

SYLLABUS

1. General information on the course

Full course name	Medical Biology
Full official name of a higher education institution	Sumy State University
Full name of a structural unit	Medical Institute. Physiology and Pathophysiology Department with Medical Biology Course
Author(s)	Biesiedina Antonina Anatoliivna
Cycle/higher education level	The Second Level Of Higher Education, National Qualifications Framework Of Ukraine – The 7th Level, QF-LLL – The 7th Level, FQ-EHEA – The Second Cycle
Semester	16 weeks across 1 semester, 18 weeks across 2 semester
Workload	6 ECTS, 180 hours, out of which 80 hours are working hours with the lecturer (12 hours of lectures,68 hours of seminars)
Language(s)	English

2. Place in the study programme

Relation to curriculum	Compulsory course available for study programme "Medicine"
Prerequisites	Basic (school) knowledge of biology, chemistry and physics
Additional requirements	There are no specific requirements
Restrictions	There are no specific restrictions

3. Aims of the course

Formation of knowledge and practical skills in human biology, genetics and parasitology for further mastering by students of the disciplines, which provide scientific, professional and practical training for the future doctor.

4. Contents

Module 1. Cytogenetics

Topic 1 Introduction to Medical Biology

Safety rules briefing. General information about the discipline. Credit-rating system of knowledge assessment. Medical biology as a science of the basics of human activity, studying the laws of heredity, variability, individual and evolutionary development and morpho-physiological and social adaptation of the person to environmental conditions in association with its biosocial essence. The current stage of development of general and medical biology. The place of biology in the medical education system.

Topic 2 Biology as a Science. Light Microscopy

Biology as a science. Branches of biology. Scientific method. Hypothesis, law, and theory. The essence of life and life forms, the levels of organization of the living. A special place for man in the system of the organic world. Relationship between physicochemical, biological and social phenomena in human life. Methods of biological research. Microscopic method. Optical systems in biological research. Types of 4 microscopes. Light microscope structure. Dry and immersion lenses. Magnification and resolution. Rules of work with a microscope. Setting up illumination in a light microscope. Change of increasing. Rules of drawing. Temporary and permanent preparations for microscopy. Technique for making temporary preparations. Making permanent preparations, fixation, staining. Study and description of preparations.

Topic 3 Cell Structure

Cell theory. Cell structure. Prokaryotes and eukaryotes, plant and animal cells, unicellular and multicellular organisms. Viruses. Water. Salts. Macroelements, microelements. Organic compounds. Cell membranes. Diffusion and osmosis. Active and passive transport. Cytoplasm and cytoskeleton. Cyclosis. Cytoplasmic organelles. Nucleus and nucleoles. Cell as an open system. Assimilation and dissimilation. ATP synthesis. Methods for studying cell structure and function.

Topic 4 Cell Division. Gametogenesis

Prokaryotic cell division. Cell cycle in eukaryotes: interphase and M phase. The biological significance of mitosis. Mitotic activity of tissues. Control of the cell cycle. Growth factors. Cell specialization and differentiation. Special types of cell division: amitosis and schizogony. Meiosis: stages, behavior of chromosomes and chromatids, bivalents. Differences between meiosis and mitosis. The biological significance of meiosis. Gametogenesis: stages, types of cell division. Differences between oogenesis and spermatogenesis. Structure of gametes. Fertilization

Topic 5 Chromatin, Chromosomes, and Karyotype

Structure of the nucleus in interphase. Chromatin structure. Chromatin types: euchromatin, heterochromatin, and sex chromatin. Types of chromosomes: mitotic (metaphase), polytene, and lampbrush chromosomes. Structure of the mitotic chromosome. Endomitosis, polyteny. Karyotype. Characteristics and classification of human chromosomes. Karyogram, idiogram. Normal and abnormal chromosomes. Cytogenetic method: material for investigation, cytostatic agents, chromosome analysis. Banding techniques. Usage of karyotyping in medicine. Bacterial chromosome

Module 2. Classical Genetics

Topic 6 Mendel's First and Second Laws. Monohybrid Cross

Probability of a random event. Multiplication rule and addition rule. Genetics, its subject, objectives, and a brief history. Main terms used in genetics. Classical objects in genetics. Principles of genetic analysis. Mendel's experiments with one trait. Law of dominance and law of segregation. Rules used for writing of schemes of crosses; steps used for solving genetic problems.

Topic 7 Mendel's Third Law. Types of Crosses. Lethal Genes

Dihybrid cross: law of independent assortment. Polyhybrid cross. Chromosome theory of heredity. Cytological bases of Mendel's laws. Statistical character of Mendel's laws. Deviations from the expected ratios. Conditions when Mendel's laws are performed. Deviations from Mendel's laws. Test cross and its practical usage. Dominant and recessive normal and pathologic human traits. Lethal and semilethal genes (sickle-cell anemia, thalassemia, brachydactyly, achondroplasia).

