



**SYLLABUS OF THE ACADEMIC DISCIPLINE**  
**«MODERN PROBLEMS OF MOLECULAR BIOLOGY»**

<b>1. General Information</b>	
<b>Faculty</b>	Faculty of Foreign Students
<b>Education Programme</b>	22 Healthcare, 226 Pharmacy, Industrial Pharmacy 2 <sup>nd</sup> (master's) degree of Higher Education, full-time
<b>Academic year</b>	2023-2024
<b>Discipline, code</b>	Modern problems of molecular biology code BF 1.3
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<b>Head of the Department</b>	Vorobets Zinovij Dmytrovych, Doctor of Biological Sciences, Professor <i>e-mail:</i> <a href="mailto:kaf_medicalbiology@meduniv.lviv.ua">kaf_medicalbiology@meduniv.lviv.ua</a>
<b>Academic year</b>	1 <sup>st</sup> year
<b>Semester</b>	I
<b>Type of discipline</b>	Selective
<b>Educators</b>	1. Solomiya Paryzhak – Ph.D., Assoc. Prof. <a href="mailto:sola.paryzhak@gmail.com">sola.paryzhak@gmail.com</a> ; 2. Olena Onufrovych – Ph.D., Assoc. Prof. <a href="mailto:onufrovychok@ukr.net">onufrovychok@ukr.net</a>
<b>Erasmus yes/no</b>	No
<b>Person, responsible for syllabus</b>	Solomiya Paryzhak – Ph.D., Associate Professor <a href="mailto:sola.paryzhak@gmail.com">sola.paryzhak@gmail.com</a> Maria Kushynska – Ph.D., Associate Professor <a href="mailto:kushynskam@ukr.net">kushynskam@ukr.net</a>
<b>Quantity of ECTS credits</b>	3
<b>Quantity of hours</b>	Total – 90 h: Lectures – 10 h; Practical classes – 20 h; Individual student's work – 60 h
<b>Language of instruction</b>	English
<b>Information about consultations</b>	According to the approved schedule

## 2. Course overview

«Modern problems of molecular biology» discipline (elective course) is studied by the I year students (specialty 226 Pharmacy, Industrial Pharmacy). The Working Program contains such chapters: «Molecular basis of heredity», «Molecular basis of hereditary diseases», «Modern issues of genetic technologies». It lays the foundation in students-pharmacists for their further mastering knowledge on the basic methods of chemical analysis of the structure and functions of biopolymers (proteins and nucleic acids); understanding of the molecular-genetic basis for the development of hereditary and multifactorial diseases and prospects for the application of the achievements of molecular biology in practical medicine. This discipline provides a study of modern problems and achievements of molecular medicine, including molecular genetic diagnostics, pharmacology, gene therapy for pharmacy students. The course includes lectures, practical classes, individual work of students and ends with a final credit. The study of the discipline "Modern problems of molecular biology" (elective course) lays the foundation for further mastering by students specialized knowledge and skills from theoretical and professional-practical clinical disciplines (bioorganic chemistry, pharmacology, physiology, medical genetics, etc.).

## 3. Aim and goals of the course

**1. The aim of the studying discipline «Modern problems of molecular biology»** follows from the objectives of the educational and professional training program for graduates of higher medical education and is determined by the content of those systemic knowledge and skills that must be mastered by a pharmacist. The study of modern problems of molecular biology generates in students-pharmacists a holistic idea of the formation of knowledge and practical aptitude for further students' mastering the block of relevant disciplines, which provide natural-science and professional-practical preparation for understanding modern problems as well as achievements of molecular medicine.

**2. The ultimate goals of the course «Modern problems of molecular biology» are:**

1. To explain the the patterns of human organism vital functions manifestation at the molecular-biological and cellular levels.
2. To be able to explain the nature and mechanisms of hereditary human diseases manifestation in the phenotype.
3. To understand the molecular-genetic basis for the development of hereditary and multifactorial diseases, prospects for the application of advances in molecular biology in practical medicine.
4. To be able to explain the nature and mechanisms of inherited human diseases phenotypic manifestation.

