FIŞA DISCIPLINEI

1. Date despre program

1.1 Instituţia de învăţământ superior	**UNIVERSITATEA DE MEDICINA SI FARMACIE "VICTOR BABEŞ" TIMIŞOARA**
1.2 Facultatea	**FACULTATEA DE MEDICINĂ DENTARĂ**
1.3 Departamentul	III ŞTIINŢE FUNCŢIONALE
1.4 Domeniul de studii de .....[1)]	Licenţă
1.5 Ciclul de studii[2)]	Licenţă
1.6 Programul de studii/ Calificarea	Medicină Dentară secţia engleză

2. Date despre disciplină

2.1. Denumirea disciplinei	**BIOFIZICĂ**							
2.2 Titularul activităţilor de curs				Prof. dr. Neagu Adrian				
2.3 Titularul activităţilor de laborator				Asist dr. Horhat Raluca Asist. dr. Arjoca Stelian				
2.4 Anul de studiu	**I**	2.5 Semestrul	**I**	2.6 Tipul de evaluare	**Examen**	2.7 Regimul disciplinei	Conţinut[3)]	**DF**
							Obligativitate[3)]	**DI**

3. Timpul total estimat (ore pe semestru al activităţilor didactice)

3.1 Număr de ore pe săptămână	4	3.2 din care: curs	**2**	3.3 laborator	**2**
3.4 Total ore din planul de învăţământ	**56**	3.5 din care: curs	**28**	3.6 laborator	**28**
Distribuţia fondului de timp					ore
Studiul după manual, suport de curs, bibliografie şi notiţe					48
Documentare suplimentară în bibliotecă, pe platformele electronice de specialitate şi pe teren					28
Pregătire seminarii/ laboratoare/ proiecte, teme, referate, portofolii şi eseuri					14
Tutoriat					
Examinări					4
Alte activităţi					

3.7 Total ore studiu individual	**90**
3.8 Total ore pe semestru	**150**
3.9 Numărul de credite[5)]	**5**

4. Precondiţii (acolo unde este cazul)

4.1 de curriculum	None
4.2 de competenţe	None

5. Condiţii (acolo unde este cazul)

5.1 de desfăşurare a cursului	• taught to the whole series of students, in a lecture room, using notebook computer, projector and whideboard
5.2 de desfăşurare a seminarului/ laboratorului/ proiectului	• taught for each group in part, either frontally (3 preparative classes and 2 laboratory works) or in teams of 2-4 students (8 laboratory works).

6. Competenţe specifice acumulate

Competenţe Profesionale	1. Analysis of physical principles that lie at the basis of diagnostic and therapeutic instruments used in dental medicine; 2. Use of physics concepts implied in physiological processes encountered in the human body; 3. Ability to apply the methods of physics for the quantitative analysis of molecular phenomena that take place in the oral cavity; 4. Handle the laboratory equipment and analyze experimental data.
Competenţe transversale	1. Teamwork skills; 2. Oral and written communication skills in English; 3. Autonomous study skills, with beneficial impact on the student's ability to engage in lifelong learning.

7. Obiectivele disciplinei (reieşind din competenţele specifice acumulate)

7.1 Obiectivul general al disciplinei	The Biophysics course aims at clarifying physics concepts needed to understand physico-chemical processes from the body, as well as the working principles of diagnostic and therapeutic devices commonly used in dentistry.
7.2 Obiectivele specifice	Lectures: • to present the physical principles of certain devices used by dentists;

	• to explain the physical mechanisms of biological processes of interest in dental medicine. Laboratory works: • to build practical skills needed to measure precisely using the laboratory equipment; • to analyze experimental results using the theory of measurement errors and to represent them graphically; • to consolidate the theoretical concepts presented at lectures.

