ORAL EXAMINATION QUESTIONS
FOR MEDICAL BIOPHYSICS

The basics of processing of results, statistical data processing
The measurement, basic units, signs
Basic particles of matter
The structure and properties of molecules
Structure of the atom and the atomic nucleus

Properties of true solution and suspensions and colloids
The basic properties of water, its function, its distribution within the organism
The importance of ions for cellular functions
Partial pressure of gases and their solubility in liquids
Surface tension of liquids
Viscosity

Composition and function of the cell membrane
Active transport mechanisms
Passive transport mechanisms
Diffusion across the cell membrane
Diffusion through protein channels
Osmosis and osmotic pressure

Resting membrane potential
Sodium–Potassium pump and other pumps
The changes of membrane potential, depolarization, hyperpolarization
The formation of generator and action potential
Action potential
The saltatory conduction of action potential
Continuous propagation of action potential
Action potential formation in postsynaptic neuron – integration of PSP
Excitatory and Inhibitory Synapses
Rheobase and Chronaxie

Basic thermodynamic terminology
Transformation and accumulation of energy in living systems
The measurement of energy expenditure of the organism
The exchange of heat between body and environment, thermoregulation
Hypothermia, hyperthermia
Thermography and the use of low temperatures in medicine
The air humidity and its significance

The receptors classification
The relation between stimulus and perception, quality, intensity and location of perception
Adaptation of receptors
The basis of sensory perception

Mechanisms of Colour Vision and Colour Vision Deficiencies
Photoreceptors

The gas exchange between inner and outer environment
The mechanics of breathing
Lung compliance and thorax compliance
Airway (respiratory) resistance
Respiratory volumes and capacities
Spirometry

Mechanical work of the heart
Blood flow and mechanical properties of vessels
The measurement of blood and air flows
Blood pressure measurement (direct and indirect methods)
Filtration and resorption in capillaries
Biophysical basics of kidney function
Action potentials of the heart, their formation and propagation, prepotential
The basic shape of ECG curve
ECG recording, ECG leads
Electrical axis of the heart
Brain action potentials, basic EEG rhythms

Biomechanics of locomotion (musculoskeletal system)
Biophysical mechanism of muscle contraction
Excitation and contraction of skeletal muscle
Mechanical and electrical manifestations of muscle contraction, EMG

Optical system of the eye
The eye accommodation and its function
Emmetropic and ametropic eye; correction of ametropia
Visual acuity, binocular and spatial vision

The propagation of acoustic signals through outer and middle ear
The reception of acoustic signals in the inner ear
Electrical manifestations of inner ear activity
Hearing disorders, their examination and correction

Excitation and ionization potential
Natural and artificial radioactivity
The sources of non-nuclear ionizing radiation
The interaction of alpha, beta and neutron radiations with matter
The interaction of gamma radiation with matter
The methods of detection of ionizing radiation
Basic mechanisms of biological effects of ionizing radiation
Biological effects of nuclear explosions
The protection against ionizing radiation

Physical principles of modern surgical instruments
Physical principles of ionizing radiation therapy
Magnetic Resonance Imaging (MRI)
Ultrasound diagnostic methods
Electric therapeutic methods
Thermal therapeutic methods
Radionuclides imaging techniques
Fluoroscopy, skiagraphy and CT

Light and its properties, laser
Interaction of light with mass
Endoscopy
Light microscopy
Electron microscopy

Effects of gravity, acceleration and force on the body
The effect of negative and positive pressure on the body
The effects of audible sound and ultrasound
The effects of ultraviolet radiation
The effects of visible and infrared radiation, biological effects of microwaves
Magnetic field of organs, the effects of magnetic fields

Propagation of electric current in the tissues
Electrical excitability, electric current injuries
Passive electrical properties of tissues

Systems – the terminology and their structure
The properties of dynamic systems
The basics of organ control and regulation
Information, its transmission and processing
Biological signals
Acquisition and recording of electrical signals
The principles of transducers for the recording of non-electric signals

Monitoring and telemetry