Ministry of Health of Ukraine
Ukrainian Medical Stomatological Academy

It is approved
on meeting of department of
medical informatics, medical and biological physics
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Head of department _____ O.V.Silkova

Methodical instructions
for students' self-preparation work at preparation for a practical lesson
at home and at the classroom

Subject matter	**Medical and biological physics**
The unit	1. Fundamentals of higher mathematics and biological physics
Theme of lecture:	**The total module control work.**
Year	1
Faculty	Medical
Speciality	Medicine

Poltava - 2020

1. **The topic significance.**

A number of biophysical processes and phenomena in a human organism have the mechanical nature. They are described by mathematical method, the same as any other process in biological systems. Integration of knoledge received in previous topic at preparation to final control promotes better comprehension of processes proceeding in human organism.

2. **Specific targets.**

To have general and specific knowledge on the studied topics;

To understand, to remember and to use the received knowledge;

To form the professional experience by reviewing, training and authorizing biophysical information.

3.A base level of preparation

The previous (providing) disciplines	Received skills
Mathematics, physics, biology	To provide calculation of received data. To speak about studied physical concepts. To speak about studied biological concepts.

4. The organization of the content of a teaching material

The list of theoretical problems to a total modular control №1.

1. Deformations, their types. Elasticity and plasticity. A Hoock's law. Modulus of elasticity.
2. Deformation properties of biological tissues. Durability. Hardness. Tensile testing method. Stress/strain curve. Ultimate tensile strengt. Tensile yield strength. Tensile Break strength.
3. Deformation properties of biological tissues: bones, muscles, ligaments, blood vessels

and others. Roles of inorganic and organix substances in mechanical properties of different tissues.

4. Determination of resilient (elastic) properties of biological tissues. Determination of a the bone Young's modulus.
5. Biomechanics of human musculoskeletal apparatus. Joint types. Degrees of freedom of different joins. Levers.
6. Biomechanics of human locomotor apparatus. Joints, types of joints and corresponding levers. Bones. Elastic properties of bones and muscles.
7. Biomechanics of human locomotor apparatus. Muscles. Types of muscles. Structure of muscular cell. Mechanism of muscle contraction.
8. Muscle contraction mechanism. Calculation of muscle work. Dynamometry and ergometry.
9. Acoustics. Sound nature. Physical characteristics of a sound. Sound rate. Resonance.
10. Infrasound, physical characteristics of infrasound. Action of ultrasound and infrasound on biological tissues and human organs.
11. Ultrasound, physical characteristics of ultrasound. Key properties and features of ultrasonic sound propagation in mediums. Influence of ultrasound on biological tissues and human organs.
12. Human ear: main parts and structure. Characteristics of hearing. Principle of hearing. A scale of intensity and a scale of volume of sound, units.
13. Physics of hearing, the characteristics of acoustical sensation. The Weber-Fechner law. Physiological characteristics of a sound.
14. A scale of intensity and a scale of sound loudness, measurement units. Hearing threshold and pain sensation threshold. Them values and dependences on frequency.
15. An audiogram registration. Audiometry. Hearing threshold and pain sensation threshold.
16. Surface tension. Coefficient of a surface tension and methods of it determination. Mechanism of appearance of embolism.
17. Methods of definition of a surface tension coefficient of fluids.
18. Method of blood viscosity determination by viscometer ВК-4. Describe Hess method.
19. Biophysics of blood circulation. The analysis of heart work. Changing of speed and pressure in blood vessels. Types of blood vessels.
20. Stationary fluxion of fluids. A continuity equation. The linear and volumetric velocities. The basic dynamical equation of fluids.
21. Internal friction. Viscosity. The formula of Newton for an internal friction. The Newtonian and non-Newtonian fluids. Viscosity of blood.
22. Laminar and turbulent flows. Reynolds number. Bernoulli equation. Flow of viscous liquids. Poiseuille formula. Hydraulic resistance.
23. Analysis of a cardiac work. Measurement of a blood pressure by Korotkov method.
24. Structure of biological membranes. Physical properties of biomembranes. Liquid-crystal state of biomembranes. Dynamic properties of biomembranes.
25. List and describe functions of biomembranes. Membrane permeability.
26. Biomembranes: the active transport. List its main types. Molecule basis of active transport on example of K^+-Na^+-pump work. Conjugation of ionic currents.
27. Methods of studying of a biological membranes permeability.The nature of membrane rest potential. Active and passive ionic transport. Membrane permeability changes. Equilibrium Nernst potentials for different ions. Diffusion potential. Donnan potential.
28. Passive transport of substances through biomembranes. Fick equation. Velocity of a diffusion. The Nernst-Plank equation. An electrochemical potential.
29. Action potential (AP). A hypothesis of AP originating. The equivalent circuitry of a membrane. Phenomenological Hodgkin-Hucksly equations. Concept about the gate ionic currents.

Literature recommended

Main sources.

- Medical and biological physics.– A.V.Chalyi et all.– Ed.A.V.Chalyi. –Kiyv, Nova Knyha Publishers.– 2013.– 480 pp.
- rovina L.D. Biophysics with beginnings of mathematical analysis and statistics. Extended course of lectures/ Vol.1. Bases of mathematical analysis, probability theory and mathematical statistics. Biomechanics. – Poltava, 2017.– 127 p. / Chapter 4.
- L.D.Korovina. Biophysics with beginnings of mathematical analysis and statistics. Extended course of lectures. – Vol.2. Basis of thermodynamics. Biomembranes. Electricity and magnetism. –Poltava, 2017. –114 p.

Additional textbooks, journals and references:

- Roland Glaser. Biophysics: An Introduction.– 2010.
- Philip Nelson. Biological Physics (Updated Edition).– 2007.
- Bengt Nölting. Methods in Modern Biophysics.– 2009.

Methodical elaboration have prepared by senior lecturer, PhD Biol.Sc. Korovina L.D.