PROGRAMME
ENTRANCE EXAMINATIONS
BIOTECHNOLOGY

General Biology

Fundamentals of cytology. The cell as an elementary form of organization of living matter. Properties of life and levels of organization of living things. The life cycle of a cell. Amitosis. Mitosis. Meiosis. Metabolism of substances and energy (photosynthesis, biosynthesis, energy metabolism). Genetics. Ontogenesis and phylogeny of organs. Basics of general genetics. Laws of G. Mendel. Interaction of genes. Chromosomal theory. Closely related inheritance. Morgan's law. Molecular basis of heredity. Regularities and mechanisms of traits variability. Basics of medical genetics. Ontogenesis. General regularities of embryonic development. General regularities of phylogenesis of vertebrates (circulatory system, urogenital system, nervous system). Elementary factors of evolution. Species, Criteria of species. Population. Biosphere and its boundaries. Problems of environmental protection and human survival.

Microbiology

Morphology of bacteria and fungi. Morphological forms of bacteria. Simple and complex methods of staining, Gram staining. Structure of bacterial cell. Morphology of actinomycetes and fungi. Physiology of bacteria and viruses. Physiology of bacteria: cultured bacteria, nutrient media, isolation of pure bacterial culture. Constructive and secondary metabolism of bacteria. Strains-producers of BAS. Bacterial enzymes, identification of isolated pure culture. Antimicrobial chemotherapeutic agents. Viruses and bacteriophages. Genetics of bacteria. Microbes and the environment. Sanitary microbiology. Role of microbes in the cycle of substances in nature. Microflora of human body. Microbiological control of water, air, equipment, hands of personnel. Microbiological control of biotechnological processes. Basics of immunology and bacterial preparations.

Basics of biochemistry and molecular biology

Basic classes of biomolecules (proteins, nucleic acids, lipids, carbohydrates, low molecular weight bioregulators), their structure, spatial organization, and biological functions in the cell. Fundamentals of enzymatic catalysis, concepts of enzymes, antibodies, structural proteins. Principles of bioenergetics; ways and mechanisms of energy conversion in living systems; aerobic and anaerobic redox. Metabolism of carbohydrates, lipids, fatty acids, proteins, amino acids, nucleic acids, and nucleotides. Matrix biosynthesis of proteins and nucleic acids. Molecular mechanisms of genetic information transfer; study of gene structure and function, enzymes, and bioengineering techniques. Biochemical research methods to assess the qualitative and quantitative composition of cellular components, study of the qualitative reactions of proteins, amino acids, enzymes, carbohydrates, lipids, nucleic acids, vitamins, and their quantification.

Basics of biotechnology

Biotechnology as a science and field of production. Brief history of biotechnology development. Obtaining medicinal, preventive, and diagnostic drugs by biotechnological methods. Bioobjects as a means of production of medicinal, preventive, and diagnostic drugs. Classification of biological objects. Bioobjects of plant origin. Bioobjects - microorganisms. Eukaryotes, prokaryotes. Viruses. Bioobjects - macromolecules. Traditional methods of breeding. Mutagenesis and selection. Physical and chemical

mutagens and mechanism of their action. Classification of mutations. Subject matter, objectives and methods of genetic engineering, applications in biotechnology. General principles and methods of genetic engineering. Recombinant DNA technology. Microorganisms of different systematic groups: yeast, eubacteria, actinomycetes, etc. as hosts for expression of foreign genes. Regulation of foreign gene expression in pro- and eukaryotic cells. Applied aspects of genetic engineering. Basic methods and tools of genetic engineering experiments. Immobilized (on insoluble carriers) bioobjects and their multiple use. Immobilized enzymes. Effect of enzyme immobilization on their substrate spectrum and kinetic characteristics. Enhancement of stability. Adsorption of enzymes on inert carriers and ion exchangers. Immobilization of enzymes by incorporation into gel structure. Microencapsulation of enzymes. Use of immobilized enzymes in production of biologically active substances. Structure of biotechnology production. Scheme of sequentially realized stages of transformation of initial raw materials into a product. Preparatory operations: equipment sterilization, air sterilization, nutrient media sterilization, preparation of inoculum. Classification of biosynthesis by technological parameters (periodic, regulated, continuous, etc.). Criteria for selection of fermenters. Basic parameters of control and management of biotechnological processes. General requirements for methods and means of control. Extraction, concentration and purification of biotechnological products. Sedimentation. Centrifugation. Filtration. Extraction methods for intracellular products. Destruction of cell wall of biobjects and extraction of target products. Chromatographic methods. High performance liquid chromatography for biotechnology production. GMP requirements for biotechnology production. Immunobiotechnology as a branch of biotechnology. Mechanisms of immune response to a specific antigen. Variety of antigenic determinants. Heterogeneity (polyclonality) of serum. Advantages of using monoclonal antibodies. Hybridomics technology. Technology to produce monoclonal antibodies. Applications of monoclonal antibodies. Monoclonal antibodies in medical diagnosis. Enzyme immunoassay.

Radioimmune analysis. Monoclonal antibodies as specific sorbents for isolation and purification of biotechnological products.

REFERENCES

Main literature:

1. Almagambetov K.Kh. Fundamentals of Biotechnology. Astana, 2006. -224 p.
2. Klunova S.M., Egorova T.A., Zhivukhina E.A. Biotechnology. Moscow, Academia, 2010.
- 256 p.
3. Zagoskina N.V., Nazarenko L.V., Kalashnikova E.A., Zhivukhina E.A. Biotechnology:
4. theory and practice. Moscow, : Onyx, 2009. - 496 p.
5. Sazykin Yu.O., Orekhov S.N., Chakaleva I.I. Biotechnology. Moscow, Academia, 2006.
6. Bakai A.V., Kochish I.I., Skripnichenko G.G. Genetics. Moscow: Kolos, 2007. - p. 448.
7. Konychev V.V. Molecular Biology. Moscow, 2008.
8. Zhimulev S.G. General and molecular genetics. Novosibirsk. Publishing house of Siberian Academy of Sciences. 2006.

- p.478.

Additional:

1. Kershanskaya O.V. Genetic engineering of plants. A practical approach. Almaty, 2007. -152 p.

2. Almagambetov K.Kh. Fundamentals of biotechnology. Astana, 2006.

3. Shupshibaev K.K. Production based on immobilized biocatalysts. Textbook. Almaty, Kazak University, 2004, -99p. 1998. -479 p.