MINISTRY OF HEALTH OF UKRAINE
KHARKIV NATIONAL MEDICAL UNIVERSITY
Department of Medical biology

Academic year 2026-2027

SYLLABUS OF THE ACADEMIC DISCIPLINE «MOLECULAR BIOLOGY IN MEDICINE AND DENTISTRY»

Normative or optional educational component Optional
Form of obtaining education full-time
(full-time; part-time; remote)
Field of science — 22 "Health"
Specialty — 221 "Dentistry"

Educational program for education of specialists of the second (master's) level of higher education course
Course of education — 3

Syllabus was approved at the meeting of the department of medical biology

Protocol
" 30 " of August, 2024 № 1

Acting Head of the Department

Iryna MESHCHERIAKOVA

Approved by the KhNMU Methodological Commission on Problems of General and Pre-professional Training

Meeting minutes
"30" August 2024 №1

Head of the Commission

Mykhailo MYROSHNYCHENKO
(signature) (initials, surname)

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Developers of the syllabus:

1. ass. professor, candidate of biological science Dzhamieiev V.Y.
(прізвище, ім'я та по-батькові, посада, вчене звання, науковий ступінь)

2. ass. professor, candidate of medical science Meshcheriakova I.P.
(прізвище, ім'я та по-батькові, посада, вчене звання, науковий ступінь)

3. _____
(прізвище, ім'я та по-батькові, посада, вчене звання, науковий ступінь)

Information about teachers

Surname, name	ass. professor, candidate of medical science Dzhamieiev V.Y.
Telephone number	(057)707-73-36
E-mail address	vy.dzhamieiev@knmu.edu.ua
Schedule of the classes	According to the schedule of the educational department
Consultations	According to the schedule of the educational department

Surname, name	ass. professor, candidate of biological science Meshcheriakova I.P.
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Schedule of the classes	According to the schedule of the educational department
Consultations	According to the schedule of the educational department

Telephone number, E-mail address of the department: (057)707-73-36, medbio@knmu.edu.ua
Full-time consultations schedule and place according to the schedule of the department.
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INTRODUCTION

The syllabus of the discipline «Molecular biology in medicine and dentistry» is compiled in accordance with the educational-professional program (hereinafter — EPP) “Dentistry” and the Standard of Higher Education of Ukraine (hereinafter — the Standard), the second (master's) level, field of knowledge 22 – “Health”, specialty 221 – Dentistry.

Description of the discipline (abstract).
Course: 3rd
Academic semester/academic year - II semester of the 2025-2026 academic year.
Discipline consists of 3 ECTS credits, 10 lecture hours, 18 practical class hours, 2 laboratory class hours, 60 hours of self-dependent student’s work.
The course "Molecular biology in medicine and dentistry" involves students gaining in-depth knowledge of theory and practice on the principles of the molecular basis of living organisms and aims to understand the possibility of using this knowledge to develop modern methods of diagnosis, treatment and prevention of diseases carried out at the cellular and molecular level and provide high accuracy therapy, individuality and low invasiveness. Molecular biology deepens and generalizes knowledge and skills in specialized theoretical disciplines and contributes to the formation of a basis for successful mastery of clinical professional and practical disciplines. Teaching the discipline includes lectures, practical classes and independent work of students.
The subject of study of the discipline is the general laws of structural organization of biological macromolecules and molecular mechanisms of storage and realization of genetic information.
Interdisciplinary links: medical biology, medical chemistry, biological and bioorganic chemistry, histology, cytology and embryology, human anatomy, physiology, medical and biological physics, microbiology, virology and immunology, pharmacology, medical genetics, molecular medicine.
Prerequisites: medical biology, medical chemistry, biological and bioorganic chemistry, histology, cytology and embryology, human anatomy, physiology, medical and biological physics, microbiology, virology and immunology, pharmacology, medical genetics.
Postrequisites: molecular medicine.

Link from the page of educational course in Moodle:

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1. The aim of teaching the discipline

1.1. The aim of teaching the discipline is to provide students with acquisition of systemic knowledge about the general laws of structural organization of biological macromolecules and molecular mechanisms of storage and realization of genetic information necessary for further study of disciplines necessary for professional training, mastering modern problems and achievements of molecular medicine.

