Questions for the exam

1. A generalized scheme for the collection, transmission and registration of medical and biological information. Electrodes for taking bioelectric signal.
2. General characteristics and classification of biomedical information sensors (measuring transducers).
3. Contact potential difference. Thermocouple, thermoelectromotive force.
4. Temperature sensors. The dependence of the resistance of metals and semiconductors on temperature.
5. Piezoelectric effect and its application.
6. Registration of biophysical parameters (sensors in medicine: sensors of parameters of the respiratory system, sensors of parameters of the cardiovascular system).
7. Physical bases of high-frequency therapy and electrosurgery.
8. High-frequency therapy equipment: block diagram of the UHF-therapy apparatus. Generator of harmonic oscillations. Therapeutic circuit.
9. Methods of HF-therapy: UHF-therapy.
10. Methods of HF-therapy: inductothermy.
11. RF therapy methods: microwave therapy, extremely high frequency therapy.
12. Methods of high-frequency therapy: diathermy, diathermocoagulation, diathermotomy, local darsonvalization.
13. Geometric optics. Laws of geometric optics.
14. The phenomenon of total internal reflection of light, the principles of fiber optics, the design of modern endoscopes.
15. The course of rays in a trihedral prism. The structure of a refractometer.
16. Dependence of the refractive index of solutions on concentration. Determination of the concentration of solutions using a refractometer.
17. Lenses. Thin lens equation. Lens aberrations
18. Optical microscopy. The path of rays in a microscope.
19. Magnification, resolution limit and resolution of optical microscopes. The Abbe diffraction limit.
20. Special techniques of optical microscopy.
21. Optical system of the eye. Eye accommodation.
22. Disadvantages of the optical system of the eye and their correction. Visual acuity.
23. Biophysical foundations of visual photoreception.
24. Sensitivity of the eye to light and color. The mechanism of adaptation of the eye to different illumination.

25. General properties of electromagnetic waves. Scale of electromagnetic waves. Wave properties of light.
26. Natural and polarized light. Types of light polarization.
27. Methods for obtaining polarized light based on the phenomena of Brewster, birefringence, absorption dichroism. The device of polarization devices based on birefringence and absorption dichroism.
28. Malus' law. Passage of light through polarizers.
29. Optical activity. The structure of a polarimeter.
30. Stimulated emission and its properties. Amplification conditions.
31. Laser device. Purpose of the active medium, pumping system and resonator in lasers. Scheme of the laser.
32. Properties of laser radiation.
33. The use of laser radiation in therapy and surgery.
34. Light absorption. Laws of absorption of light by matter.
35. The absorption index of a substance, its dependence on the wavelength of light and the concentration of the solution. Transmittance and optical density, their dependence on wavelength and concentration.
36. The device of a photoelectrocolorimeter, determination of the concentration of solutions with its help. Determination of the absorption spectrum of a substance by a spectrophotometer.
37. Scattering of light, its types and regularities. Rayleigh's law. Nephelometry.
38. Bohr's theory. Emission and absorption spectra. The spectrum of the hydrogen atom.
39. Structure of energy levels of atoms and molecules.
40. Fundamentals of atomic and molecular spectral analysis.
41. Luminescence, its types and characteristics. Stokes and Vavilov laws.
42. Luminescent analysis in medicine. Intrinsic luminescence of biological objects. Luminescent labels and probes.
43. Photobiological processes, action spectrum. Photodynamic therapy.
44. Wave function and its physical meaning. Schrödinger equation.
45. Wave properties of electrons. De Broglie wavelength.
46. Fundamentals of electron microscopy. Resolution limit of the electron microscope.
47. Physical principles of probe microscopy and its use in the study of biomedical objects.
48. Thermal radiation of bodies. The main characteristics of thermal radiation: energy luminosity, spectral density of energy luminosity, monochromatic absorption coefficient.
49. Absolutely black, gray and other bodies. The laws of thermal radiation (Kirchhoff, Stefan-Boltzmann, Wien). Planck formula.

50. Thermal radiation of the human body. Methods of heat exchange of the body with the environment.
51. The use of thermal imaging and thermography in medicine.
52. Electron magnetic moments - orbital and spin. Orbital gyromagnetic ratio for an electron.
53. Electronic paramagnetic resonance. Paramagnetic properties of free radicals. Scheme of installation for observation of electron paramagnetic resonance. Identification of free radicals and determination of their concentration by the methods of electron paramagnetic resonance.
54. Magnetic properties of nuclei of chemical elements. Nuclear magnetic resonance (NMR). Chemical shift.
55. Principles of magnetic resonance imaging.
56. The nature of bremsstrahlung and characteristic X-rays, their characteristics and properties.
57. X-ray tube device, bremsstrahlung spectrum and its adjustment.
58. Characteristic radiation. Moseley's law.
59. The law of X-ray attenuation by matter, the layer is half oh weakening. Linear and mass attenuation coefficients.
60. Types of interaction of X-rays with matter. Law of attenuation of X-ray radiation by matter, layer of half attenuation. Linear and mass attenuation coefficients, their dependence on radiation hardness and substance properties.
61. Physical principles of X-ray diagnostics. Fundamentals of x-ray computed tomography.
62. The use of x-rays in radiation therapy. Methods of protection against x-ray radiation.
63. Radioactive decay and its types. Energy spectra of α- and β particles, gamma radiation.
64. Basic law of radioactive decay. Half-life time.
65. Activity of radionuclides, units of its measurement. Change of activity of a specimen over time.
66. Specific, mass and surface activities.
67. Obtaining radionuclides.
68. Characteristics of the interaction of ionizing radiation (IR) with matter: linear ionization density, linear energy losses, average linear range.
69. Features of interaction with matter of various particles.
70. Main biological effects under the action of AI. Physical basis of radiation therapy.
71. Principles of radionuclide diagnostic methods. Fundamentals of positron emission tomography.