Confirmed:

Dean:

/Prof. DSc Al. Dreischuh/

Conspect

For entrance exams to the PhD degree in Biophysics

***2018***

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| **№** | **Question** |
| 1 | Biophysics – subject and tasks. Physical and physicochemical interpretation of biological phenomena - hierarchical structure, synergy. |
| 2 | Thermodynamics of biological systems. Equations for balance and continuity. Entropy, information and biological order. Production of entropy in open systems. Theorem of Prigojin. Common Evolution Criterion. |
| 3 | Biophysics of water. Structure and physicochemical properties of water. States of water in biomembranes, role in stabilizing bio-structures. |
| 4 | Biological membranes. Structural components. Key features of biomembranes and specialization; basic research methods. Artificial analogs of biomembranes. |
| 5 | Major classes of lipids in the composition of biological membranes. Lipid asymmetry. Role of proteins for the architecture of biomembranes. Membrane Modeling. |
| 6 | Shape of lipid molecules. Critical packing parameters. Formation and curvature of lipid micelles. Hydration of lipids. Phase diagrams of water-lipid systems. |
| 7 | Lipid-protein monolayers at air-water surface. Solid supported (Langmuir-Blodgett) monolayers. Application. |
| 8 | Methods for studying the surface structure of Lipid and Lipid-Protein Mono-, Bi- and Multi-Layer Structures. Fluorescence microscopy, probes and application. Brewster-Angle Microscopy (BAM), Atomic Force Microscopy (AFM). |
| 9 | Investigation of the interactions of biological fluids with biocompatible materials (contact lenses, implants, etc.): Dynamic and equilibrium wetting, contact angle hysteresis, Casie-Bexter and Wenzel models, deposits and biocompatibility. |
| 10 | Axisymmetric Drop Shape Analysis (ADSA): Modeling of dynamic lipid-protein layers (tear film, pulmonary surfactant, etc.). Fundamentals of the method. |
| 11 | Electrical properties of model membranes. Theory of Gui-Chapmen-Stern. Transmembrane potential. ΔV- potential. Dependence between potential and surface charge. Experimental Studies. |
| 12 | Non-invasive (non-contact) *in vivo* front-eye examination methods: biomicroscope, specular microscopy, keratograph, evaporation fingerprints. Applications to study the structure and dynamics of a tear film. |
| 13 | Lipid nanoparticles and nanoemulsions. Applications to the modeling of biological membranes and as drug carriers and medical devices (cancer therapy, ophthalmology, etc.). |
| 14 | Liposomes. Applications in Biomembrane Modeling and Clinical Practice. |
| 15 | Biomaterials: biocompatibility, biofunctionality, antiadhesiveness, interactions with water, material properties. Applications in ophthalmology. |

Assoc. prof. Dr G. Georgiev