

Kazan State Medical University

**A SYNOPSIS of a course of
practical and seminar classes of MEDICAL PHYSICS
for students in GENERAL MEDICINE
Academic year 2019/2020**

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| 1. | Practical training: examination of physical and psychophysical parameters of sound |
| 2. | Practical training: examination of the range of hearing. Pure tone audiometry |
| 3. | Seminar: Properties of ultrasound. Ultrasound's interaction with the medium. Doppler ultrasound. |
| 4. | Practical training: viscosimetry. Dynamics of blood flow. <u>Control work №1.</u> |
| 5. | Seminar: Electrical properties of biological tissues and liquids |
| 6. | Seminar: Effect of ionizing radiation on human organism. Dosimetry quantities. <u>Control work №2.</u> |
| 7. | Practical training: Basic of geometric optics. Endoscopes. Refractometry. Optical microscope. |
| 8. | Practical training: Spectrophotometry |
| 9. | <u>Control work №3.</u> Practical trainings: |
| 10. | Practical training: Determination of the reflection coefficient of ultrasound from the interface between two media |
| 11. | Practical training: Blood Pressure measurement by Sphygmomanometr |
| 12. | Practical training: Electrocardiography. ECG measurement (Einthoven's original leads). |
| 13. | Practical training: Radioactivity. The detection of radiation. |
| 14. | Final examination |
| 15. | Rework |

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**A SYNOPSIS of a course of
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Academic year 2019/2020**

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| 1. | Practical training: examination of physical and psychophysical parameters of sound <i>- Изучение физических и физиологических характеристик звука. Решение задач.</i> |
| | Mechanical oscillations and waves, period, frequency, wavelength. Harmonic oscillation equation. Equation of mechanical wave propagation, transverse and longitudinal waves. Physical characteristics of sound. Energy in waves. The intensity of the wave. |
| 2. | Practical training: examination of the range of hearing. Pure tone audiometry <i>- Изучение физических основ тональной аудиометрии. Знакомство с работой аудиометра. Решение задач.</i> |
| | The range and sensitivity of human hearing. The decibel scale. The distinction between loudness and intensity. Equal loudness curves. Hearing tests. Audiometry. Objective and subjective sound characteristics. Determination of threshold of hearing by plotting an auditory threshold curve – audiogram |
| 3. | Seminar: Properties of ultrasound. Ultrasound's interaction with the medium. Doppler ultrasound. - <i>Физические свойства ультразвука. Эффект Доплера. Решение задач.</i> |
| | Properties of ultrasound. Piezoeffect and reverse piezoeffect. Physical principles of echography. Ultrasound's interaction with the medium. The Doppler effect. Doppler ultrasound techniques. |
| 4. | Practical training: viscosimetry. Dynamics of blood flow. Control work №1. <i>- Механика биологических жидкостей. Определение вязкости жидкости. Решение задач. Контрольная работа №1 по акустике</i> |
| | Hydrostatics. Basic concepts: density, ideal and real fluids, hydrostatic pressure. Archimedes force, atmospheric pressure. Effect of pressure on human organism. Hydrodynamics – medical applications. Continuity equation and Bernoulli's equation. Laminar and turbulent flow, Reynolds number. Newton's law for inner friction. Poiseuille's law, viscosimetry. |
| 5. | Seminar: Electrical properties of biological tissues and liquids <i>- Электрические свойства биологических жидкостей. Решение задач.</i> |
| | Intensity and potential of point charge and electric dipole in vacuum. Electric field in material medium. Orientational and induced polarization. Electric capacity of a conductor and a flat capacitor. Electrical conductivity of solids and liquids. Electrolytic dissociation. Solvation (hydration) and recombination of ions. Degree of electrolytic dissociation. Conductivity of electrolytes. Faraday's law. Direct and alternating electric current. Basic terms of RC circuit. Modelling the impedance of the human skin using RC circuits. The relationship between the human skin impedance and the frequency of electric current |
| 6. | Seminar: Radioactivity. Effect of ionizing radiation on human organism. Dosimetry quantities <i>Влияние ионизирующего излучения на организм. Дозиметрия ионизирующего излучения. Решение задач.</i> |
| | A scale model of the atom. The nature of the nucleus. The three basic types of radioactivity – alpha, beta and gamma. Radioactive decay and half-life. Medical radioisotopes. The detection of radiation. Effects of ionizing radiation on biologic material. Measurement of radiation exposure. How to minimize your exposure. External and internal irradiation. Dose, power of dose, exposure, conversion factor, equivalent dose, radiation weight coefficient, effective dose, tissue weight coefficient |
| 7. | Seminar: Basic of geometric optics. Endoscopes. Refractometry. Optical microscope. <i>- Законы геометрической оптики. Рефрактометр. Эндоскоп. Оптический микроскоп.</i> |
| | Reflection and refraction of light. Snell's law. Total internal reflection, conditions for total internal reflection. Fiber optics. Endoscopes. Refractometry. |

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| | Optical microscope Principal diagram, optical scheme, microscope magnification. Resolution, numerical aperture, useful magnification of optical microscope. Immersion objective. Methods of microscopic observation. Polarizing and fluorescence microscopes. |
| 8. | Seminar: Spectrophotometry - <i>Определение состава и количества вещества с помощью монохроматора-спектроскопа.</i> |
| | Principles of corpuscular microscopy – de Broglie waves. Comparison of electron and optical microscopes. Quantum theory of the atom. Pauli principle, optical transitions between energy levels. Atomic spectral analysis; emission, absorption and fluorescence analysis. Energy levels and transitions in molecules. Molecular spectral analysis, types of. Spectrophotometry. |
| 9. | <i>Контрольная работа №3 по темам. Самостоятельное выполнение лабораторных работ:</i> |
| | Practical training: Determination of the reflection coefficient of ultrasound from the interface between two media |
| 10. | - <i>Ознакомление с физическими основами использования ультразвука в медицинских приборах, изучение устройства и работы эхолота.</i> |
| | Practical training: Blood Pressure measurement by Sphygmomanometr |
| 11. | - <i>Измерение артериального давления и проверка существенности различия средних значений давлений без физической нагрузки и с нагрузкой.</i> |
| | Practical training: Electrocardiography. ECG measurement (Einthoven's original leads). |
| 12. | - <i>Регистрация и анализ биопотенциалов сердца</i> |
| | Practical training: Radioactive decay and half-life. Medical radioisotopes. The detection of radiation. Effects of ionizing radiation on biologic material. Measurement of radiation exposure. |
| 13. | - <i>Определение активности радиоактивного препарата, числа нераспавшихся ядер препарата и определения длины максимального пробега β-части и в воздухе.</i> |
| 14. | Final examination |
| 15. | Rework |