

SYLLABUS IN MEDICAL PHYSICS

MEDICINE

1-st year, 1-st semester (45 lecture classes)

2023/2024

Mechanics (acoustics and rheology)

- 1.** Mechanical waves. Sound. Physical characteristics of sound: pressure, intensity, frequency, wavelength, propagation speed, acoustic impedance, spectrum.
- 2.** Psychophysical characteristics of sound: intensity level, loudness, pitch, timber. Audibility area.
- 3.** Sound diagnostics and therapy methods: auscultation, blood pressure measurement, audiometry, phonocardiography, extracorporeal lithotripsy.
- 4.** Ultrasound (US). Physical properties. Production and detection of US for medical purposes.
- 5.** US imaging. Ultrasonography modes.
- 6.** US therapy. Sonophoresis. HIFU
- 7.** Infrasound (IS). Physical properties. IS sources. Influence of IS on human body.
- 8.** Gradients. Transfer processes: diffusion, internal friction, heat conduction. Medical methods based on transfer processes.
- 9.** Structure of liquids. Molecule pressure and surface tension. Additional (Laplace) pressure. Embolism.
- 10.** Movement of fluids. Laminar and turbulent flow. Steady flow. Poiseuille's law.
- 11.** Blood flow in cardiovascular system. Pulse wave.
- 12.** Mechanics of breathing. Surfactant.

Electricity and Magnetism

- 13.** Electric currents. Electric conductivity. Conductors, semi-conductors and dielectrics.
- 14.** Direct, pulsing and altering current. Ohm's law. Components of electric circuits and their properties. Impedance.
- 15.** One-way and two-way current rectification.

16. Electrodiagnostics: passive and active diagnostics. Transducers. EIT (electric impedance tomography). EMG, EEG, EKG.
17. Electrotherapy. Medical procedures with direct and alternating currents. Therapy by electromagnetic fields.
18. Electro conductivity of electrolytes. Faraday's law. Medical electrophoresis.
19. Electric currents in gases. Aeroions. Biological influence of aeroions. Ozone therapy.
20. Magnetic properties of matter. Origin of magnetic field.
21. Magnetic resonance imaging (MRI). Image forming parameters r ; T1, T2.

Non-ionizing electromagnetic radiation

22. Electromagnetic radiation – spectrum, parameters. Wave-particle duality.
23. Reflection, refraction, full inner light reflection of light. Light absorption and scattering.
24. Ultraviolet (UV) radiation: parameters, bands, sources of UV radiation. Biological action. Protection.
25. Infrared (IR) radiation: parameters, bands, properties, sources. Biological action and application in image diagnosis (thermovision).
26. Luminescence. Atomic conversions in luminescent light emission. Characteristics and laws of luminescence. Diagnostic methods using luminescence.
27. Optical quantum generators - Lasers. Stimulated emission. Population inversion, three and four level scheme of generation. Laser components. Types of lasers.
28. Parameters of laser radiation Medical applications of laser radiation.
29. Observation of microobjects in medicine. Microscope – optic scheme, magnification. Optical resolution. Observation modes by microscope.
30. Human eye - optic system, refractive power, reduced schematic eye. Optic disorders, correction. Spectral sensitivity of the eye. Color vision.

Ionizing radiation

31. Ionizing radiation. Directly and indirectly ionizing radiations. Interactions between photon radiation and matter: photoelectric absorption, incoherent scattering (Compton effect), couple (e^-e^+) production. Attenuation of the radiation.
32. X-rays (Roentgen radiation): nature, properties. Production of X-rays – roentgen tube. Characteristic and braking radiation.
33. Medical applications of X-rays. X-ray imaging: radiography and radioscopy, conventional angiography, DSA, DEXA. Computer tomography. Hounsfield scale.
34. Radioactivity. Radioactive decays, parameters, law. Radio-pharmaceutics.

35. Nuclear medicine imaging. Gamma-camera, SPECT- and PET- systems.

36. Dosimetry of the ionizing radiations. Dosimetric quantities and units: exposure, absorbed equivalent and effective dosage dose. Radiation and tissue weighting factor.

37. Basics of radio-therapy. LINAC, cyber knife, brachytherapy.

Lecturer:

Prof. V. Turiyski, PhD

12.09.2023

Head of Department:

Prof. P. Zagorchev, PhD, DBSc

Adopted by the Department Meeting with №100/12.09.2023г.

