

Exam questions of Medical Physics and Biophysics

Faculty of Dentistry (Stomatology)

- 1. Physical basics of structural organization and functioning of biomembranes:**
Membrane functions in a living organism. Cell membrane structure (modern fluid-mosaic model). Membrane lipids. Membrane lipids.
- 2. Membrane proteins:**
Biophysical mechanisms of interaction between membrane components (lipids and proteins).
- 3. Selective permeability of plasma membrane. Molecular basics of passive transport of substances:**
Membrane permeability; the role of membrane in the regulation of water homeostasis in a living organism. Mechanism of Passive and active transports across the biological membrane. Mechanisms of simple passive transports: Diffusion, Osmosis, filtration.
- 4. Principle mechanisms of facilitated passive transport:**
Selective channels (ligand- and potential-dependent channels), facilitated diffusion, mobile carriers.
- 5. Mechanisms of active transport of substances:**
Primary and secondary active transport. Primary active transport (pumps coupled with ATP-hydrolysis (Na^+/K^+ -ATP -ase, Ca^{2+} - ATP -ase, H^+ -pump, CPx- ATP -ase). Primary active transport (Mitochondrial proton pump (H^+ ATP-ase), ABC-transporters), pumps coupled with absorption of light quantum.
- 6. Secondary active transport**
- 7. Bioelectric phenomena in excitable tissues. Electric properties of plasma membrane;**
Transmembrane potential, Nernst's equation. Membrane potential generation mechanisms (diffusion potential, Donnan's potential, electrogenic ion pumps).
- 8. Resting potential:**
Membrane resting potential generation mechanisms (osmotic forces, ion fluxes, selective channels, active transport). Goldman equation. Functions of membrane Resting potential.
- 9. Action potential:**
Ionic mechanisms of action potential generation. Mechanisms of propagation of action potential.

10. Biomechanics:

Viscose-elastic properties of biomaterials. Mechanical motion in living organisms. Mechanical properties of muscles. Biophysical mechanisms of muscles constriction.

11. Fluid biomechanics:

Basic concepts and laws of hydrostatics (fluid pressure, Archimedes's law, surface tension, Capillary effect, Laplace's law). Hydrodynamics (stationary equation for fluid jet flow, internal friction in fluids, laminar and turbulent flow, Reynolds number). Physical concepts of hemodynamic.

12. Physical concepts of hemodynamics:

Blood circulation; Basic determinants of blood circulation and its direction. Resistance of blood circulation; determinants of the resistance. Physical property of blood – viscosity. Laminar/turbulent flow of blood circulation; Reynolds number. The effect of blood vessel shape, length and diameter on blood circulation. Mechanical elasticity of blood vessels. Blood pressure, physical basis of blood pressure measurement.