1.2. The main tasks of the discipline:

- be able to explain the manifestations of human life at different stages of ontogenesis at the molecular and cellular levels;
- to explain the causes of hereditary and multifactorial diseases, based on knowledge of the mechanisms of storage and realization of genetic information in living cells;
- to understand the latest methods of diagnosis and treatment that have emerged from the achievements of molecular biology;
- to be creative in learning by extrapolating the directions of development of molecular genetic research and anticipate the use of certain scientific advances in the development of future methods of diagnosis and treatment.

1.3. Competences and learning outcomes, the formation of which is facilitated by the discipline (relationship with the normative content of training of higher education, formulated in terms of learning outcomes in the Standard).

1.3.1. The study of the discipline provides students with the acquisition of **competencies**:

Integral competencies:

ability to interpret the general biological patterns that underlie the processes of human life, to find the relationship between human health and the peculiarities of its hereditary apparatus.

General competences (GC):

GC1. Ability for abstract thinking, analysis, and synthesis.
GC2. Knowledge and understanding of the subject area and professional activity.
GC3. Ability to apply knowledge in practical activities.
GC6. Skills in the use of information and communication technologies.
GC7. Ability to search, process, and analyse information from various sources.
GC11. Ability to work in a team.
GC12. Commitment to environmental protection.

Professional competences (PC)

PC 2. Ability to interpret the results of laboratory and instrumental investigations.
PC 13. Ability to assess the impact of the environment on the health of the population (individual, family, population level).

1.3.2. The study of the discipline ensures that students acquire the following program learning outcomes:

LO15. Assess the impact of the environment on the health of the population in healthcare institutions using standard methodologies.
LO16. Formulate goals and determine the structure of personal activities based on the analysis of social and personal needs.
LO17. Maintain a healthy lifestyle and apply methods of self-regulation and self-control.
LO19. Adhere to the principles of ethics, bioethics, and deontology in professional activities.

1.3.3. The study of the discipline provides students with the following **social skills (Soft skills):**

- ability to abstract thinking, analysis and synthesis;
- ability to learn and master modern knowledge;
- ability to apply knowledge in practical situations;
- knowledge and understanding of the subject area and understanding of professional activity;
- ability to adapt and act in a new situation;
- ability to make informed decisions;
- ability to work in a team; interpersonal skills;
- ability to communicate in the state language both orally and in writing;
- ability to communicate in a foreign language;
- skills of using information and communication technologies;
- determination and persistence in terms of tasks and responsibilities;
- ability to act socially responsibly and consciously;
- the desire to preserve the environment;
- ability to act on the basis of ethical considerations (motives).

2. Information about educational course

Name of indices	Branch of knowledge, direction of training, educational-qualification level	Characteristics of the course
		Day tuition
Number of credits — 3,0	Direction of training I «Health Protection»	Elective course
Total number of hours — 90	Specialty I1 «Dentistry»	**Year of study:**
		3rd
		Term
		6th
		Lectures
Number of hours for day tuition: Classroom classes — 30, Independent work — 60	Educational-qualification level: «second (master's) level»	10 hours
		Practical classes
		18 hours
		Laboratory classes
		2 hours
		Independent work
		60 hours
		Individual tasks: 10 hours
		Type of control: Credit

2.1 Description of the discipline

2.2.1 Lectures

No	Lectures topic	Hours	Types of lectures
1	Introduction to molecular biology	2	Informational
2	Dna structure and replication	2	Informational
3	Gene expression mechanisms	2	Informational
4	Regulation of gene expression in prokaryotes and eukaryotes	2	Informational
5	Genetic engineering methods	2	Informational
	Total for lectures	**10**	

2.2.2 Seminars — not provided by the program

2.2.3 Practical classes

No	The practical lesson topic	Hours	Education methods	Methods of control
1	Main stages of development and pro-spects of molecular biology	2	story-explanation,	oral ex-amination

			presentation	
2	Structure and compaction of DNA. Formation of chromatin. DNA replication in prokaryotes and eukaryotes	2	story-explanation, presentation	test control
3	Structure of prokaryotic and eukaryotic genes. Transcription	2	story-explanation, presentation	oral examination
4	Mechanisms and significance of RNA processing	2	story-explanation, presentation	test control
5	Protein synthesis in prokaryotes and eukaryotes	2	story-explanation, presentation	oral examination
6	Regulation of gene expression in prokaryotes and eukaryotes	2	story-explanation, presentation	test control
7	Genetic engineering. Recombinant DNA methods	2	story-explanation, presentation	oral examination
8	Use of genetic engineering methods in science and medicine	2	story-explanation, presentation	test control
9	Final practical lesson, test	2	story-explanation, presentation	oral examination
	Total for practical classes	**18**		

