MINISTRY OF EDUCATION AND SCIENCE OF RUSSIA

**Federal State Budgetary Educational Institution of Higher Education**

Astrakhan State University  
 (Astrakhan State University)

APPROVED

By Academic Council of

HSBEI HE Astrakhan State University

October 28, 2021

Protocol No. 3

PROGRAMME OF IN-HOUSE ENTRANCE EXAMINATION IN BIOLOGY

**for master programmes**

06.04.01 Biology

**Specialty/major - Microbiology and virology**

**2022**

ASTRAKHAN - 2021

The programme was considered at the Department meeting of Biotechnology, Zoology and Aquaculture August 31, 2021. (Protocol No.1)

1. CONDUCTION OF ENTRANCE EXAMINATION

The programme is designed to prepare for the entrance examination for the master's degree programme in Biology at Astrakhan State University in the specialty 06.04.01 "Biology" program "Microbiology and Virology".

Programme of in-house entrance examination for master programme includes questions on basic biological disciplines, based on the Bachelor programmes in Biology, provided by the relevant state educational standard.

The sections of the program include basic information on the life activity of microorganisms, reflecting the evolutionary and comparative-cytological aspects of the course. This knowledge is basic for the in-depth study of microbiology and virology at the Master's level.

Master programme in Microbiology and Virology provides an in-depth study of the fundamentals of microbiology and virology and the varieties of its methodology, as well as the practical and theoretical foundations of modern microbiological science.

Knowledge of all sections of the programme should reveal a competent scientific outlook, modern scientific understanding of the life activity of micro-organisms and their regulation mechanisms.

The purposes of the entrance examination are:

1. to assess the basic level of knowledge sufficient for the qualitative master programmes

in "Biology" (programme - microbiology and virology);

1. to assess the ability to analyse current information within the microbiological and related sciences (biochemistry, molecular biology, genetics);
2. to assess the knowledge of fundamental problems in microbiology;
3. to identify the understanding of the principles of basic methodological approaches to conduct microbiological experiments;
4. to assess the applicant’s knowledge of the main history stages of formation and development of microbiological science; knowledge of leading domestic and foreign scientists - microbiologists, their role in solving fundamental problems of microbiology and virology.

An examination board approved by the Rector's order is formed to conduct the entrance examination. The examination board consists of higher-education teaching personnel of the faculty head departments corresponding to the Master's programme profiles.

2. FEATURES OF THE ENTRANCE EXAMINATION:

1. The form of the entrance examination is written and oral. Tests are held in 2 stages: written questions on the subjects required for the Master programme in the

respective field of study and stipulated in the State Educational Standard for a Bachelor degree in that field of study and the applicant's answer to those questions.

1. The duration of the entrance examination is 25 minutes for written preparation and 10 minutes for the answer.
2. The grading system is a 100-point grading system.

The examination checks: the level of the applicant's scientific thinking, knowledge of the main theoretical issues of the educational process, the ability to independently solve professional tasks of different nature and level of complexity. The commission assesses the completeness, substantiation and argumentation of the applicant's answer, understanding and comprehension of the material presented, independence of judgement, and verbal presentation of the answer.

1. The decision on the grade awarded is taken by a simple vote, immediately after the applicant's answer

3. TEXTBOOKS AND STUDY GUIDES RECOMMENDED FOR EXAM PREPARATION:

1. Gusev M.V. Microbiology: recommended by the Ministry of Education of the Russian Federation as a textbook for university students studying in 510600 "Biology" and biology specialties / M.V. Gusev L. A. Mineeva. - 7th ed. - Moscow: Academy, 2007.
2. Netrusov A.I. Microbiology: textbook for students of higher education institutions in the field of training programme. "Pedagogical education" profile "Biology" / A. I. Netrusov I. B. Kotova. - M.: Academy, 2012. - 378, [6] p. : ill.
3. Netrusov A.I. Microbiology: Added by the Ministry of Education and Science of the Russian Federation as a textbook for undergraduate students in Biology and Biological specialties / A. I. Netrusov I. B. Kotova. - M.: Academy, 2006. - 352
4. Tepper E.Z. Microbiology Workshop: Textbook for Higher Education Institutions / E.Z. Tepper V. K. Shilnikova G.I. Pereverzeva V. K. Shilnikova, - M.: Drofa, 2004. - 256 p.
5. Aleshukina A.V. Medical Microbiology: Textbook. - Rostov on Don: Phoenix, 2003. – 480p. (Higher education series).
6. Emtsev V.T. Microbiology: textbook for universities / V.T. Yemtsev E.N. Mishustin. - 5th ed., reprint and supplement - M.: Drofa, 2005. - 445, [3] p. : ill.
7. Firsov, N.N. Microbiology / N. N. Firsov. - M.: Drofa, 2005. - 256 p. - (Biological Sciences. Glossary of terms).
8. Schlegel G.G. History of microbiology / G. G. Schlegel; translated from German. T.G. Mirchink; Foreword. L.V. Kalakutsky. - ed. 3-E. - M.: LKI, 2008. - 304 p.