8. Conţinuturi

8.1 Curs	Metode de predare	Număr de ore	Observaţii
1. The atomic and molecular structure of matter: atoms, ions, molecules, chemical bonds and intermolecular forces encountered in living matter. Water: the structure of the water molecule and its dipolar character, hydrogen bonds, physical properties of water and their biological importance.	Interactive lectures	2	The lectures are presented interactively, using a projector, with PowerPoint slides, which offer an up-to-date visual support, being based on textbooks of international circulation and on recent articles published in ISI journals. New notions are introduced by case studies analyzed with the voluntary participation of the audience. Numerical examples are worked out by the instructor, or by a voluntary student, on a whiteboard. The lectures, printed in PDF format, are posted in advance on the Moodle platform of the e-learning center of our university (moodle.umft.ro). For better understanding, weekly office hours are being held by the instructors involved in teaching Biophysics to students of dental medicine.
2. Electromagnetic waves and elements of optics: the spectrum of electromagnetic waves (infrared radiations, visible light, ultraviolet radiations, X-rays), wave-particle duality of the electromagnetic field, properties of photons, light sources used in dental practice, refraction and reflection of light, total internal reflection of light, optic fibers and their uses in dental medicine.		2	
3. Lasers and their applications in dental medicine: spontaneous and stimulated emission, metastable states and population inversion, the ruby laser, the He-Ne laser, the Nd-YAG laser, the CO_2 laser, the XeF excimer laser, the european classification of laser devices, applications of lasers in dental medicine (treatment of parodontosis, caries prevention, caries diagnostics, laser drilling, facilitation of teeth whitening procedures, surgery).		2	
4. Elements of optoelectronics: semiconductors of type n and p, the structure of energy bands of semiconductors of type n and p, absorption and emission of light by semiconductors, optoelectronic devices used in dentistry (LEDs and laser diodes).		2	
5. Color in dentistry: the structure of retina and the physiological basis of color perception, colorimetric parameters (hue, saturation and lightness), CIE standard light sources, the CIELAB color space, expressing differences in color in terms of distances between points in the CIELAB color space, color analysis in dental medicine (visual analysis and instrumental analysis by colorimetry and spectrophotometry), color communication in dental medicine.		2	
6. Uses of X-rays in dental imaging: generation of X-rays, bremsstrahlung and characteristic radiation, attenuation of X-rays described in terms of the linear attenuation coefficient and in terms of the radiodensity (expressed in Hounsfield units HU), dental radiography, the physical principle of computed tomography (CT), classical CT, spiral CT, multi-slice spiral CT, cone-beam computed tomography (CBCT) and its uses in oral imaging (orthodontics, implantology and maxillofacial surgery).		2	
7. Solvation equilibria in the oral cavity: the law of mass action, characterization of solvation equilibria, solubility, the role of solubility product in the characterization of the dissolution of hardly soluble ionic compounds, hydroxyapatite - the mineral component of enamel, the demineralization-remineralization equilibrium of dental enamel.		2	
8. Acid-base equilibria in the oral cavity: definition of pH, buffer systems present in the human body, salivary buffer systems, the role of bicarbonate ions in maintaining salivary pH between physiological limits, the impact of pH on the dissociation equilibrium of hydroxyapatite in the oral environment, the pH of bacterial plaque and the formation of dental caries.		2	
9. Elements of thermodynamics and thermal properties of dental materials: state parameters, the principles of thermodynamics, thermodynamic forces and fluxes, heat transfer, thermal conductivity and thermal diffusivity of dental materials, thermal expansion of solids and liquids, thermal expansion requirements for dental materials.		2	

