

Department of Medical Biology, Parasitology and Genetics



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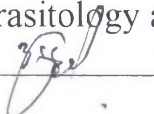
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WORKING PROGRAM OF THE DISCIPLINE

«BIOLOGY WITH BASIS OF GENETICS»

OK 8

**for the training of specialists of the 2nd (master's degree) level of higher education
education sector 22 Public Healthcare
Specialty 226.1 «Pharmacy, Industrial Pharmacy»
(Full-time education)**

Discussed and approved
at the methodical meeting of the
department of Medical Biology,
Parasitology and Genetics
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Head of Medical Biology,
Parasitology and Genetics department

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«Approved»
the profile methodical commission on
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Protocol No3
from “25” 05. 2023
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INTRODUCTION

Working Program of the discipline «Biology with basis of genetics» according to the higher education academic standard of *the second (Master's) level*

Education sector *22 Public Healthcare*

Specialty 226 Pharmacy, Industrial Pharmacy (Full-time education)

Education program *Master of Pharmacy*

Description of the discipline «Biology with basis of genetics» (Annotation)

Working program of the discipline «Biology with basis of genetics» is a part of the Educational-professional program «Pharmacy, Industrial Pharmacy» of the second (master's) level, it is studied by students mastering the specialty 226 «Pharmacy, Industrial Pharmacy» in the first year (Full-time education).

«Biology with basis of genetics» as an Academic discipline:

a) is based on previously studied by students subjects in secondary school such as «General Biology», «Human Biology», «Biology of Animals», «Biology of Plants»;

b) ensures a high level of general biological training;

c) 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, infectious disease epidemiology, internal medicine, surgery, pediatrics, etc).

Working program of the discipline «Biology with basis of genetics» is structured as follows: Chapter 1. «Biological features of human vital activities. Molecular-genetic level of life organization. Organism level of life organization. Fundamentals of human genetics. Population, species, biogeocenotic and biospheric levels of living matter organization».

In the Chapter 1 the molecular-genetic, cellular and ontogenetic levels of life organization are being considered, taking into account specificity of the human organism, cell biology, reproduction and basics of human genetics. Medical and biological aspects of human ecology are being revealed, which should ensure the formation of ecological thinking, necessary for the doctor nowadays. This section shows the animal world as part of the ecological human environment. Considerable attention is given to the study of parasites life cycles, various forms of relationships between them and the human organism, the origin and evolution of parasitism, modes of infection, methods of diagnosis, parasites prophylaxis. The study of various aspects of parasitology is important because a large number of parasitic diseases very common in the human population. From the perspective of modern synthetic theory of evolution questions of speciation, population patterns of species and microevolution process (for elementary evolutionary factors, elementary evolutionary phenomena) are being taught. Attention is drawn to the specific action of elementary evolutionary factors in human populations, genetic and phenotypic polymorphism of people.

The material is represented in such way that obtained knowledges are closely related to the further study of hereditary diseases at theoretical and clinical departments and could be used by a physician in his practice.

The types of lessons according to the working program are:

a) lectures; b) practical classes, c) individual student's work, d) consultations.

Structure of the discipline	Quantity of credits, hours, from them			Year of study, semester	Forms of the control	
	Total	Auditory				ISW
		Lectures (hours)	Practical classes (hours)			
Name of the discipline: Medical biology with basis of genetics Chapter <i>1</i>	3 credits / 90 hours	14	30	46	I course (1 semester) exam	

The subject of the academic discipline study is the basics of human vital functions, the study of the laws of heredity, variability, individual development and human morphophysiological adaptation to the environment due to its biosocial nature and impact of molecular-genetic, cellular, ontogenetic, population and ecological factors on human health.

Interdisciplinary links: the integration with related departments, in which biomedical disciplines are being studied (Histology, Cytology, Embryology, Human anatomy, Microbiology, Virology, Immunology, Epidemiology, Infectious diseases).