**3. Competencies and studying process results:**

**1) General (3K):**

- 3K 01. The ability for abstract thinking, analysis and synthesis.
- 3K 02. Knowledge and understanding of the subject area and understanding of professional activity.
- 3K 03. The ability to communicate in the official language both orally and in writing.
- 3K 04. The ability to communicate in the foreign language at level that ensures effective professional activity.
- 3K 05. The ability to evaluate and ensure the quality of work being performed.
- 3K 06. The ability to work as a team member.
- 3K 07. The ability to realize the own rights and responsibilities as a member of society, to recognize the values of civil (free democratic) society and the need for its sustainable development, the rule of law, human and civil rights and freedoms in Ukraine.
- 3K 08. The ability to preserve and multiply the moral, cultural, scientific values and achievements of society based on understanding the history and patterns of development of the subject area, its place in the general system of knowledge about nature and society and in the development of society,

techniques and technologies, to use different types and forms of motor skills for recreation and a healthy lifestyle.

3K 09. The ability to apply information and communication technologies.

**2) special (professional) (ΦK):**

ΦK 01. The ability to integrate knowledge and solve complex problems of pharmacy/industrial pharmacy in broad or multidisciplinary contexts.

ΦK 07. The ability to conduct sanitary-educational work among the population to prevent common diseases of internal organs, prevention of infectious and parasitic diseases, and to promote early detection and maintaining adherence to treatment of these diseases according to their medical-biological and microbiological peculiarities.

**4. Preliminary requirements**

1. An academic discipline «Modern problems of molecular biology» is based on the knowledge of students obtained on the basis of the State standard of basic and complete general secondary education in such subjects as "General Biology", "Human Biology", "Biology of Animals", "Biology of Plants".
2. Ensure a high level of general biological training.
3. Provides for students a foundation for the further assimilation of knowledge of relevant theoretical and practical clinical professional disciplines (Medical Chemistry, Medical Genetics, Clinical Immunology, and Infectious Disease with Epidemiology etc.).

**5. Programme learning outcomes**

**List of learning outcomes**

IPPH 01. To possess specialized conceptual knowledge in the field of pharmacy and related fields, taking into account modern scientific achievements, and to be able to apply them in professional activities.

IPPH 03. To possess specialized knowledge and abilities/skills for solving professional problems and tasks, including for the purpose of improving knowledge and procedures in the field of pharmacy.

IPPH 04. To communicate freely in the national and English languages orally and in writing to discuss professional problems and results of activities, presentation of scientific research and innovative projects.

IPPH 06. To develop and make effective decisions to solve complex/complex problems of pharmacy personally and based on the results of joint discussion; formulate the goals of one's own activity and the activity of the collective, taking into account public and industrial interests, the general strategy and existing limitations, determine the optimal ways to achieve goals.

IPPH 10. To provide the sanitary and educational work among the population for the purpose of prevention and in case of outbreaks of dangerous infectious, viral and parasitic diseases.

<b>Code of the learning outcomes</b>	<b>The content of the learning outcomes</b>	<b>Matrix of competencies</b>
<i>3H – knowledge</i> <i>YМ – skills</i> <i>AB – independence and responsibility</i> <i>K – competencies</i>		IPP – program learning outcomes
<i>3H-1</i>	To know how to interpret the importance of molecular-genetic methods for hereditary and infectious diseases diagnosis in forensic medicine	<i>IPPH-1,3,4,6,10</i>

<i>3H-2</i>	To know and apply knowledge of molecular basis of heredity, the mechanisms of development of hereditary and acquired human diseases in the physician practice
<i>3H-3</i>	To know and understand modern advances in molecular biology
<i>3H-4</i>	To know modern methods of human genome investigation and the basic mechanisms of apoptosis.
<i>3H-5</i>	To know the molecular mechanisms of mutagenic factors action and methods of mutagenic activity studying.
<i>YM-1</i>	Be able to solve situational problems, to identify the primary structure of the protein, the number of amino acids, the molecular weight of the polypeptide according to the gene structure encoding it
<i>YM-2</i>	Be able to analyze the structure of pro- and eukaryotic genes, to determine the types of mutations (gene or chromosomal)
<i>YM-3</i>	Be able to analyze the complex mechanisms of human traits inheritance
<i>YM-4</i>	To develop measures for reduction the degree of pathological condition manifestation in patients with hereditary pathology
<i>YM-5</i>	To choose the appropriate methods of human heredity studying to diagnose different hereditary diseases
<i>K-1</i>	The ability to apply in the practice of pharmacist knowledge of modern advances in molecular biology in practical medicine
<i>K-2</i>	To apply knowledge of molecular and cytological bases of heredity in practical activity of a pharmacist
<i>K-3</i>	The ability to apply the knowledge of peculiarities of human ontogenesis in diagnostic and treatment of various human diseases
<i>K-4</i>	The ability to estimate the impact of environmental factors on human health, use of the own professional activities for the environment protection
<i>AB-1</i>	Be responsible for mastering the relevant knowledge and content
<i>AB-2</i>	Be responsible for the measures that preserve the environment within its own competence