10. Transport phenomena in fluids: (i) diffusion, Fick's laws, (ii) osmosis, the Van't Hoff law, osmotic flux through the endothelium of capillary vessels, the uses of reverse osmosis in water filtering in dental clinics, (iii) flow, viscosity, characterization of the flow certain dental materials (restorative composits, dental impression materials).		2	
11. The laws of classical mechanics and mechanical properties of dental materials: motion, Newton's laws, types of forces acting on hard and soft tissues from the oral environment, deformable solids, Hooke's law, Young's modulus, shear modulus, thermal expansion stress, deformability characteristics of solid dental materials.		2	
12. The biomechanics of the rigid body: torque, the equilibrium of a rigid body, the classification of levers, anatomic levers, biomechanics of mastication, biomechanical aspects of prosthetics and dental implantology.		2	
13. Electric and magnetic phenomena: electric charges, electric potential, the intensity of an electric current, Ohm's law, Kirchhoff's laws, conductometric characterization of the purity of water, magnetic fields, electromagnetic induction, electric motors and generators, characteristics of electric motors used in dental medicine.		2	
14. Electrochemistry and oral galvanism: redox reactions, galvanic cells, standard electrode potential, corrosion of metals in the oral environment, oral galvanism.		2	

Bibliografie obligatorie:

1. Adrian Neagu, Monica Neagu, Gheorghe I. Mihalaş, *Textbook of Biophysics, Second Edition,* Editura Eurobit, Timişoara, 2005.

Bibliografie facultativă:

1. Jackson M.B., *Molecular and Cellular Biophysics*, Cambridge University Press, Cambridge, 2006.
2. Sybesma C., *Biophysics. An Introduction*, Kluwer Academic Publishers, Dordrecht, 1995.
3. Damjanovich S., Mátyus, L., eds., *Orvosi biofizika*, Medicina Könyvkiadó, Budapest, 2003.
4. Pope A.J., *Medical Physics*, Heinemann Educational, Oxford, 1989.
5. Kovács Eugenia et al., *Biofizică şi biotehnologie celulară. Metode de cercetare. Manual de lucrări practice*, Editura Universitară "Carol Davila", Bucureşti, 2002.
6. Popescu A., *Fundamentele biofizicii medicale*, Editura ALL, Bucureşti, 1994.
7. Dimoftache C., Herman Sonia, *Biofizica medicală*, Editura Cerma, Bucuresti, 1993.
8. Mihăilescu D., Flonta Maria-Luiza, Movileanu L., *Probleme de biofizică*, Editura Universităţii din Bucureşti, 1997.

8.2 Laborator	Metode de predare-învăţare	Număr de ore	Observaţii
1. Organizing the laboratory works. Training on work safety.	Coordination of laboratory works	2	During laboratory works, students are organized in small teams of 2-3 students. The laboratory activity includes three introductory classes, eight laboratory works performed by the teams, two frontal laboratory works done by the whole group of students and a final test of the practical skills acquired by the students. Information on the laboratory activity and final test is found also in the laboratory manual.
2. Laboratory materials. Ways of expressing concentrations and preparation of solutions of desired concentrations.		2	
3. Measurements of physical quantities. Analysis of experimental data using error calculus. Graphical representation of experimental data.		2	
4. Measurements of the coefficient of surface tension of a liquid. The importance of surface tension in dental medicine.		2	
5. Measurements of the coefficient of viscosity of a liquid. The clinical relevance of the viscosity of dental materials.		2	
6. Refractive index measurements for finding the concentrations of certain solutions used in dental medicine. Implications of light refraction, reflection and total internal reflection in dental instruments.		2	
7. Measurements of the concentration of an optically active substance by polarimetry. The uses of polarized light in dental medicine.		2	
8. Experimental study of absorption spectra and concentration measurements by spectrophotometry. The implications of light absorption in dental medicine.		2	
9. Measurements of the pH of aqueous solutions and the analysis of the effects of strong acids and bases on the pH of buffered and non-buffered solutions. Estimation of the buffering capacity of artificial saliva. Salivary buffer systems and the impact of pH on enamel demineralization.		2	
10. Measurements of voltages generated at metal-solution interfaces. Galvanic phenomena in the oral environment.		2	

11. Measurements of electrolyte concentrations by conductometry. Estimation of the purity of distilled water. Dental uses of conductometry.		2	
12. Measurements of the density of solids materials used in dental practice.		2	
13. Experimental study of electrolysis. Measurement of the mass of metal deposited by electroplating.		2	
14. Practical skills test.		2	

Bibliografie obligatorie:

1. Bogdan - Nicolae Marincu, Monica Neagu, Adrian Neagu. *Laboratory works in Biophysics*, Editura Eurobit, Timişoara, 2018.