2.2.4. Laboratory classes

No	The laboratory lesson topic	Hours	Education methods	Methods of control
1	Molecular biology research techniques	2	story-explanation	oral examination
	Total for laboratory classes	**2**		

2.2.5. Independent work of students

No	The independent work topic	Hours
1.	Subject, tasks, development and main achievements of molecular biology	2
2.	Basic methods of molecular biological research	2
3.	Formation and maintenance of spatial structure and activity of chromatin	4
4.	Domain structure of core histones and the mechanism of nucleo-	2

	some formation	
5.	Heterochromatin as the basis of differentiation	4
6.	Mechanisms of cellular memory	2
7.	DNA methylation	2
8.	High-fidelity DNA polymerases of prokaryotes and eukaryotes	2
9.	The concept of the matrix surface	2
10.	Modern ideas about the replisome. The "thrombone" model	2
11.	The problem of affinity of DNA polymerases to the DNA molecule	2
12.	The problem of terminal underreplication	2
13.	Basic principles of the organization of genomes of viruses, prokaryotes and eukaryotes	2
14.	Types and characteristics of genetic constructs	2
15.	Nucleotide pairing ambiguity and the genetic code	2
16.	Structure, synthesis, maturation and functions of small RNAs	2
17.	Structure, synthesis, maturation and functions of interfering RNAs (microRNAs)	2
18.	Post-translational modification of proteins	2
19.	Topological regulation of prokaryotic genes	2
20.	Histone code and epigenetic regulation in eukaryotic cells	2
21.	Mechanism of X-chromosome inactivation in mammalian female cells	2
22.	Mechanisms of suppression of bacterial gene activity that depend on the spatial structure of template RNA	2
23.	Features and significance of cloning vectors	2
24.	Evolution of DNA sequencing methods	2
25.	Molecular genetic methods in forensics	2
26.	CRISPR-Cas systems bacteria	2
27.	Theoretical foundations of organism cloning	2
28.	Biotechnology in medicine	2
	Total for of independent work students	**60**

3. Assessment Policy

3.1. Evaluation of the success of education of students is carried out on the basis of the current "Instructions for evaluating the educational activities of students of KHNMU"

Teachers shall ensure that each master receives the necessary competences in the areas covered by practical classes. Mastering the topic (current control) is controlled by practical lessons according to specific goals, tests, solution of situational tasks, control of the acquisition practical skills.

Assessment system and requirements:

— *types of control*: preliminary, current and final;

— *forms*: individual, group and frontal;

— *methods of current control*: oral examination, interview, solving situational problems and other methods of written control, practical verification of existing professional skills, test control, observation;
— *methods of final control*: credit for the last lesson in the form of a written test, which includes test tasks, theoretical questions and control of practical skills (solving situational exercises, analysis of instrumental research data, etc.);
— a credit is given to a student who has attended all classes, completed all topics and performed individual independent work.
Elimination of academic debt (practice): missed classes and unsatisfactory grades are worked off in the manner prescribed by KhNMU.

3.2. Questions for credit:

1. The purpose and objectives of molecular biology in understanding the fundamental principles of life processes.
2. The main stages in the development of molecular biology and molecular genetics.
3. The practical significance of achievements in molecular biology.
4. Prospects for the use of modern biotechnological advances in clinical medicine. The concept of molecular medicine.
5. Structure, chemical composition, and functions of DNA.
6. Organization and types of DNA double helices.
7. Levels of DNA compaction in prokaryotes and eukaryotes.
8. Chromatin and its molecular organization.
9. Domain structure of core histones. Formation of nucleosomes.
10. Chromatin fibrils.
11. Loop organization of chromatin. DNA supercoiling.
12. Metaphase chromosomes.
13. Epigenetic markers of chromatin state. Post-translational chemical modification of histones. Sites and types of histone modifications: acetylation, methylation, ubiquitination, phosphorylation. The histone code.
14. Cellular memory.
15. Basic principles of genome organization in viruses, prokaryotes, and eukaryotes.
16. DNA replication in bacteria and eukaryotes. The essence of the polymerase reaction.
17. Structure and properties of DNA polymerase. The polymerase reaction cycle.
18. Tautomerization of nitrogenous bases as the main cause of spontaneous errors in DNA synthesis.
19. Initiation of DNA replication in bacteria and eukaryotes.
20. Structure and properties of DNA helicase. The role of the helicase loader in DNA helicase activation.
21. Structural features of replication origins. The role of inverted repeats in origin formation.
22. Structure and significance of SSB proteins.