#### 6. Course format and content

<b>Course format</b>	<b>Full-time Course</b>	
<b>Classes</b>	<b>Hours</b>	<b>Groups</b>
lectures	10	
practical	20	
individual	60	

#### 7. Topics and content of the Course

<b>Code of the</b>	<b>Topic</b>	<b>Content</b>	<b>Code of the</b>	<b>Educator</b>
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classes type			learning outcomes	
Л – lecture П – practical class CPC – individual student's work				
Л-1	Subject and tasks of molecular biology. The main stages of development. Prospects for the application of modern advances in molecular biology in clinical medicine.	To acquaint students with the subject and tasks of molecular biology; stages of development; achievements; the possibility of application in clinical medicine.	<i>3H-1</i> <i>YM-2-5</i> <i>K-1,2,4</i> <i>AB-1,2</i>	Assoc. Prof. Paryzhak S.Ya., Assoc. Prof. Onufrovyh O.K.
Л-2	Genomic organization in non-cellular and cellular organisms. Regulation of gene expression.	To consider the structure and functions of viral genomes, the Lac operon of <i>E. coli</i> and the exon-intron organization of the eukaryotic genome. Control of gene expression in pro- and eukaryotes. Regulation at the level of translation and post-translation processes.	<i>3H-2,5</i> <i>YM-2-5</i> <i>K-1,2,4</i> <i>AB-1,2</i>	Assoc. Prof. Paryzhak S.Ya., Assoc. Prof. Onufrovyh O.K.
Л-3	Cell cycle. Genetic mechanisms of carcinogenesis. Regulation of the cell cycle.	To consider the mitotic cycle, its regulation. The role of cyclins and cyclin-dependent kinases. Principles of mitotic signal transmission. The role of growth factors, integrins and cadherins. Characteristics of genes involved in carcinogenesis: viral oncogenes, protooncogenes, tumor suppressor genes, mutator genes. Carcinogenic factors.	<i>3H-2</i> <i>YM-2-5</i> <i>K-1,2,4</i> <i>AB-1,2</i>	Assoc. Prof. Paryzhak S.Ya., Assoc. Prof. Onufrovyh O.K.
Л-4	Genetic engineering. Transgenic organisms. Gene therapy: prospects for application in medicine.	Recombinant DNA, principles of their construction. Cloning of nucleic acid fragments <i>in vivo</i> . Definition of the concept of vector in biology. Vectors: plasmids, bacteriophages, cosmids, artificial chromosomes. Principles of construction of transgenic organisms. Transgenic bacteria, plants, animals. Principles	<i>3H-1,3,4</i> <i>YM-2-5</i> <i>K-1,2</i> <i>AB-1,2</i>	Assoc. Prof. Paryzhak S.Ya., Assoc. Prof. Onufrovyh O.K.

