specific to the discipline)* ***teaching strategies / technologies***

Biophysics is a compulsory discipline and teaches according to the classical university standard: lectures and practical papers. The theoretical course at lectures is held by the course holders. At the initial practical work, the basic theoretical notions are discussed using modern techniques applied to the subject, followed by the laboratory work. Experiences happen with demonstration medical devices. They allow the student to practice under their own coordination. Following the experiments, the data obtained is recorded. These data are entered in the work notebook. The paper finishes with the completion of the minutes.

✓ ***Methods of assessment*** *(including the method of final mark calculation)*

Current: frontal and / or individual control through:

- applying computerized tests,
- solving problems / exercises,
- control work.

Final*:* Exam.

Method of mark rounding at different assessment stages

Intermediate marks scale (annual average, marks from the examination stages)	National Assessment System	ECTS Equivalent
1,00-3,00	**2**	**F**
3,01-4,99	**4**	**FX**
5,00	**5**	**E**
5,01-5,50	**5,5**	
5,51-6,0	**6**	
6,01-6,50	**6,5**	**D**
6,51-7,00	**7**	
7,01-7,50	**7,5**	**C**
7,51-8,00	**8**	
8,01-8,50	**8,5**	**B**
8,51-9,00	**9**	
9,01-9,50	**9,5**	**A**
9,51-10,0	**10**	

The average annual mark and the marks of all stages of final examination (computer assisted, test, oral) - are expressed in numbers according to the mark scale (according to the table), and the final mark obtained is expressed in number with two decimals, which is transferred to student's record-book.

Absence on examination without good reason is recorded as "absent" and is equivalent to 0 (zero). The student has the right to have two re-examinations in the failed exam.

XI. RECOMMENDED LITERATURE:

A. Compulsory :

1. D. Croitoru, V.Vovc, N. Gubceac, V. Tonu, I. Cojocaru, Practical Papers of Medical Biophysics, 2015.
2. D. Croitoru, V. Vovc, I. Cojocaru, Lectures, Exercices, Medical Biophysics, 2014.

B. Additional

1. Philip Nelson, Biological Physics: Energy, Information, Life 2010.
2. *2.* Richard Berry, Biophysics of Molecular Motors, Oxford 2010.