1. The Aim and Objectives of the discipline.

1.1. The overall aim of «Biology with basis of genetics» teaching process is determined by the goals of Program, outlining educational and professional training of higher medical institutions, as well as by the content of systemic competence and practical skills required for a pharmacist. The study of biology with basis of genetics forms in students-pharmacists a complete picture of the general laws of nature; the essence of life, its forms, individual and historical development of the organic world and human place in it; forms of biotic relationships in nature, the life cycles of parasites and parasitic diseases of humans; human place in the biosphere; provides fundamental biological training and practical skills for further professional practice of pharmacist.

1.2. The ultimate goals of the course «Biology with basis of genetics» are:

1. To determine the biological nature and mechanisms of diseases that arise from anthropogenic changes in the environment.
2. To identify the manifestations of general biological laws during human ontogenesis.
3. To explain the patterns of human organism vital functions manifestation at the molecular-biological and cellular levels.
4. To explain the nature and mechanisms of inherited human diseases manifestation in a phenotype.
5. To make a preliminary conclusion about the presence of parasitic infestations in human organism and define measures of disease prevention.

1.3. Competencies and training results

According to the requirements of Higher Education Standard, subject «Biology with basis of genetics» provides the development of the following *competencies*:

Integral competencies

The ability to solve complex problems, including those of a research and innovation nature in the field of medicine. Ability to continue learning with a high degree of autonomy.

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 t a 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.

Special (professional) (ΦK):

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

ΦK 03. The ability to solve pharmacy problems in new or unfamiliar environments in the presence of incomplete or limited information, taking into account aspects of social and ethical responsibility.

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.

Matrix of competencies

No	Competence	Knowledge	Skills	Autonomy and responsibility
1	The ability to use in pharmacist practice knowledge of molecular and cytological basis of heredity, mechanisms of hereditary and	Levels of the living things organization, forms of life and its fundamental properties; structural and functional organization and life cycle of eukaryotic cell; the forms of organisms	To examine microscopic specimens at different magnification; to prepare temporary specimens; to differentiate components of animal cells on electron micrographs and drawings; to define the primary structure of the protein,	1. Be responsible for the acquirement of relevant knowledge and skills. 2. Be responsible for the measures that preserve the environment

	acquired human diseases development.	reproduction. Molecular basis of heredity, basic regularities of heredity and variation. Methods for study of human heredity, classification of hereditary diseases. The concept of population as an elementary unit of evolution, the population structure of mankind.	number of amino acids, molecular weight of polypeptide according to the sequence of nucleotides of the gene encoding it; to predict phenotypes and genotypes for offspring according to genotypes of parents; to define the probability of birth a sick child with monogenic diseases when genotypes of the parents are known; to exclude paternity by determining blood groups of parents and children; to analyze karyotypes of patients with the most common chromosomal disease and determine the diagnosis; to build a family tree and spend its genealogical analysis; to define the role of heredity and environment in terms of characteristics (based on analysis of twins); to calculate the frequencies of genes and genotypes based on the law of Hardy-Weinberg.	within the own competence.
2	The ability to apply the knowledge of peculiarities of human ontogenesis and effects of pharmaceuticals on its various stages.	Ontogenesis and its periods; the main stages of embryonic development. Molecular and cellular mechanisms of differentiation; classification of congenital malformations; teratogenic factors.	To recognize the developmental defects, find out their causes.	1. Be responsible for the acquirement of relevant knowledge and skills. 2. Be responsible for the measures that preserve the environment within the own competence.
3	The ability to apply knowledge of biological basis of parasitism, life cycles of the human parasites for diagnostics,	The forms of symbiosis, parasitism as a biological phenomenon; principles of classification of parasites and hosts;	To define the placement of biological object (causative agents of parasitic diseases) in the system of nature; to prove the relation of human parasitic diseases to the group of	1. Be responsible for the acquirement of relevant knowledge and skills. 2. Be responsible for the measures