4. A LIST OF QUESTIONS BASED ON BACHELOR PROGRAMME FOR THE RESPECTIVE AREAS OF STUDY

1. The most important types of micro-organisms, their characteristics and diversity. Animalcules, fungi, algae, bacteria, cyanobacteria, actinomycetes, viruses, phages.
2. A brief history of microbiology. Discoveries of A. Van Leeuwenhoek L. Pasteur, R. Koch, S.N. Vinogradsky, S. Ivanovsky and other microbiologists. The history of the differentiation of microbiological science.
3. Basics of microbial taxonomy and classification. Basics of microbial nomenclature. The separation of microorganisms with a prokaryotic cellular organisation (prokaryotes) into a special kingdom Procaryotae.
4. Problems of classifying micro-organisms, classification attributes. The main groups of prokaryotes: eubacteria and archaebacteria. Bergey's Manual of Systematic Bacteriology.
5. Morphology of micro-organisms in terms of shape, cell arrangement. Micro-organisms: prokaryotes and eukaryotes. Basic features of a prokaryotic cell structure. Differences in cell structure between prokaryotes and eukaryotes.
6. The anatomy of a bacterial cell. Cell wall, cytoplasmic membrane, surface structures, intracytoplasmic membranes, cellular inclusions. Genetic material of microorganisms, its organisation.
7. Nucleoid DNA. Plasmids. Features of bacterial chromosome replication. Methods of cell division and reproduction of microorganisms.
8. The structure of viruses. Types of symmetry of viruses. The basics of virus classification. Virus-cell interaction. Virus reproduction. Bacteriophages.
9. Heredity and Variation in Microorganisms. Pathways of genetic material exchange in bacteria. Mutations. Conjugation, transduction, transformation in microorganisms.
10. Microevolution of the cell. Primitive atmosphere. Chemical evolution. Biological evolution. Evolution of prokaryotes and eukaryotes. Miller's experiments. Evolutionary improvement of the eukaryotic cell from the prokaryotic cell.
11. Sources of carbon for prokaryotes. Autotrophy and heterotrophy. Nitrogen sources for prokaryotes: reduced and oxidised nitrogen compounds, molecular nitrogen. Sulphur and phosphorus sources for prokaryotes. The metal requirements of prokaryotes.
12. Parasitic prokaryotes (obligate and facultative), saprophytes, oligotrophs, copiotrophs, prototrophs and auxotrophs.
13. The main types of energy metabolism of prokaryotes. Types of ATP synthesis: phototrophic, autotrophic, heterotrophic, chemotrophic. The ways in which prokaryotes obtain energy: fermentation, photosynthesis, respiration.
14. Fermentation is the most primitive way of obtaining energy. Energy resources. Anaerobic nature of fermentation processes.
15. Photosynthesis. Prokaryotes use solar energy. Photosynthetic eubacteria: cyanobacteria, purple and green bacteria. Photosynthetic halophilic archaebacteria.
16. The relationship of microorganisms to oxygen. Ways to use molecular oxygen absorbed by the cell. Anaerobes and aerobes classification. Enzymatic oxygen uptake.
17. Microbial applications in biotechnology, industry, agriculture and medicine.
18. Theoretical and practical foundations of microbial production of protein products, vitamins, enzymes, amino acids, alcohol and other biotechnology products.
19. The role of micro-organisms in the cycle of substances. Carbon cycle. Nitrogen cycle. Sulphur, phosphorus cycles.
20. Microorganisms and the environment. The role of microorganisms in cleaning the environment. The use of microorganisms to treat wastewater and industrial plants waste.
21. Microbial ecology: ecosystems and environmental factors. Microorganisms interactions, antagonistic symbiosis. Microflora of air, water, soil and other habitats.
22. Microorganisms and human health. Normal flora. Basic methods of pathogens isolation, identification and study.
23. Basic sanitary and medical microbiology. Microorganisms as agents of plant, animal and human diseases.
24. Antagonism of microorganisms. Pathogenic microorganisms. Infectious diseases. Concepts of infectious immunology, antigens, antibodies.
25. Artificial nutrient media. The concepts of colony, culture, strain, clon. Microbial cultures on solid and liquid media. Cultivation media. Methods of culturing microorganisms.
26. Methodes for microscopic study of microorganisms. Techniques for microscopic study of microorganisms. Methods for microscopical staining of microorganisms.
27. BASIC CRITERIA FOR ASSESSING THE MASTER PROGRAMME APPLICANT'S ANSWER

* Knowledge of the actual material;
* Ability to analyse theoretical ideas about fundamental problems of microbiology, involving the vital mechanisms of different microorganisms;
* Ability to think critically about controversial microbiological issues;
* Knowledge of the literary sources recommended for the entrance examination.

1. THE CORRELATION OF THE APPLICANT'S RESPONSE CRITERIA AND THEIR LEVELS OF KNOWLEDGE

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| **Levels and sublevels of knowledge** | **Score** |
| The answer reflects the main concepts and theories on the issue, describes and compares the main current theoretical data on the issue, and presents the material in a professional language, using an appropriate system of concepts and terms. | 90-100 scores |
| The answer reflects only theoretical data on the issue, there is no analysis and comparison of these theories. The material is presented in professional language, using an appropriate system of concepts and terms. | 70-89 scores |
| the answer does not show the aplicant's knowledge of the theoretical background to the question. The applicant cannot give practical examples. The material is presented in everyday language, without using the concepts and terms of the relevant scientific field. | 60-69 scores |
| The answer reflects the applicant's worldly understanding of the stated problem; the applicant cannot name a single scientific theory, and does not define the basic concepts. | Up to 60 scores |