23. DNA topoisomerases. Activity cycle and significance of topoisomerase I.
24. Bacterial and eukaryotic DNA polymerases and their functions.
25. The problem of DNA polymerase affinity for the DNA molecule. Functions of the sliding clamp.
26. The role of RNA primase. Primase activity of DNA polymerase α in eukaryotes.
27. Replication bubble and replication fork. Synthesis of leading and lagging strands. Okazaki fragments.
28. The end-replication problem. Telomeres and telomerase.
29. The gene as a unit of genetic information.
30. Gene expression as a complex of mechanisms for the realization of genetic information. The central dogma of molecular biology.
31. Classification of genes according to their functions.
32. General structure of a gene. Types and characteristics of genetic constructs: monocistronic and polycistronic genes, operons, interrupted genes.
33. Functional parts of genes. Structural features of promoters. Recognition and binding sites for RNA polymerase and transcription regulators.
34. The coding region of a gene. Terminator.
35. RNA synthesis in *E. coli*. Bacterial RNA polymerases. Core enzyme and holoenzyme.
36. The elongation cycle of transcription.
37. Termination. Types of terminators in bacterial genes.
38. Transcription in eukaryotes. Eukaryotic RNA polymerases.
39. Initiation of transcription of protein-coding genes.
40. Structure of the eukaryotic promoter binding RNA polymerase II. Basal, proximal, and distal cis-elements.
41. Components of the pre-initiation complex. General and specific transcription factors.
42. Polymerization of pre-mRNA.
43. Termination of pre-mRNA transcription.
44. Initiation of transcription by RNA polymerases I and III.
45. Significance of histone modifications and chromatin remodeling in the activation of eukaryotic genes.
46. Mechanisms and significance of mRNA processing in eukaryotes.
47. Capping of the 5′ end of pre-mRNA. Structure of the 5′ cap.
48. Splicing – removal of introns. Consensus sequences in human gene introns required for their recognition. The role of small nuclear RNAs in the splicing mechanism.
49. The phenomenon of alternative splicing and its significance.
50. Polyadenylation of the 3′ end of pre-mRNA.
51. Features of processing of transfer, ribosomal, small, and interfering RNAs.
52. RNA and its chemical structure. Nucleotide composition of RNA. Unusual nitrogenous bases of RNA and their significance.
53. RNA as the oldest universal informational molecule with catalytic properties. Ribozymes.

54. Types of RNA, their structure and functions: transfer RNA, ribosomal RNA, small nuclear and small nucleolar RNAs, small interfering RNAs (microRNAs), high-molecular-weight RNAs.
55. Translation (protein synthesis). Components of the translation complex.
56. Structure and functions of tRNA. Wobble pairing between the first position of the anticodon and the third position of the codon.
57. Activation of amino acids and formation of aminoacyl-tRNA. Aminoacyl-tRNA synthetases.
58. Molecular organization of ribosomes in prokaryotes and eukaryotes. Ribosomal RNAs and ribosomal proteins.
59. Elongation of translation (polypeptide chain synthesis).
60. Interaction of aminoacyl-tRNA with the A-site of the ribosome. Translation factor EF1. Accommodation of aminoacyl-tRNA in the ribosome.
61. Mechanism of peptide bond formation. Ribosome translocation.
62. Initiation of translation and assembly of the translation complex in prokaryotes and eukaryotes. Sequences responsible for start codon recognition.
63. The significance of translation factors in protein synthesis mechanisms.
64. Features of protein synthesis in the cytoplasm and on endoplasmic reticulum membranes. Polyribosomes.
65. Termination of translation. Release factors.
66. Effects of antibiotics on protein synthesis.
67. Co-translational protein folding. Formation of a functionally active protein. Chaperones and chaperonins.
68. Post-translational chemical modification of proteins and its significance.
69. Types of transcription factors and features of their interaction with DNA in promoter regions of genes.
70. General characteristics of transcription regulation of prokaryotic operon genes. Types of regulation involving protein transcription factors and low-molecular regulators.
71. Control of expression of the lactose operon of *E. coli*. Negative inducible and positive inducible regulatory mechanisms.
72. Control of expression of the tryptophan operon of *E. coli*. Positive repressible regulation. Attenuation of the tryptophan operon.
73. Significance of the spatial organization of the genome for gene expression intensity. Topological regulation of bacterial gene expression.
74. Guanine riboswitch.
75. Autogenous control of ribosomal protein expression.
76. Features of regulation of eukaryotic gene expression. Regulation of transcription factor activity in eukaryotes.
77. Assembly of the pre-initiation complex at the promoter of a eukaryotic gene.
78. Structure and functional state of chromatin. Selective chromatin condensation.
79. Heterochromatin and euchromatin. Formation and role of heterochromatin.
80. Significance of post-translational modifications of histone proteins for chromatin spatial structure. Molecular markers of chromatin state.