	prevention and treatment of human parasitic diseases, development of preventive measures.	transmission of parasitic diseases; obligate-borne and facultative vector-borne diseases; natural focal disease, the structure of the natural foci; basis of parasitic diseases prevention; the most common pathogens of protozoan infection, trematodiasis, cestodiasis, nematodiasis; <i>Arthropoda</i> as the vectors and pathogens of human infections; poisonous representatives of Phylum <i>Arthropoda</i>	transmissible and natural foci; using macro- and microspecimen to diagnose pathogens and pathogens carriers of parasitic diseases which are studied; to prove the methods of laboratory diagnosis of parasitic diseases in humans; to prove prevention methods of parasitic diseases based on their modes of infection	that preserve the environment within the own competence.
4	The ability to estimate the impact of environmental factors on human health, to use the own professional activity for protection of the environment and conducting sanitary-educational work.	The subject of ecology; types of environment; environmental factors, the role of man as environmental factor; main directions and results of anthropogenic changes in the environment; the main ideas of academician V.I. Vernadsky theory on the biosphere and the noosphere; adaptive ecotypes of people; functional types of people respond to environmental factors ("sprinter", "stayer", "mixed"); concept of biological	To form the requirements themselves and others to protect the environment.	<ol style="list-style-type: none"> 1. Be responsible for the acquirement of relevant knowledge and skills. 2. Be responsible for the measures that preserve the environment within the own competence.

		rhythms, their medical significance.		
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Learning outcomes (IPPH):

Integrative final program learning outcomes, for the formation of which contributes an academic discipline «Biology with basis of genetics»:

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.

2. Informational content of the discipline

For discipline studying is given 3 credits ECTS 90 hours.

Structure of the discipline «Biology with basis of genetics»:

Chapter 1.

«Biological features of human vital activities. Molecular-genetic level of life organization. Organism level of life organization. Fundamentals of human genetics. Population, species, biogeocenotic and biospheric levels of living matter organization».

3. Structure of the discipline

Topic	Lectures	Practical (seminar)	ISW	Personal tasks
Chapter 1. «Biological features of human vital activities. Molecular-genetic level of life organization. Organism level of life organization. Fundamentals of human genetics».				
Topic 1. Levels of living matter organization. Non-cellular and cellular forms of life. Structural and functional organization of a cell. Life safety during wartime. Provision of emergency medical and psychological assistance.	2	4	12	-
Topic 2. Reproduction – the basic property of living matter. Cell cycle.		2	3	-

Topic 3. Peculiarities of human genetics. Basic patterns of the main types of inheritance. Gene interactions. Linkage inheritance. Genetics of sex. Chromosomal theory of heredity.	2	4	-	-
Topic 4. Variability of organisms, its forms. The basic principles of medical genetics. Methods of human inheritance investigation. Hereditary human diseases.	2	4	6	-
Topic 5. Peculiarities of human ontogenesis. Infringements of ontogenesis and their place in human pathology.	-	-	6	-
Topic 6. Medical Protozoology. Phylum Sarcostigophora, Class Lobosea. Class Zoomastigophorea Phylum Ciliophora. Class Rimostomatea. Phylum Apicomplexa. Class Sporozoa – the causative agents of human diseases.	2	6	6	-
Topic 7. Medical Helminthology. Phylum Flat worms (Platyhelminthes). Class Trematoda, Class Cestoidea; Phylum Round worms (Nemathelminthes). Class Nematoda – the causative agents of human diseases.	4	6	4	-
Topic 8. Medical Arachnoentomology, Phylum Arthropoda. Class Arachnoidea. Class Insecta – vectors and causative agents of human diseases.	2	4	6	-
Topic 9. Biosphere as a system, supporting existence of human being. Human ecology..	-	-	3	-
Total hours 90/3 credits ECTS	14	30	46	
Final control	Exam			

4. Thematic plan of lectures

No	Topic	Hours
1.	Introduction to Medical Biology Course. Structural and functional organization of a cell.	2
2.	Organismic level of the genetic information organization. Gene interactions. Chromosomal theory of heredity. Genetics of sex.	2
3.	The basic principles of human genetics. Methods of the human inheritance investigation. Human hereditary diseases.	2
4.	Introduction to Medical Parasitology. Medical and biological basis of parasitism. Protozoa are human parasites.	2
5.	Medical Helminthology. Flat worms are human parasites.	2
6.	Phylum <i>Nemathelminthes</i> . Class <i>Nematoda</i> – causative agents of human diseases.	2
7.	Medical Arachnoentomology. Arthropods as the carriers of human infections and invasions.	2
	Total	14

