CONTENT OF CLASSES
«PHYSICS, MATHEMATICS»
Anglophone Students of the 1 Course
Specialty «GENERAL MEDICINE»
1 term of 2024/2025

MODULE 1
"Mathematical Statistics. Mechanics. Acoustic"

Class No. 1
Theme: Elements of Mathematical Analysis 1

1. Derivative of a function. Basic derivative rules.
2. Differential of a function.
3. The concept of the gradient of a function in medical physics.

Class No. 2
Theme: Elements of Mathematical Analysis 2 (duration is **1 h 30 min)**

1. Primitive function. Indefinite integral and its basic properties. Table of the basic indefinite integrals
2. Definite integral. Newton-Leibniz formula.
3. Definition of differential equation. Solution of first-order differential equations. Application of differential equations in medical physics.

Theme: Mathematical Statistics 1 (duration is **1 h)**

1. Problems of mathematical statistics. General population and Sample.
2. Statistical series. Graphical representation of Statistical Series: Polygon of Frequencies, Histogram.

Class No. 3
Theme: Mathematical Statistics 2 (duration is **40 min**)

1. Numerical characteristics of Statistical Series (Sample mean, Mode, Median, Dispersion, Standard Deviation).
2. Evaluation of the General Population parameters from its Sample.
3. Confidence interval. Confidence Probability. Significance Level.

Class No. 4
CONTROL WORK

Class No. 5
Theme: Mechanical properties of solids (duration is **2h 45 min**)

1. Deformation. Methods of deformation of bodies. Types of deformation. Hooke's law for Elastic deformation.
2. Stretch-Strain Diagram. Elasticity Limit. Tensile Strength.
3. Mechanical properties of some biological tissues. Types of deformation of biological tissues. Relaxation and Creep.
4. Laboratory work No.3

Class No. 6
Theme: Flow and viscosity of fluids. Surface tension

1. Internal friction (viscosity) of the fluid. Stationary (laminar) flow. Newton's equation. Newtonian and non-Newtonian fluids.
2. Laminar flow of fluid in cylindrical tubes. Poiseil's formula. Hydraulic resistance.
3. Turbulent flow. Reynolds number.
4. The role of viscosity parameters, hydraulic resistance and types of fluid flow in medicine.
5. Strength and coefficient of surface tension. Hydrophilic and hydrophobic liquids.
6. Capillary phenomena, their role in medicine.
7. Laboratory works No.4 and No.18 (Surface tension).

Class No. 7
Theme: Mechanical oscillations and waves. Acoustics. Sound. Audiometry

1. Mechanical oscillations and waves (student's independent work).
2. Sound. Physical (objective) characteristics of sound: frequency, intensity, intensity level, sound pressure. Relationship between intensity and sound pressure. Acoustic spectrum.
3. Characteristics of auditory sensation (subjective sound characteristics) and their relationship with the objective sound characteristics. Weber-Fechner law.
4. Physical bases of sound research methods in medicine: auscultation, percussion, phonocardiography and audiometry.
5. Laboratory work No.2

Class No. 8
Theme: Physical fundamentals of ultrasound application in medicine

1. Ultrasound. Sources and detectors of ultrasound.
2. Ultrasonic wave properties, ultrasound propagation features.
3. Action of ultrasound on substance and biological tissues.

4. Application of ultrasound in medicine for diagnostic and treatment of diseases.
5. Solution of problems.

Class No. 9
COLLOQUIUM 1

MODULE 2
"Electromagnetism. Electrical processes in cells and tissues"

Class No. 10
Theme: Passive electrical properties of biological tissues

1. Passive electrical properties of biological tissues. Specific Resistance, Conductivity and Relative Permittivity of biological tissues.
2. Dispersion of Relative Permittivity: α -, β - and γ – regions.
3. Impedance of body tissues. The frequency dependence of the impedance of biological tissues. Dependence of impedance of tissues on the alternating current frequency.
4. The equivalent electrical circuit of biological tissues.
5. Laboratory work No.7

Class No. 11
Theme: Electric current. Physical processes in tissues under the action of electric current

1. Direct electric current (DC). Electromotive power of current sources (student's independent work).
2. Action of DC on body tissues. Application of DC in medicine.
3. Alternating current (AC) and its basic characteristics (student's independent work).
4. Active and Reactive Resistance of an AC circuit. AC circuit Impedance.
5. Phasor diagrams of an AC circuits.
6. Laboratory works No.6. and No.8.

Class No. 12
Theme: Physical processes in tissues under the action of electric, magnetic and electromagnetic fields

1. Physical processes that occur in body tissues under the action of low and high frequency current.
2. Thresholds of perceptible and non-released current. Methods in medicine which are based on the AC application.
3. Electric and magnetic fields and their general characteristics (student's independent work).
4. Action on biological tissues and application in medicine of alternating electric and magnetic fields, and electromagnetic waves.
5. Laboratory work No.10.

Class No. 13
Theme: Biological membranes. Transport of substances across membranes. Osmosis

1. Biological membranes: structure and physical properties.
2. Types of transport of molecules and ions across biological membranes.
3. Fick's equation for homogeneous media and membranes.
4. Electrodiffusion. Transport of ions across membranes. The Nernst-Planck equation. Resting membrane potential. Goldman-Hodgkin-Katz equation.
5. Artificial membranes. Membrane technologies in medicine.
6. Osmosis. Osmotic resistance of erythrocytes. Laboratory work No.5.

Class No. 14
Theme: Physical fundamentals of Electrocardiography

1. Electric dipole. The electric field of the dipole. A dipole electric generator (current dipole) and its electric field.
2. Physical fundamentals of electrography of organs and tissues. Methods of electrography in medicine (electrocardiography, electroencephalography, electromyography).
3. Einthoven's theory as the basis of electrocardiography. The heart as an equivalent electric generator. Genesis of electrocardiograms in three standard leads.
4. Student's independent work on the topic "Physical fundamentals of Electrocardiography".
4. Laboratory work No.11.

Class No. 15
COLLOQUIUM 2

Class No. 16
FINAL CONTROL TEST. CREDIT

Утверждено на заседании кафедры 26 августа 2024 года, протокол № 11.

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