Bibliografie facultativă:

9. Coroborarea conţinuturilor disciplinei cu aşteptările reprezentanţilor comunităţilor epistemice, asociaţilor profesionale şi angajatori reprezentativi din domeniul aferent programului

During lectures, students assimilate theoretical concepts of Biophysics, whereas during laboratory works they acquire practical skills that enable them to use laboratory equipment and to analyze the aquired data (plot it and estimate measurement errors). As a result, students will be proficient in using dental equipment safely and effectively.

10. Evaluare

Tip activitate	10.1 Criterii de evaluare	10.2 Metode de evaluare	10.3 Pondere din nota finală
10.4 Curs	*For a mark of 5, a student needs to:* answer questions related to the most important topics of the course, highlighted in Italic in the list of topics required for a mark of 10. *For a mark of 10, a student needs to:* · *enumerate the components of atoms;* · *explain the mechanisms of formation of ionic and covalent bonds;* · analyze the major types of intermolecular forces and write the potential energy of interaction for each type; · *represent the structure of the water molecule;* · explain the electric dipole character of the water molecule and argue its impact on the physical properties of water; · explain the mechanism of formation of hydrogen bonds; · *discuss the physical properties of water and point out their biological role;* · describe the spectrum of electromagnetic waves and characterize light as an electromagnetic wave; · discuss the wave-particle duality in the context of an electromagnetic field; · give examples of light sources; · *describe the refraction, reflection and total internal reflection of light;* · *present the physical basis of the function of optic fibers and give examples on the use of optic fibers in dental medicine;* · *characterize the phenomena of spontaneous emission and stimulated emission of light;* · define metastable electronic states of atoms and argue their importance in laser media; · represent the scheme of a ruby laser; · analyze the energy level structure of a helium-neon laser; · characterize laser systems that are used in dental medicine (Nd-YAG, CO_2, argon, excimer); · present the European classification of laser devices; · *describe applications of lasers in dental medicine;* · analyze the composition of n and p type semiconductors and represent their energy bands; · *discuss physical phenomena that lead to light emission by a semiconductor;* · give examples of optoelectronic devices used in dental medicine; · describe the structure of retina and explain the physiologic basis of color vision;	The Biophysics examination consists in a set of 50 multiple choice questions that evaluates the level of understanding of the basic concepts presented at lectures and the students' abilities to apply these concepts in a practical context. The examination is in accord with the Methodology of examination at the Victor Babes University of Medicine and Pharmacy Timisoara. The exam subjects are randomly picked by the students from a pool of questions. The grading scheme used in the theoretical examination is version 2 from the Methodology of examination (Art. 12). To obtain the passing mark, 5, a student needs to obtain at least 50% of the maximum score, whereas for a mark of 10 he/she needs to obtain at least 90% of the maximum score.	50 %