5. Thematic plan of practical classes

No	Topic	Hours
1	Levels of living matter organization. Plant and animal cells. Structural components of the cytoplasm.	2
2	Hereditary apparatus of the cell. Morpho-functional characteristic of chromosomes. Human karyotype and ideogram.	2
3	Life cycle of a cell. Meiosis. Gametogenesis.	2
4	Peculiarities of human genetics. Basic patterns of human mendelian traits inheritance. Properties of the gene.	2
5.	Allelic and non-allelic gene interactions. Inheritance of blood groups according to ABO and rhesus factor systems.	
6.	Linkage inheritance. Genetics of sex. Sex-linked inheritance.	2
7.	Methods of the human inheritance investigation: cytogenetic and biochemical analysis. Chromosomal and gene diseases, their diagnostics.	2
8.	Genealogy of human and twins study as methods of human inheritance investigation.	2
9.	Medical and biological basis of parasitism. Protozoa as the parasites of human. Phylum <i>Sarcomastigophora</i> , Class <i>Lobosea</i> . Phylum <i>Ciliophora</i> . Representatives of the Class <i>Zoomastigophorea</i> – parasites of human.	2
10.	Representatives of Class <i>Rimostomatea</i> – parasites of human. Phylum <i>Apicomplexa</i> . Representatives of the Class <i>Sporozoea</i> – human parasites.	2
11.	Phylum Flat worms (<i>Platyhelminthes</i>). Class <i>Trematoda</i> : liver, cat's, lancet-like and lung flukes.	2
12.	Classis <i>Cestoidea</i> : pork, beef, dwarf tapeworms and echinococcus – causative agents of human diseases.	2
13.	Phylum <i>Nemathelminthes</i> . Class <i>Nematoda</i> : large intestinal roundworm, pinworm (seatworm), whipworm, and trichinella – causative agents of human diseases.	2
14.	Phylum <i>Arthropoda</i> . Class <i>Arachnoidea</i> . Ticks and mites are activators and vectors of human diseases.	2
15.	Class <i>Insecta</i> : lice (<i>Anoplura</i>), fleas (<i>Aphaniptera</i>), <i>Diptera</i> – causative agents and vectors of human diseases.	2
	Total	30

6. Thematic plan of Individual student's work

No	Topic	Hours	Type of control
1	Organization for matter and energy flow in the cell.	3	Current control during practical classes
2	Cells membranes. Transport across plasmalemma.	3	
3	Characteristic of nucleic acids. Organization of the information flow in a cell.	3	
4	Coronavirus SARS-CoV-2: structure and methods of diagnosis and prophylaxis of coronavirus disease.	3	
5	Reproduction and its types.	3	
6	Variability, its forms and manifestations: phenotypic and genotypic.	3	
7	Dermatoglyphics and population-statistic methods: their importance for diagnosis of hereditary diseases.	3	
8	Peculiarities of prenatal period of human development. Pre-conditions of congenital developmental anomalies.	3	
9	Postnatal period of human development and its	3	

	periodization. Aging as the finishing stage of human ontogeny. Theories of ageing.		
10	Methods of laboratory diagnosis of diseases caused by protozoa parasites.	3	
11	Teaching of E.N. Pavlovsky about natural-focal diseases. Transmissible protozoan diseases.	3	
12	Laboratory diagnostics of helminthiasis.	4	
13	Blood sucking insects – causative agents and vectors of human diseases. Midges and it components.	3	
14	Poisonous plants and animals for human.	3	
15	Biosphere as a system, supporting the existence of human beings. Fundamentals of human ecology.	3	
	Total	46	

7. Individual tasks. Preparing scientific reports for a scientific students' association meetings and for the Annual Student Scientific Conference.

8. Teaching methods:

- Verbal methods: lecture, conversation;
- Visual methods: illustration, demonstration;
- Practical methods: practical work and solving situational problems to develop skills;
- Independent work of students with material understanding and learning;
- Using an educational computer programs on discipline.

