

CONTENT of PRACTICAL and LABORATORY CLASSES

«FUNDAMENTALS OF PHYSICAL METHODS OF DIAGNOSTICS AND THERAPY»

Anglophone Students of the 1 Course

2 term of 2020/2021

MODULE 1: Medical apparatus

Class No.1

Theme: Medical apparatus

- 1). Classification of medical apparatus.
- 2). Electrical safety of medical apparatus.
- 3). Reliability of medical apparatus.
- 4). General scheme of the device for the reading, transmission and recording of biomedical information.
- 5). Electrodes for reading of biopotentials. Sensors for reading of biomedical information.
- 6). Amplifiers: appointment; gain (amplification factor); amplitude characteristic; frequency characteristic; amplifier pass band. Features of bioelectric signals amplification.
- 7). Recording devices.

Class No.1.1

Theme: Sensors

- 1). Sensors: definition, classification. Types of sensors: generator and parametric.
- 2). Sensor characteristics: transform function (sensor characteristic), sensitivity, threshold of sensitivity, sensitivity limit.
- 3). Laboratory work No.11.

Class No.1.2

Theme: Physical fundamentals of electrocardiography

- 1). Electric dipole Electric dipole field.
- 2). The concept of a dipole electric generator (current dipole).
- 3). Einthoven's theory as the basis of electrocardiography.
- 4). The block diagram of the electrocardiograph, the appointment of individual elements.
Frequency characteristic of the electrocardiograph.
- 5). Laboratory work No.14.

Class No.1.3

Theme: Electrical properties of biological tissues

- 1). Passive electrical properties of biological tissues. Impedance of body tissues.
- 2). The frequency dependence of the impedance of biological tissues. α -, β - and γ - areas of dispersion impedance.
- 3). The equivalent electrical circuit of biological tissue.
- 4). Laboratory work No.9.

Class No.1.4

Theme: Physical processes in tissues under the action of current and electric and magnetic fields

- 1). Physical processes that occur in the tissues of the body under the action of: direct current, low frequency current. Thresholds of perceptible and non-released current.
- 2). Physical processes that occur in the body tissues under the action of: high frequency current, alternating magnetic field, alternating electric field.
- 3). Use of electrical currents and fields in medicine. Clinical methods: galvanization, electrophoresis, local darsonvalization, diathermy, diathermocoagulation, electrosurgery, UHF-therapy, inductothermy.
- 4) Laboratory work No.12.

Class No.1.5

Theme: Acoustics

- 1). Sound. Physical characteristics of sound: frequency, intensity, intensity level, sound pressure. Relationship intensity and sound pressure. Acoustic spectrum.
- 2). Characteristics of the auditory sensation, their connection with the physical characteristics of sound. Weber-Fechner's law.
- 3). Physical basis of sound research methods in the clinic. Auscultation, percussion, phonocardiography, audiometry.
- 4) Laboratory work No.3.

Class No.1.6

Theme: Biological membranes. Transport of substances across membranes

- 1). Functions and physical properties of biological membranes.
- 2). Transfer of molecules through membranes. Fick's equation.
- 3). Transfer of ions through membranes. Nernst-Planck's equation.
- 4). Varieties of passive transport of molecules and ions.
- 5). Osmotic stability of erythrocytes.
- 6). Laboratory work No.6.

MODULE 2: Physical fundamentals of diagnostic and therapeutic methods

Class No.2.1

Theme: Physical fundamentals of the ultrasound application in medicine

- 1). Ultrasound. Sources and detectors of ultrasound.
- 2). Ultrasonic wave properties, ultrasound propagation features.
- 3). Action of ultrasound on a substance, on the body tissue.
- 4). Use of ultrasound in medicine for treatment and diagnostics.
- 5). Solution of problems.

Class No.2.2

Theme: The interaction of light with a matter: absorption, scattering

- 1). Absorption of light. Booger's law. Natural absorption coefficient.
- 2). Absorption of light by solutions. The effective absorption cross section of the molecule. Bouguer-Lambert-Beer's law.
- 3). Transmission coefficient. Optical density. Absorption spectrum.
- 4). Concentration colorimetry.
- 5). Light scattering. Nephelometry.
- 6). Laboratory work No.17.

Class No.2.3

Theme: «Optical system of the eye»

- 1). Light-conducting apparatus of the eye.
- 2). Light-perceiving apparatus of the eye.
- 3). Accommodation. Distance of the best vision. Near point of the eye.
- 4). Reduced eye. The resolution of the eye, acuity of vision.
- 5). Disadvantages of the optical system of the eye and their correction with the help of lenses.
- 6). Solution of problems.

Class No.2.4

Theme: Physical fundamentals of Thermography

- 1). Thermal radiation. Characteristics of thermal radiation.
- 2). Black, white, gray body.
- 3). The laws of thermal radiation. Planck's formula.
- 4) Laboratory work No.20.

Class No.2.5

Theme: Dosimetry of ionizing radiation

- 1). Absorbed dose. Dose rate.
- 2). Exposure dose. Dose rate, relationship of exposure dose rate and radioactive drug activity.
- 3). Quantitative estimation of the biological effects of ionizing radiation. Quality factor Equivalent dose.
- 4). Effective equivalent dose. Coefficient of radiation risk.
- 5). Natural background and permissible values of ionizing radiation doses. Protection against ionizing radiation.

Literature

1. Fundamentals of physics / David Halliday, Robert Resnick, Jearl Walker.-6th ed., USA, 2001.
2. Maksina A.G., Dainiak B.A. Medical and biological physics, M.2004.
3. Maksina A.G. Chichuk T.V., M.2003.
4. Laboratory practice. А.Г. Максина, Т.В. Мачнева, З.М.Смирнова М. 2011.

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