	· *define the colorimetric parameters;* · represent the CIELAB color space and express color differences in terms of distances between points of this color space; · *describe objective and subjective methods for analyzing colors in dental medicine;* · *explain the mechanisms of X-ray generation in a Coolidge tube;* · write the formula that describes the attenuation of X-rays while traversing a medium and define the linear attenuation coefficient; · define radiodensity (expressed in Hounsfield units, HU) and give examples of radiodensity values for certain tissues of interest in dental medicine; · *explain the physical principle of dental radiology;* · describe the function of a classical device of computed tomography (CT); · represent schematically the structure of a spiral CT, a multi-slice spiral CT, and a cone-beam CT (CBCT); · *exemplify the uses of CBCT in dental medicine;* · state the law of mass action; · *characterize solvation equilibria of non-electrolytes, electrolytes and gases;* · *describe the demineralization-remineralization equilibrium of dental enamel and identify the factors that influence this equilibrium;* · *define pH and represent the pH scale;* · characterize the composition of a buffer system and explain the role of buffer systems that are presents in various compartments of the human body; · *explain the function of salivary buffer systems and analyze the role of bicarbonate ions in maintaining the pH of saliva between normal limits;* · identify the dominant ionic form of a weak acid in a medium of given pH (maintained by a buffer system); · *analyze the impact of salivary pH on the demineralization-remineralization equilibrium of dental enamel;* · *present the stages of dental caries formation and identify the major factors that contribute to this process;* · *characterize extensive and intensive thermodynamic parameters;* · *state the principles of thermodynamics;* · exemplify the correlation between thermodynamic fluxes and the thermodynamic forces that give rise to the fluxes; · define the material constants that characterize heat transfer by heat conduction; · characterize dental materials in terms of their thermal conductivity and thermal diffusivity; · state the law of thermal expansion and argue the importance of the thermal expansion coefficient of restorative dental materials; · *state Fick's laws and apply them in a simple, one dimensional context;* · *define osmosis and state Van't Hoff's law;* · present an experiment that illustrates osmosis; · describe the technical applications of reverse osmosis (ultrafiltration); · characterize osmotic fluxes through the endothelium of capillary vessels; · *define the viscosity coefficient;* · describe the flow of a viscous fluid in a rigid tube; · give examples of flow phenomena encountered in dental practice; · state Newton's laws; · *give examples of forces that act on hard and soft oral tissues;* · define stress, strain and Young's modulus; state Hooke's law; · describe shear deformation; · define shear stress, shear strain and shear modulus; · characterize the deformability of solid dental materials; · *describe the mechanical equilibrium of a rigid body;* · *classify levers and give examples from everyday life and from*		

	anatomy; · *identify levers implied in mastication;* · describe forces and levers that contribute to the retention and stability of a dental prosthesis; · *define the intensity of an electric field and the electric potential;* · *define the intensity of an electric current;* · *define the resistivity and conductivity of a material;* · state Ohm's law for a portion of an electric circuit; · present the study of electrolyte solutions by conductometry; · analyze the magnetic field created by a conductor traversed by electric current; · state the law of electromagnetic induction and explain the function of an electric generator; · describe the function of an electric motor; · give examples of galvanic cells; · *analyze the corrosion of metal restorations in the oral cavity;* · *characterize the phenomenon of oral galvanism.*		
10.5 Laborator	*To obtain a mark of 5, the student should be able to:* - calibrate the instruments studied in the laboratory; - perform measurements with those instruments. *To obtain a mark of 5, the student should be able to:* - calibrate the instruments studied in the laboratory; - perform measurements; - interpret the measurement results; - enumerate and describe the medical applications of the studied experimental techniques; - plot the experimental data; - assess the experimental error.	The practical examination is composed of a test of practical skills, which verifies the student's abilities to operate the laboratory apparatus and interpret the obtained data, and a written test of multiple choice questions, which verifies the theoretical knowledge related to the laboratory works. The test of practical skills represents 50% of the mark of practical examination, whereas the multiple choice questions represent 40% of the mark of practical examination; the remaining 10% of the practical examination mark stems from the student's laboratory activity. The practical examination is eliminatory. In order pass the practical examination, a student needs to obtain 50% of the maximum score.	40 %
10.6 Standard minim de performanţă			
The student needs to demonstrate the theoretical knowledge and practical skills needed to obtain a mark of 5 at the practical exam, as well as at the theoretical exam (listed in detail in section 10.5).			

Data completării 22.10.2018	Semnătura titularului de curs Prof. dr. Neagu Adrian	Semnătura titularilor de laborator Asist dr. Horhat Raluca Asist. dr. Arjoca Stelian
Semnătura şefului de disciplină Prof. dr. Neagu Adrian		
Data avizării în departament	Semnătura directorului de departament Prof. Dr. Păunescu Virgil	