9. Control methods

1. Current control is performed during the practical classes and is aimed at checking the reproduction by students the learning material. The form of the current control during the practical classes is defined by the operational curriculum from the discipline. Current control is based on control of theoretical knowledge and skills during practical classes.

2. The final control is performed in the form of written exam (I semester).

Criteria for evaluation. The teacher evaluates each student's knowledge at each practice according to four-mark (traditional) system, taking into account the approved evaluation criteria:

Excellent ("5") – 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.

Good ("4") – 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 presentation of theoretical content or in the implementation of practical skills.

Satisfactory ("3") – 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 a practical 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

Unsatisfactory ("2") – 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.

Traditional scales are converted into the points.

10. Current control 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.

The forms of current control are:

- 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");
- b) individual oral examination, interview;
- c) solving of typical situational problems;
- d) identification of causative agents and vectors of parasitic diseases in the photos, macro- and micropreparations;
- e) control of practical skills;
- f) solving of typical problems from genetics and medical genetics.

10.1. Evaluation of students' current educational activity is carried out at each practical (laboratory or seminar) class according to four-mark system, taking into account the approved evaluation criteria for the discipline and is represented in the Journal of Academic Performance. All types of work and the list of competencies, provided by the curriculum and methodical recommendations for the topic study, are taken into account.

A student must receive a grade on each topic.

10.2. Individual work of students is estimated during current control on the relevant lesson.

11. A form of final control of learning success (exam)

Exam – a form of final control of mastering of student theoretical and practical material from studying discipline.

The final control is performed in the form of a written exam according with exam card tasks, which includes:

- a) test tasks (50), composed in accordance with the topics (50 points – 1 point for each test task);
- b) 4 describing questions (20 points – 5 points for each question);
- c) two situational problems (on molecular biology, and medical genetics) (10 points – 5 points for one problem).

Totally – 80 points.

12. The scheme of calculation and distribution of points that are received by students:

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

Minimum quantity of points, which student can collect for the current educational activity for admission to the exam (differentiated credit) makes 72 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:

$$x = \frac{AM \times 120}{5}$$

Maximum quantity of points, which the student can collect on the exam makes 80 points.

Minimum quantity of points on the exam – not less than 50.

Mark of the discipline, which is completed with an exam is defined as the sum of points for current educational activity (at least 72) and points for the exam (at least 50).

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.

Points of discipline 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:

Points from discipline	Estimation on 4-point scale
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

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

13. Methodological support

Methodological support of the lecture course:

1. Lecture theses from the discipline.
2. Methodical recommendations for lectures.
3. Presentations of lectures.
4. Video content of lectures, placed on the platform for distance learning MISA.

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. Questions and tasks for final control (exam).
6. Methodical materials, placed on the platform for distance learning MISA.

Logistical support

1. Multimedia projector.

14. Recommended literature

1. 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.

2. Additional:

1. Bihunyak T.V. Medical biology / T.V. Bihunyak. – Ternopil: TSMU Ukrmedknyha, 2020. – 214 p.
2. Bogitsh B.J., Carter C.E., Oeltmann T.N. Human parasitology. – 5th ed. Textbook. – Academic Press, 2019. – 407 p.
3. Elsheikha H.M., Jarroll E.L. Illustrated Dictionary of Parasitology in the Postgenomic Era. – Caister Academic Press, 2017. – 332 p.
4. Ghosh S., Chander J. Paniker's Textbook of Medical Parasitology. 8th Edition. – Jaypee Brothers Medical Pub, 2018. – 276 p.
5. Kaplan Medical's USMLE STEP 1. Biochemistry and Medical Genetics. Lecture notes. – 2018. – 432 p.
6. 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.
7. Ryabokon E.V., Onishchenko T.E., Ushenina L.O., Furyk E.A., Mashko O.P. Manual of helminthiasis: for the students of medical faculty. – Zaporozhye: [ZSMU], 2013. – 66 p.

15. 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.ucsc.edu/ENCODE/>