		of gene therapy. Ex vivo and in vivo gene therapy. Viral and non-viral vectors in chemotherapy. Prospects and limitations of gene therapy.		
Л-5	Cell engineering. Cloning of organisms. Biological and ethical problems of cloning.	The concept of cloning. Natural and artificial clones. History of organisms cloning. Biological and ethical problems of cloning. Therapeutic cloning and its prospects in medicine.	<i>ЗН-1,3,4</i> <i>УМ-2-5</i> <i>К-1,2</i> <i>АВ-1,2</i>	Assoc. Prof. Paryzhak S.Ya., Assoc. Prof. Onufrovych O.K.
П-1	Molecular mechanisms of DNA replication.	Characteristics of the DNA replication process. Events occurring in the replication fork. Replication error correction system.	<i>ЗН-1-3</i> <i>УМ-1,2</i> <i>К-1</i> <i>АВ-1,2</i>	Assoc. Prof. Paryzhak S.Ya., Assoc. Prof. Onufrovych O.K.
П-2	DNA repair. Mechanisms of damaged DNA repair. Hereditary diseases with defects in DNA repair.	To consider the types and molecular mechanisms of DNA repair. Excisional, non-excise, recombinant reparation. The concept of DNA repair diseases	<i>ЗН-1-3</i> <i>УМ-1,2</i> <i>К-1</i> <i>АВ-1,2</i>	Assoc. Prof. Paryzhak S.Ya., Assoc. Prof. Onufrovych O.K.
П-3	Genome structure and molecular mechanisms of gene expression in viruses.	Organization of the viral genomes. The concept of the lysogenic and lytic cycles of viruses. Peculiarities of the retroviruses genome and life cycle.	<i>ЗН-1-3</i> <i>УМ-1,2</i> <i>К-1</i> <i>АВ-1,2</i>	Assoc. Prof. Paryzhak S.Ya., Assoc. Prof. Onufrovych O.K.
П-4	Genome structure and molecular mechanisms of gene expression in pro- and eukaryotes.	Current state of pro- and eukaryotic genomes study. Regulation of gene expression in prokaryotes. Catabolic and anabolic operons of bacteria. Control of gene expression in eukaryotes. Regulation of gene expression at the structural organization level, at the level of transcription and translation.	<i>ЗН-1-3</i> <i>УМ-1,2</i> <i>К-1</i> <i>АВ-1,2</i>	Assoc. Prof. Paryzhak S.Ya., Assoc. Prof. Onufrovych O.K.
П-5	Genome structure and molecular mechanisms of gene expression in in pro- and eukaryotes.	Current state of research genomes of eukaryotes. Regulation of gene expression in eukaryotes. Control of gene expression in eukaryotes. Regulation of gene expression at the level of structural organisation, at the level of transcription and translation	<i>ЗН-1-4</i> <i>УМ-1,2</i> <i>К-1</i> <i>АВ-1,2</i>	Assoc. Prof. Paryzhak S.Ya., Assoc. Prof. Onufrovych O.K.
П-6	Human genome organization.	«Human Genome» Project. Nuclear and mitochondrial genome. Features of the human genome. The main ways of the human genome research:	<i>ЗН-1-4</i> <i>УМ-1,2</i> <i>К-1</i> <i>АВ-1,2</i>	Assoc. Prof. Paryzhak S.Ya., Assoc. Prof. Onufrovych O.K.

		structural, functional, comparative, informative. Knowledge of the human genome opens new perspectives in the diagnosis and treatment of inherited human diseases.		
II-7	Molecular mechanisms of mutations.	Classification of gene mutations. The concept of monogenic hereditary diseases. Molecular and cytological mechanisms of chromosomal mutations. Classification of mutations. Generative and somatic mutations. Mutagenic factors, methods for determining the mutagenic activity of substances. Antimutagenesis.	3H-1-5 YM-1,2,4,5 K-1,2,4 AB-1,2	Assoc. Prof. Paryzhak S.Ya., Assoc. Prof. Onufrovykh O.K.
II-8	Regulation of the cell cycle. Molecular basis of oncogenetics.	To consider the mitotic cycle, its regulation. The role of cyclins and cyclin-dependent kinases in changing the phases of the mitotic cycle. Mitogenic signaling pathways. Characteristics of genes involved in carcinogenesis: viral oncogenes, protooncogenes, tumor suppressor genes, mutator genes. Carcinogenic factors.	3H-1-3 YM-1,2 K-1,2 AB-1,2	Assoc. Prof. Paryzhak S.Ya., Assoc. Prof. Onufrovykh O.K.
II-9	Gene therapy. Transgenic organisms.	Principles of gene therapy. <i>Ex vivo</i> and <i>in vivo</i> gene therapy. Viral and non-viral vectors in gene therapy. Prospects and limitations of gene therapy. Principles of construction of transgenic organisms. Transgenic bacteria: the main areas of application in the national economy and medicine. Transgenic plants, their use. Transgenic animals as disease models and bioreactors. Environmental safety issues.	3H-1-3 YM-2,3 K-1,2,4 AB-1,2	Assoc. Prof. Paryzhak S.Ya., Assoc. Prof. Onufrovykh O.K.
II-10	Cloning of organisms and cells. Therapeutic cloning and its prospects in medicine.	The concept of cloning. Natural and artificial clones. History of cloning of organisms. Therapeutic cloning and its prospects in medicine.	3H-1-3 YM-3-5 K-1,2,4 AB-1,2	Assoc. Prof. Paryzhak S.Ya., Assoc. Prof. Onufrovykh O.K.
CPC-1	Proteins, their role in providing of biological specificity. The concept of	The role of proteins in providing of biological specificity. Formation of a polypeptide chain. The structure of protein molecules. Classification of proteins according to biological functions. Carrier proteins, signaling, protective, structural, receptor,	3H-1-3 YM-1,2 K-1 AB-1,2	Assoc. Prof. Paryzhak S.Ya., Assoc. Prof. Onufrovykh O.K.

