

## **Exam questions of Medical Physics and Biophysics**

### **Faculty of Physical Medicine and Rehabilitation**

**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 ( $\text{Na}^+/\text{K}^+$ -ATP -ase,  $\text{Ca}^{2+}$ - ATP -ase,  $\text{H}^+$ -pump, CPx- ATP -ase). Primary active transport (Mitochondrial proton pump ( $\text{H}^+$  ATP-ase), ABC-transporters), pumps coupled with absorption of light quantum. Secondary active transport

**6. Electricity.**

Charge. The law of charge conservation. Coulomb's law. Electric field. Strength and potential of electric field; equipotential surfaces. Electric dipole, dipole in electric field; Dipole's electric field. Conductors and dielectrics. Electrodynamics: Electric current. Ohm's law for direct electric current. Joule-Lenz law. Capacitor.

**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.