

LIST OF ENTRANCE EXAM QUESTIONS

FOR THE INTERNATIONAL MASTER'S DEGREE PROGRAM

CHEMOINFORMATICS AND BIOENGINEERING

ITMO

12.04.04 Biotechnical systems

1. Ways of representing the chemical structure of molecules. Molecule conformations. Relativity of the concepts of configuration and conformation.
2. Spatial structure of molecules and their biological activity.
3. Types of organic reactions and reagents. The concept of substrate, reagent, reaction direction and molecularity of reactions.
4. Acid and basic properties of organic compounds. Acidity and basicity according to Bronsted-Lowry. Lewis acids and bases.
5. Chemical balance. Direction of chemical reactions. Reactions of the first, second and zero order. The dependence of the reaction rate on temperature. Experimental methods for determining the rate and order of the reaction.
6. Polymers: structure, properties. Intermolecular interactions in polymer systems.
7. Structure and properties of biopolymers.
8. Biocompatible polymeric materials: features, application, examples.
9. Biodegradable materials: features, applications, examples.
10. Polymer composites in bioengineering.
11. RNA and DNA, their structure, biological role.
12. Structure and biological functions of proteins.
13. Lipids: structure, properties, and biological functions.
14. Carbohydrates, their structure, biological role. Polysaccharides (starch, cellulose, chitin).
15. The structure of animal cells and their application in bioengineering.
16. Plant cells, structure, and application in bioengineering.
17. Prokaryotes, structure, and application in bioengineering.
18. Fungi (yeast-like, mold) structure and application in bioengineering. (yeast-like, mold) structure and application in bioengineering.
19. Substances obtained by micro-biotechnology.
20. Nanomaterials in bioengineering: structure, properties, application.
21. Nanotechnologies in bioengineering and medicine.
22. Biosensors. Application of biosensors.
23. Biocatalysis. Examples of biocatalytic reactions.
24. Optical methods for the study of materials. Optical microscopy and optical spectroscopy.
25. Physical and mechanical characteristics of materials and research methods.
26. Thermal characteristics of materials and research methods.
27. The concept of the general population and the sample population. Principles of sampling. Histograms for sampling sets. Types of histograms.
28. Mathematical expectation, mode, med
29. Laws of distribution of a random variable. Normal distribution law and its parameters, formula, sample standard deviation.
30. Linear regression, variables in linear regression, regression coefficient. Regression example. Evaluation of the quality of linear regression.
31. Numerical methods of approximation. Least square method. The essence of the method, application, connection with linear regression.
32. Numerical methods of interpolation. Selection of a polynomial by the Lagrange or Newton method.
33. Numerical optimization methods. Method of "golden section".

- 34. Algorithm. Linear algorithm, types of cycles, branching of the algorithm.
- 35. Methods for modeling polymer systems (quantum-chemical modeling, molecular modeling).
- 36. Bioinformatics, methods of bioinformatics.ian. Sample variance and standard deviation.