	proteomics. Prion diseases.	regulatory, enzymes. The concept of proteomics and prion diseases.		
CPC-2	Mobile genetic elements. Molecular mechanisms of general genetic recombination.	Mobile genetic elements of the human genome (MGE): transposons, retrotransposons. Structure, distribution and functional role. Chromosomal and gene localization of MGE. The role of MGE in genome function, participation in recombination processes, regulation of gene activity and in the formation of new genes.	<i>3H-1-3</i> <i>YM-1,2</i> <i>K-1</i> <i>AB-1,2</i>	Assoc. Prof. Paryzhak S.Ya., Assoc. Prof. Onufrovyh O.K.
CPC-3	Nucleic acid research methods. Methods of DNA diagnostics. Molecular genetic research methods in forensic medicine.	Methods of DNA isolation from plant and animal tissues. Characteristics of enzymes used for genetic engineering research. Indications for DNA diagnostics. Direct and indirect methods. DNA chips. Genetic identification of a person in forensic examination.	<i>3H-1-4</i> <i>YM-1-5</i> <i>K-1,2</i> <i>AB-1,2</i>	Assoc. Prof. Paryzhak S.Ya., Assoc. Prof. Onufrovyh O.K.
CPC-4	Modern methods of human karyotype study.	Human karyotype. Obtaining samples of mitotic chromosomes, their differential staining. Molecular cytogenetic methods: FISH-method, comparative genome hybridization, spectroscopic analysis of chromosomes.	<i>3H-4,5</i> <i>YM-5</i> <i>K-3</i> <i>AB-1,2</i>	Assoc. Prof. Paryzhak S.Ya., Assoc. Prof. Onufrovyh O.K.
CPC-5	Molecular mechanisms of cell aging.	Telomeric regions of chromosomes, their functions. Replication of telomeric regions of DNA. Telomerase, its activity in germ and stem cells. Participation of telomerases in the processes of cell aging and cancer therapy.	<i>3H-1-5</i> <i>YM-5</i> <i>K-3</i> <i>AB-1,2</i>	Assoc. Prof. Paryzhak S.Ya., Assoc. Prof. Onufrovyh O.K.
CPC-6	Molecular mechanisms of intercellular signaling and transmembrane transport	To consider the molecular organization and functions of biological membranes; surface receptors of cell membranes. To draw students' attention to the mechanisms of transmembrane signaling. To consider the types of substances transport.	<i>3H-4,5</i> <i>YM-3-5</i> <i>K-3</i> <i>AB-1,2</i>	Assoc. Prof. Paryzhak S.Ya., Assoc. Prof. Onufrovyh O.K.
CPC-7	Extranuclear heredity. Mitochondrial genome.	Extranuclear heredity: DNA of mitochondria and plastids. Mitochondrial genome, structure peculiarities. Mitochondrial diseases. Using mtDNA analysis to study maternal lineage, human evolution, population migration, human identification.	<i>3H-1-5</i> <i>YM-1-5</i> <i>K-1-4</i> <i>AB-1,2</i>	Assoc. Prof. Paryzhak S.Ya., Assoc. Prof. Onufrovyh O.K.



