Al-Farabi Kazakh National University

Biology and Biotechnology faculty

Biotechnology department

**Final exam program by discipline**

RG5303 Genome regulation

6M070100 — Biotechnology, 1 course

2022

Final exam program of the discipline is made by Kenzhebayeva S.S., D.b.s., professor

Reviewed and approved at the chair meeting of the Biotechnology department

On «26» \_10\_ 2021, Protocol № 9

Head of department \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Kistaubayeva A.S.

Reviewed and approved at the meeting of the methodological council of the Faculty of Biology and Biotechnology

On «11» \_11\_ 2021, Protocol № 5

Chairman of the Methodological Council \_\_\_\_\_\_\_\_\_\_ Asrandina S.Sh.

**The form of exam on discipline** – writing (offline, Univer system). The ticket will be in 3 tasks (question). Total score is estimated at 100 points (30/30/40).

The first block includes questions of cognitive (knowledge) competence, which assess knowledge and understanding of the learning object. This assignment is aimed at identifying the ability to demonstrate knowledge and understanding of advanced knowledge in the field of study, which is based on the content of modern advanced textbooks. Estimated at 30 points.

The second block includes questions that identify functional competence, which assess the ability to apply and analyze information. This task is aimed at identifying the ability to apply their knowledge, formulate and substantiate arguments and solutions to problems within the study area. Estimated at 30 points.

The third block includes questions of systemic competence, which reveal the ability to synthesize and evaluate information. This question is an applied task that is aimed at testing the practical skills of students. Estimated at 40 points.

**Topics on which the task will be compiled:**

1. The structure of the bacterial chromosome.
2. Features of the prokaryote genome structure (the polycistronic gene structure).
3. Plasmids as prokaryote genome elements
4. The structure of the eukaryotic genome.
5. Replays, the satellite DNA.
6. The unique genome sequences.
7. The mobile genome elements.
8. The intermittent eukaryotic genes
9. Repressors and Negative Control of Transcription
10. Transcription regulation of λ-phage development
11. Positive Control of Transcription
12. Transcriptional Attenuation
13. The lactose operon.
14. Regulation of transcription of lambda phage development.
15. Principles of DNA recognition by regulatory proteins (CAP-protein and lambda phage repressor)
16. Regulation of the tryptophan operon expression.
17. "Riboswitches".
18. The mechanisms of transcription termination
19. Cellular regulation of metabolic pathways
20. Patterns of allosteric modulation
21. Regulation of the Activity of Protein – Kinases and Protein Phosphatases

# Transcriptional Regulation of Metabolism

1. Mechanisms, factors ans functions of riboswitches
2. Initiation of transcription, factors, regulation
3. Formation of "open complex"
4. Elongation of transcription, factors, regulation
5. Termination of transcription, factors, regulation.
6. Prokaryotic RNA polymerase, its subunit and three-dimensional structure.
7. A variety of sigma factors.
8. The promoter of prokaryotic genes, its structural elements
9. The features of transcription in eukaryotes.

## cis-Acting Regulatory Sequences: Promoters and Enhancers

## Transcriptional Regulatory Proteins

## Structure and Function of Transcriptional Activators

## Eukaryotic Repressors

## Relationship of Chromatin Structure to Transcription

## DNA Methylation

1. RNA processing in eukaryotes.
2. Caping, splicing and polyadenylation of the transcripts
3. Mechanisms of the splicing.
4. The role of small nuclear RNAs and protein factors.
5. The alternative splicing, its examples
6. Pre-mRNA Processing
7. Pre-mRNA Splicing
8. The mRNA stability.
9. Alternative splicing.
10. The speed of mRNA transport through the nuclear memrane.
11. The time of mRNA life
12. 3' Cleavage and Polyadenylation of Pre-mRNAs
13. Alternative Splicing
14. Differential mRNA longevity
15. Selective inhibition of mRNA translation
16. Control of RNA expression by cytoplasmic localization
17. Targets for translational regulation: initiation factors, mRNA and the ribosome
18. Classic examples of translational regulation
19. Novel concepts in translational control: microRNAs
20. Futures of the genome of mitochondria
21. Futures of the genome of сhloroplasts
22. Functional sites of genome
23. Regulation of genes expression in eukaryots
24. Transcriptional Regulation in Eukaryotes
25. Transcription Factors and Combinatorial Control
26. The "Ground State" of DNA Expression
27. The Role of Chromatin
28. MicroRNA as regulators gene expression
29. Genomics of Gene Regulation
30. Genome-wide approaches to identify targets of post-transcriptional gene expression regulation
31. Alternative proteomic approaches to study translational regulation
32. Antibiotics acting on the stages of translation
33. Decoding and A-site occupation
34. Peptide bond formation
35. Translocation and tRNA-release
36. Proteasome structure
37. Ubiquitin-dependent proteolysis
38. Non-classic proteasome proteolysis
39. The regulation of proteasome
40. Replication of mitochondrial genome
41. Polimorphysm of mitochondrial genome and human evolution
42. The origin of DNA of organells

**Evaluation criteria:**

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 main 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.

REFERENCES

1. Nuclear Mechanics & Genome Regulation / Edited by G.V. Shivashankar. - Elsevier Inc., 2010. - 367p.
2. Baltazar D. Aguda. Models of Cellular Regulation. - Oxford University Press Inc., New York, 2008. - 199p.
3. Edward R. Dougherty, Ilya Shmulevich, Jie Chen, Z. Jane Wang. Genomic signal processing: perspectives. - Hindawi Publishing Corporation, 2005. - 449p.
4. Alberts B., et al. Molecular biology of the cell. - New York: Garland science, 2004. - 1463p.
5. Gene Regulation and Metabolism. Postgenomic Computational Approaches / edited by Julio Collado-Vides Ralf Hofestadt. - The MIT Press Cambridge, Massachusetts, London, England, 2002. - 323p.

# Genomes, 2nd edition // Terence A Brown. Department of Biomolecular Sciences, UMIST, Manchester, UK Oxford: Wiley-Liss; 2002. ISBN-10: 0-471-25046-5

1. Mark Ptashne. A Genetic Switch: Gene Control and Phage Lambda. - Cell Press& Blackwell Scientific Publications, 1986. - 126p.
2. Lectures