**Al-Farabi Kazakh National University**

**Faculty of Biology and Biotechnology**

**Department of Molecular Biology and Genetics**

**Final exam program by discipline**

XGI 5208 "Chromosomal and Genetic Engineering"

Educational program in the specialty "7M05109 - Biotechnology"

Master, 1 course, autumn semester 2021-2022 academic year

**2021 y.**

The program of the final exam of the discipline "Chromosomal and genetic engineering" of the specialty "7M05109 - Biotechnology" was compiled by Amirova Aigul Kuzembaevna, candidate of Biology sciences and Smekenov I.T., Ph.D.

Reviewed and approved at a meeting of the Department of Molecular Biology and Genetics

From "20" October 2021, protocol No. 5

Head of Department \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Zhunusbaeva Zh.K.

**The form of the final exam on the discipline** – Writing / offline

**The purpose of the assignment** is to assess the students' knowledge and understanding of the topics covered in this discipline; to recreate the conditions under which they will be able to assess the problem, analyze ways to solve the problem and apply the knowledge gained in practice; Test their ability to reason for their answers.

**Type of options -** tickets.

**Evaluation criteria:** Block I - 30 points, Block II - 30 points, Block III - 40 points.

A (90-100%) - the student carefully studied the educational material; consistently and comprehensively answers the questions posed; freely applies the acquired knowledge in practice.

B (75-89%) - the student knows the educational material; does not make serious mistakes when answering; he can apply the acquired knowledge in practice.

С (60-74%) - the student knows only the basic material, does not always give an answer clearly and completely.

D (50-59%) - the student has separate ideas about the material being studied; cannot fully and correctly answer the questions posed, when answering, he makes gross mistakes.

**Exam program**

**Block I**

1. The goals and tasks of chromosome engineering.

2. History of the development of chromosome engineering technologies.

3. Chromosome structure and organization of DNA sequences of viruses, bacteria and cellular organelles: chloroplasts and mitochondria.

4. DNA packaging in chromosomes. Karyotype and idiogram. Euchromatin and heterochromatin.

5. Chromosome abnormalities. Chromosome mutations: quantitative and structural variability. Chromosomal translocation, chromosomal inversion, and chromosomal deletion to identify the underlying genes.

6. Chromosomes of viruses and bacteria, mitochondria and chloroplasts.

7. Lamp brush chromosomes. Polyteny as a phenomenon. Polytene chromosomes.

8. Quantitative changes in chromosomes: Autopolyploidy, allopolyploidy. Duplications, translocations, deletions and inversions.

9. Plant and animal breeding. Genetic foundations of evolution, the possibility of restoring the genetic basis for breeding of ancient cultivated species with a depleted gene pool. Types of crosses and their practical application.

**Block II**

1. Use of monosomal, nullisomal genetic lines of wheat for gene mapping and genome research.

2. Genome projects, predictions of the development of these projects.

3. Modern methods of gene mapping, creation of genomic libraries. Chromosome walking method.

4. Basic principles of genetic engineering. Realization of genetic information.

5. Molecular vectors used in genetic engineering and their application.

6. Genetic elements regulating the expression of prokaryotic genes.

7. Characterization of repressors as elements controling the synthesis of inducible enzymes. Operon organization of bacterial genes. Model of Jacob F. and Monod J. on the example of lactose (lac) operon.

8. Features of the application of genetic engineering methods for various groups

microorganisms (Bacillus, Streptococcus, Streptomyces, Pseudomonas, Coryneform bacteria, yeast).

9. Methods of cloning of recombinant DNA molecules. Methods of isolaton of cloned genes.

**Block III**

1. Recombinant DNA technology of plant using of crown gall plasmids.

2. Methods of transformation of plant protoplasts, cells and tissues. Crown galls are tumors induced by some soil bacteria. Tumor-inducing plasmids. Characterization of Ti-plasmids. Integration of T-DNA with the plant chromosome.

3. Basic methods of DNA sequencing. What are the principles of each of these methods? DNA replication. Enzymes and other proteins involved in DNA replication. General characteristics of bacterial plasmids as autonomously replicating mini chromosomes. Episomes, non-transmissible plasmids.

4. Plant viruses as vectors for genetic engineering.

5. General characteristics of DNA-containing oncogenic viruses on the example of SV40 viruses and polyoma. Features of expression of early (T- and t-proteins), as well as late (VP1-, VP2-, and VP3-proteins) genes of the SV40 virus.

6. Recombinant DNA and hereditary diseases

7. Genomic organization of the cauliflower mosaic virus (CaMV) and the mechanism of transcription.

8. Method of two-hybrid analysis. Reporter genes.

9. Recent significant discoveries in genetic engineering and their applications.

**RECOMMENDED LITERATURE**

Main:

1. S.N. Shchelkunov "Genetic Engineering", SUI, Novosibirsk - 2004.

2. B. Glick, J. Pasternak “Molecular Biotechnology. Principles and Application ”, M.,“ Mir ”, 2002.

3. Watson J., Ace J., Kuru D. Recombinant DNA. M.: Mir, 1986.

4. T. Maniatis, E. Fritsch, J. Sambrook. Genetic engineering methods. Molecular cloning. M., Mir, 1984.

5.S.G. Inge-Vechtomov. Introduction to Molecular Genetics. M., VSh, 1983.

6. New in DNA cloning. Methods. M., Mir, 1989 (edited by D. Glover). B. Lewin. Genes. M., Mir, 1987.

7. Mobility of the plant genome. Moscow, VO "Agropromizdat", 1990 (edited by B. Hon and E. S. Dennis).

8.E.S. Piruzyan. Fundamentals of Plant Genetic Engineering. M., Science, 1988.

Additional:

1.G.Stent, R.Kelindar. Molecular genetics. M. Mir, 1981.

2. J. Watson. Molecular biology of the gene. M., Mir, 1979.

3. Genetic engineering (under the editorship of Academician AABaev). Molecular Biology, vol. 123, 4.1, Moscow, VINITI, 1977.

4. M. Ptashne. Switching genes. Regulation of gene activity and phage (M., Mir, 1988.

5.G. Meinell. Bacterial plasmids. M., Mir, 1976.

6. L.A. Osterman. Methods for the study of proteins and nucleic acids. Electrophoresis and ultracentrifugation. M., Nauka, 1981.

***Internet resources:***

1) http://elibrary.kaznu.kz/ru

2) https://www.goodreads.com/

3) https://www.coursera.org/

4) https://www.edx.org/

5) https://ed.ted.com/

6) http://znanium.com/bookread.php?book=302262

7) https://urait.ru/book/biotehnologiya-rasteniy-409930