CPC-8	Apoptosis: molecular mechanisms. Ways to realize the apoptosis program.	Apoptosis as a physiological process of cellular suicide. Morphological manifestations of apoptosis. Molecular mechanisms of apoptosis. Ways to realise the apoptosis program: the role of physiological inducers of mitochondrial proteins, endoplasmic reticulum, granzyme B cytotoxic T-lymphocytes, RGD-peptides. Regulation of apoptosis by external factors and autonomous mechanisms.	3H-1-5 УМ-1-5 К-1-4 АВ-1,2	Assoc. Prof. Paryzhak S.Ya., Assoc. Prof. Onufrovych O.K.
CPC-9	Mutagenic factors. Methods for substances mutagenic activity determination.	Mutagenic factors, their classification. Spontaneous and induced mutations. Causes of spontaneous mutations. Chemical mutagens. Methods for determining the genotoxicity of substances: analysis of gene mutations, analysis of chromosomal and genome mutations, analysis of the DNA effect. Antimutagenesis.	3H-1-5 УМ-1-5 К-1-4 АВ-1,2	Assoc. Prof. Paryzhak S.Ya., Assoc. Prof. Onufrovych O.K.
CPC-10	Genetic mechanisms of carcinogenesis.	Carcinogenic factors, their classification. Carcinogens of direct and indirect action. Characteristics of genes involved in carcinogenesis: viral oncogenes, protooncogenes, tumor suppressor genes, mutator genes.	3H-1-5 УМ-1-5 К-1-4 АВ-1,2	Assoc. Prof. Paryzhak S.Ya., Assoc. Prof. Onufrovych O.K.
CPC-11	Gene therapy. Viral and non-viral vectors in gene therapy. Gene vaccines.	Principles of gene therapy. <i>Ex vivo</i> and <i>in vivo</i> gene therapy. Viral and non-viral vectors in gene therapy. Prospects and limitations of gene therapy. DNA vaccines: method of production; advantages and limitations.	3H-1-5 УМ-1-5 К-1-4 АВ-1,2	Assoc. Prof. Paryzhak S.Ya., Assoc. Prof. Onufrovych O.K.
CPC-12	Transgenic organisms. Recombinant drugs.	Basic methods and principles of construction of transgenic organisms. Methods used to produce transgenic bacteria. Application of transgenic organisms in the national economy and medicine.	3H-1-5 УМ-1-5 К-1-4 АВ-1,2	Assoc. Prof. Paryzhak S.Ya., Assoc. Prof. Onufrovych O.K.

#### System of classes

- information sources: verbal and auditory perception methods of learning information (lecture, conversation, explanation, discussion); methods of presenting information and visual methods (illustration, demonstration of slides, tables, figures, review of literature; visual sources of information); methods of practical application of the information (practical assignment, practical tasks solving, mastering of practical skills).

- according to individual work: by means of problems, partial-searching, research (situational tasks solving, preparing scientific reports)

#### Interactive methods

-problem-oriental method

-method of individual educational-research and practical tasks

- method of competing groups			
- method of training technologies			
- «business game» method			
- brainstorming method			
<b>8. Verification of results</b>			
<b>Current control</b>			
<p><b>Current control</b> is performed during the studying classes and is aimed at checking the mastering by students the learning material. The forms of current control are:</p> <p>a) tests with a choice of one correct answer (multiple choice questions), the definition of the correct sequence of actions, definition of correspondency, the definition of specific areas in a picture or diagram («recognition»). The control can be performed using the Misa distance learning platform.</p> <p>b) individual oral examination, interview;</p> <p>c) solving of typical situational problems from molecular biology.</p> <p>During the estimation of mastering of each topic for current educational activity student is graded in 4-point (traditional) scale according with the approved assessment criteria for the appropriate discipline. This takes into account all types of work, provided by the program of the discipline. The traditional scores from discipline are converted to the points.</p> <p><b>Individual student's work</b> is estimated during current control topics at the proper lesson and is a part of the final grade of student.</p>			
Learning outcome code	Code of classes type	The method of learning outcomes verification	Criteria of evaluation
<i>3H-1</i>	<i>Л-1,4,5 П-1-8,10 СРС-1-12</i>	Types of educational activities of students are: a) lectures b) practical classes c) individual work of students (ISW) Thematic plans of lectures, practical classes, ISW ensure the implementation in the educational process of all topics according to the program.  <b>The lecture course</b> consists of 5 lectures. The topics of the lecture course reveal the problematic issues of the relevant chapters of Genetics. During lectures, students develop theoretical basic knowledge, provides a motivational component and a general-indicative stage of mastering scientific knowledge during individual work. The lecture course makes maximum use of various didactic tools - multimedia presentations, educational films, slides. Practical classes aim at control of theory, the formation of practical skills and ability to analyze and	<b>Excellent ("5")</b> – the student perfectly mastered the theoretical material of the topic, demonstrates deep and comprehensive knowledge of the topic, the main concepts of scientific sources and recommended literature, thinks logically and answers thoroughly, freely uses the acquired theoretical knowledge in analyzing of practical material, expresses his attitude to certain problems, demonstrates high level of practical skills acquisition.  <b>Good ("4")</b> – the student has well mastered the theoretical material of the lesson, knows the basic aspects of primary sources and recommended literature; possess practical skills, expresses his views on certain issues, but assumes certain inaccuracies and errors in the logic of the
<i>3H-2</i>	<i>Л-2,3 П-1-10 СРС-1-12</i>		
<i>3H-3</i>	<i>Л-4,5 П-1-10 СРС-1-12</i>		
<i>3H-4</i>	<i>П-10 СРС-1-12</i>		
<i>3H-5</i>	<i>Л-1-5 П-5-10 СРС-1-12</i>		
<i>УМ-1</i>	<i>П-1-6,10 СРС-1-12</i>		
<i>УМ-2</i>	<i>Л-1-4 П-1-7,10 СРС-1-12</i>		
<i>УМ-3</i>	<i>Л-1-5 П-7,8,10 СРС-1-12</i>		
<i>УМ-4</i>	<i>Л-1-5 П-5,8-10 СРС-1-12</i>		
<i>УМ-5</i>	<i>Л-1-5 П-5-10</i>		