81. Changes in the histone code and chromatin remodeling.
82. DNA methylation. Significance and evolution of cytosine methylation. The role of DNA methylation in genomic imprinting.
83. The epigenetic code as a complex of supragenetic mechanisms regulating eukaryotic gene expression.
84. The significance of the epigenetic code in mechanisms of cellular memory. The role of non-histone proteins in inheritance of the three-dimensional chromatin structure.
85. Mechanism of inheritance of DNA methylation patterns.
86. Mechanism of X-chromosome inactivation in female mammalian cells. Barr bodies.
87. Significance of sex chromatin in the diagnosis of chromosomal diseases.
88. Study of nucleic acids. Isolation and purification of DNA from plant, animal, and bacterial cells.
89. Cloning vectors (plasmids, bacteriophages, cosmids, artificial chromosomes). Structure of a plasmid vector.
90. Principles of recombinant DNA construction. Restriction enzymes and ligases.
91. Transformation of recombinant DNA into bacterial cells by electroporation.
92. Amplification of plasmid-inserted DNA fragments in bacteria.
93. Types of electrophoresis used for separation of macromolecules.
94. DNA electrophoresis in agarose gel. Use of ethidium bromide for identification of DNA fragments in the gel.
95. Creation of genomic libraries. The shotgun method.
96. Synthesis of cloned DNA and creation of cDNA libraries.
97. Nucleic acid hybridization. Influence of external conditions (temperature, chemical composition of the medium) on hybridization accuracy.
98. Screening of specific recombinant DNA.
99. Identification of DNA fragments by hybridization using radioactive DNA probes: dot blotting and Southern blotting.
100. In vitro amplification of DNA fragments. Polymerase chain reaction. Thermocyclers.
101. DNA sequencing by the Sanger method. Use of primers labeled with radioactive isotopes or fluorescent groups.
102. Pyrosequencing. Nanopore sequencing.
103. Methods of personal identification in forensic science: DNA fingerprinting.
104. Use of microarrays (DNA chips) in scientific research and medical diagnostics. Structure of a microarray.
105. Analysis of total gene expression (total mRNA) using microarrays.
106. Use of DNA chips for the diagnosis of infectious diseases.
107. Fluorescence in situ hybridization (FISH).
108. Application of the FISH method for detection of chromosomal translocations, karyotyping, and identification of mutant genes.
109. CRISPR-Cas systems and their role in bacterial immunity. Stages of CRISPR-Cas system functioning.

110. Classes and types of CRISPR-Cas systems. Structural and functional features of class I and class II systems.
111. CRISPR-Cas9 as the most convenient system.
112. Plasmids used in CRISPR-Cas9 technology.
113. Structural and functional features of the Cas9 protein.
114. Applications of CRISPR-Cas9 for genome editing, regulation of gene activity, and visualization of genomic loci using fluorescence.

3.3. Control questions

Control questions consist of methodical recommendations from each lesson.

3.4. Individual tasks

Preparation of abstracts and speeches on a given topic. Works are evaluated from 1 to 10 points.