	<i>CPC-1-12</i>	<p>apply their knowledge to solve practical problems. Each lesson begins with a test to assess the initial level of knowledge and determine degree of readiness of students for classes.</p> <p>The teacher determines the purpose of the lesson and creates a positive cognitive motivation; answers questions from students that arose during the ISW on the topic of the lesson. The main stage of the lesson is to perform practical work. Students consider microslides and macropreparations, solve typical situational problems, problems in molecular biology, genetics and medical genetics, make an album. At the final stage of the lesson in order to assess the student's mastery of the topic he is asked to answer the situational tasks. The teacher summarizes the lesson, gives students tasks for individual work, points out the main issues of the next topic and offers a list of recommended reading. The duration of the practical lesson is 2 academic hours</p>	<p>presentation of theoretical content or in the implementation of practical skills.</p> <p><b>Outstanding ("3")</b> – the student has mainly mastered the theoretical knowledge of the subject, is guided by primary sources and recommended literature, but answers unconvincingly, confuses concepts, additional questions cause the student uncertainty or lack of stable knowledge; answering questions of apractical nature, reveals inaccuracies in knowledge, is unable to assess facts and phenomena, relate them to future activities, makes mistakes in the implementation of practical skills.</p> <p><b>Poor ("2")</b> – the student has not mastered the study material of the topic, does not know the scientific facts, definitions, almost does not navigate in the original sources and recommended literature, there is no scientific thinking, practical skills are not formed.</p>
<i>K-1</i>	<i>Л-1-5</i> <i>П-1-10</i> <i>CPC-1-12</i>		
<i>K-2</i>	<i>Л-1-5</i> <i>П-5-10</i> <i>CPC-1-12</i>		
<i>K-3</i>	<i>П-10</i> <i>CPC-1-12</i>		
<i>K-4</i>	<i>Л-1-3</i> <i>П-5-10</i> <i>CPC-1-12</i>		
<i>AB-1</i>	<i>Л-1-5</i> <i>П-1-10</i> <i>CPC-1-12</i>		
<i>AB-2</i>	<i>Л-1-5</i> <i>П-1-10</i> <i>CPC-1-12</i>		
<b>Final control</b>			
General evaluation system	Is performed after the discipline completion in the form of a credit according to a 200-point scale		
Grading scales	traditional 4-point scale, multi-point (200-point) scale, ECTS rating scale		
Conditions of admission to the final control	The student attended all practical classes, performed all types of educational activities, and received at least 120 points for current performance.		
Type of final control	Methods of final control		Criteria for crediting «pass» or «fail» (Credit/No Credit)
Credit	<b>Credit evaluation criteria</b>		

	<p>This is a form of final control, which is performed on the basis of a comprehensive assessment of student activities and acquired competencies (knowledge, skills, abilities, etc.), which includes the entry-level control of knowledge, quality of practical work, level of theoretical training and the results of the final knowledge control.</p> <p>The credit from disciplines is held after the end of its study, before the exam session. All topics submitted for current control must be included.</p>	<p><i>Maximum quantity of points – 200.</i></p> <p><i>Minimum quantity of points – 120.</i></p>
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**Maximum quantity of points**, which student can collect for the current educational activity for admission to the credit (differentiated credit) makes 200 points.

**Minimum quantity of points**, which student can collect for the current educational activity for admission to the credit (differentiated credit) makes 120 points.

**The calculation of the number of points** is made on the basis of the collected student's marks on the traditional scale during the discipline study, by calculating the arithmetic mean (AM or average), rounded to two decimal places. The obtained value is converted into points according to the scoring scale as follows:

$$x = \frac{CA \times 200}{5}$$

The assessment of the discipline, the form of final control of which is credit, is based on the results of the assessment of current educational activities and is marked on a two-point scale: "pass" or "fail". To pass the discipline, the student must collect for the current educational activity not less than 60% of the maximum amount of points (for a 200-point scale - not less than 120 points). Scores and grades ("pass" or "fail") the teacher puts in the examination sheet and in the student's record book (except for a failing grade). The scores from discipline are converted to the ECTS scale. Grade F (failing grade). Grade F (unsatisfactory with obligate repeat of the course) is awarded to students who have attended all classes in the discipline, but did not collect the minimum number of points for the current academic activity. Such students receive a grade "fail" and are not allowed to take the exam session.