1. Mechanisms of extracellular signals reception.
2. Components of the intracellular signaling system.
3. Effector molecules. Significance of chemical modification of proteins in extracellular signal transduction. Signal kinases and phosphatases.
4. Quick and slow signal reactions. Cascade signaling mechanisms. Transcription cascade.
5. Structure and properties of proteins. Significance of protein conformation in specific interactions.
6. Synthesis and posttranslational modification of proteins, folding.
7. Proteomics and its tasks.
8. Prions and prion diseases. Prions of mammals and yeast. Prionization and conformational inheritance of proteins. Mechanisms of prionization.
9. Basic principles of organization of genomes of viruses, prokaryotes and eukaryotes.
10. Mechanisms of direct and excisive repair of damaged DNA. Postreplication and SOS-repair.
11. Molecular mechanisms of genetic recombination.
12. Mobile genetic elements.
13. Violation of the mechanisms of DNA replication and repair and genetic recombination as a cause of gene and chromosomal mutations.
14. Translation (protein synthesis). Activation of amino acids, formation of aminoacyl-tRNA.
15. Molecular organization of the ribosome. Initiation of translation, assembly of the translation complex. Elongation (synthesis of a polypeptide chain) and termination of translation.
16. Posttranslational modification of proteins and its significance.
17. Topological regulation of bacterial gene expression.
18. Autogenic control of ribosomal protein expression in prokaryotes.
19. Methods of DNA diagnostics. Indications for DNA diagnostics.
20. Transgenic organisms. The principle of construction of transgenic organisms.

21. The main directions of application of transgenic organisms in the national economy and medicine.
22. Transgenic bacteria. Recombinant drugs.
23. Transgenic plants. The main areas of use of transgenic plants.
24. Transgenic animals as disease models and bioreactors. Problems of ecological safety.
25. Cell engineering. The concept of cloning. Natural and artificial clones.
26. History of cloning of living organisms. Biological and ethical problems of cloning.
27. Therapeutic cloning and its prospects in medicine.
28. Gene therapy. Principles of gene therapy. Ex vivo and in vivo gene therapy.
29. Viral and non-viral vectors in gene therapy.
30. Prospects and limitations of gene therapy. Gene vaccines.
31. Gene therapy in oncology.

3.5. Rules for appealing the assessment

The grade in the discipline can be appealed according to the provision on the appeal of the results of the final control of students of KhNMU.

4. Course politics

Discipline requirements: the student must have a thorough knowledge of medical biology, genetics and biochemistry and be ready for active cooperation.

Attendance and behavior: the student's presence in the classroom is allowed only in medical clothing; a student who is more than 5 minutes late is considered absent; in case of violation of academic discipline, the teacher may ask the student to leave the classroom.

The use of electronic gadgets is allowed only with the permission of the teacher.

5. Academic integrity

Academic Integrity Policy: Violation of academic integrity (writing off, other types of plagiarism, drawing up by another student, etc.) entails annulment of the mark, commission reorganization of the discipline and responsibility of the student in the manner prescribed by KhNMU.

6. Recommended literature

Basic

1) Molecular biology of the cell. 6th ed. / B. Alberts, A. Johnson, J. Lewis et al. — N.-Y.: Garland Science, 2014. — 1464 p.

Additional

1) Molecular Cell Biology. 8th ed. / H. Lodish, A. Berk, Kaiser C.A. et al. — N.-Y.: W.H. Freeman & Co. Ltd, 2016. — 1280 p.
2) Medical biology / Yu. I. Bazhora, R. Ye. Bulyk, M. M. Chesnokova [et al.]. — Vinnytsia : Nova Knyha., 2018 — 448 p.

3) Medical biology: The study guide of the practical classes course / O.V. Romanenko, O. V. Golovchenko, M.G. Kravchuk, V.M. Grinkevych; Edited by O.V. Romanenko. – K.: Medytsyna, 2008. – 304 p.
4) First Aid For The USMLE Step 1 2019 : a student-to-student guide / T. Le, V. Bhushan, M. Sochat [et al.]. — 29th ed. — New York : McGraw Hill Education, 2019. — 792 p.

7. Information resources

1. **Page of educational course in Moodle**

The procedure for informing about changes in the Syllabus: the necessary changes in the Syllabus are approved by the methodological commission of the KhNMU on the problems of professional education of the surgical profile and are published on the website of the KhNMU, the website of the Clinical parmacology department of the KhNMU.