The scores from discipline are converted to the ECTS scale and to the 4-point scale independently.

„A”, „B”, „C”, „D”, „E” ranking is made for students studying at one of the specialty and who have successfully completed study course.

Discipline points for students who have successfully completed the program are converted into traditional 4-point scale by absolute criteria, which are listed in the following table:

<b>Points from discipline</b>	<b>Estimation on 4-point scale</b>
From 170 to 200 points	5
From 140 to 169 points	4
From 139 points to minimal quantity of points, which student must collect	3
Less than minimal quantity of points, which student must collect	2

Estimation of ECTS and traditional scale is not converted because the ECTS scale and 4-point scale are independent.

Objective evaluation of educational activities of students is tested by statistical methods (the correlation coefficient between ECTS score and score in a national scale).

### 9. Course policy

The policy of the course is determined by the system of requirements for the student in the study of the discipline "Modern problems of molecular biology" and is based on the principles of academic integrity. Students are explained the value of acquiring new knowledge, the need for independent performance of all types of work and tasks provided by the work program of this discipline. Lack of references to used sources, fabrication of sources, writing off, interference in the work of other students are examples of possible academic dishonesty. Detection of signs of academic dishonesty in the student's work is the basis for its non-enrollment by the teacher, regardless of the extent of plagiarism or deception. Literature resources may be provided by the teacher exclusively for educational purposes without the right to transfer to third parties. Students are encouraged to use other literature resources which are not provided by the recommended list.

### 10. Literature

#### Basic:

1. Paryzhak S.Ya., Vorobets Z.D. Medical Biology. Textbook – Lviv: Qvart, 2020. – 426 p.
2. Bazhora Y.I., Bulyk R.Ye., Chesnokova M.M., Shevelenkova A.V., Smetyuk O.O., Lomakina Yu.V. Medical Biology: textbook. – Vinnytsia: Nova Knyha, 2018. – 448 p.: il.
3. Paryzhak S.Ya., Odnorih L.O. Medical biology and parasitology. Manual for the first-year students of the English department, the faculties of medicine and dentistry. – Lviv: Danylo Halytsky Lviv National Medical University, 2021. – 306 p.
4. Step 1. Lecture notes 2018 Biochemistry and Medical genetics. New York. Kaplan, Inc. – 2018 – 403 c.

#### Additional:

1. Kaplan Medical's USMLE STEP 1. Biochemistry and Medical Genetics. Lecture notes. – 2018. – 432 p.
2. Pap E., Falus A., László V., Oberfrank F., Szalai C., Tóth S. Medical Genetics and Genomics. Edited by Typotex Kiadó. – Budapest University of Technology and Economics, 2016. – 206 p.
3. Rautenstrauss B.W., Liehr T. FISH technology. – Berlin: Springer, 2012, 494 p.

#### Informational resources:

1. Testing center – database of license tests Krok – 1 <http://testcentr.org.ua/>
2. OMIM (Online Mendelian Inheritance in Man) – An Online Catalog of Human Genes and Genetic Disorders <http://omim.org/>
3. NCBI databases <http://www.ncbi.nlm.nih.gov>
4. Encyclopedia of DNA elements <http://genome.ucse.edu/ENCODE/>

### 11. Equipment, hardware and software resources of the discipline/ course

#### Methodological support of the lecture course:

1. Lecture theses from the discipline.
2. Methodical recommendations for lectures.
3. Presentations of lectures.

#### Methodological support of practical classes:

1. Methodical recommendations for practical classes for lecturers.
2. Methodical recommendations for practical classes for students.
3. Variants of test questions and tasks to check the initial level of knowledge on each topic.

4. Variants of situational tasks to check the mastering by students the learning topics.

5. Variants of tasks (theoretical and practical) for final control (credit).

**Logistical support**

1. Multimedia projector.

**12. Additional information**

Responsible for the educational process at the department – Associate Professor Oksana Pershyn. There is a scientific students’ association at the department. Meetings take place in the auditorium №1.

Practical classes are held in the classrooms of the department at the address: 3a Shimzeriv street, Theoretical building, 2nd floor.

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