Topic 8 Interaction of Allelic Genes. Multiple Allelism. Blood Groups

Allelic genes. Interaction of allelic genes: complete dominance, incomplete dominance, codominance, overdominance. Multiple alleles, causes of their appearance. Human blood groups. ABO, MN, and Rhesus systems. Rhesus incompatibility.

Topic 9 Interaction of Nonallelic Genes

Nonallelic genes. Complementation; 9:3:3:1 and 9:7 ratios. Epistasis; 13:3 and 12:3:1 ratios in the case of dominant epistasis; 9:3:4 ratio in the case of recessive epistasis. Qualitative and quantitative characteristics. Polygenic traits, multiple genes. Cumulative effect in the case of polygenic inheritance.

Topic 10 Gene Linkage. Chromosome Mapping

Morgan's experiments with linked genes. Linkage groups. Complete and incomplete linkage. Crossing over, its mechanism, cytological evidence, biological importance. Factors that influence crossing over. Genetic maps, purpose and methods of their construction. Eukaryotic gene mapping, map units. Somatic cell hybridization.

Topic 11 Genetics of Sex. Sex Linkage. Cytoplasmic Inheritance

Sex and sex characteristics. Hermaphroditism. Sex determination in mammals, birds, reptilians, insects, worms, fish, and mollusks. Inheritance of sex in human. Bisexual nature of human. Autosomes, sex chromosomes. Homogametic and heterogametic sex. Biological importance of sex chromosomes. Structure of X and Y chromosomes in human. Sex chromatin. Sex linkage: dominant and recessive X linked inheritance, holandric inheritance. Hemizygous genes. Sex-linked diseases: hemophilia, colour blindness, muscular dystrophy, hypophosphatemia (vitamin D resistant rickets). Cytoplasmic inheritance

Topic 12 Genotype and Phenotype

Penetrance. Expressivity (example – phenylketonuria). Pleiotropy (examples – sickle-cell anemia, Marfan syndrome). Sex and heredity. Sex-influenced and sex-limited characteristics. Variation, phenotypic and genotypic variation. Age variation. Phenotype as a result of interaction of genotype with environment. Modifications and norm of reaction. Genocopies and phenocopies.

Module 3. Molecular Genetics. Mutations

Topic 13 The Structure of Nucleic Acids. DNA Repair

DNA as the genetic material. Central dogma of molecular biology. Nucleotide structure. Purines and pyrimidines. Ribose and deoxyribose. Ribonucleotides and deoxyribonucleotides. Energy-rich bond. Primary, secondary, and tertiary structure of DNA. RNA molecules. Phosphodiester and hydrogen bonds. Chargaff's rules. Changes in DNA structure. DNA repair systems. Xeroderma pigmentosum

Topic 14 DNA Replication. Transcription

DNA replication: mechanism, enzymes. Replication in prokaryotes and eukaryotes. Okazaki fragments. Proofreading mechanisms. Transcription of a prokaryotic gene: mechanism. Structure of a prokaryotic gene: the promoter, the structural part, and the terminator. Structure and transcription of eukaryotic genes. Exons and introns. RNA processing: capping, splicing, polyadenylation, cutting, and base modifications. Influence of antibiotics on transcription. Reverse transcription

Topic 15 Translation. Gene Regulation

Primary, secondary, tertiary, and quaternary structure of a protein. Peptide and disulfide bonds. The genetic code and its properties. Translation, its stages (activation of amino acids, initiation, elongation, and termination). Colinearity. Influence of antibiotics on translation. 6 Regulation of gene activity on the chromatin level. Transcriptional level of gene regulation. An operon in prokaryotes; the lac and trp operons. Translational level of gene regulation. Posttranslational modifications of proteins.

Topic 16 Genes and Genomes. Horizontal Gene Transfer

Methods of investigation of genes and genomes. DNA sequencing. The structure of prokaryotic and eukaryotic genes. Structural and regulatory genes, genes for tRNAs and rRNAs. Genomes of viruses, bacteria, and eukaryotes. Transposable genetic elements. Human genome. Gene engineering. Biotechnology. Gene therapy. Horizontal gene transfer: bacterial conjugation, bacterial transformation, and transduction; their importance for science and practice. Conjugation in infusorians. Sex factor in bacteria. Construction of genetic maps of prokaryotes.

Topic 17 Mutations

Classification of mutations. Gene and chromosome mutations. Variation caused by mutations. Molecular mechanisms of mutations. Induced mutagenesis. Physical, chemical, and biological mutagens. Genetic monitoring.

Module 4. Medical Genetics. Population Genetics and Evolution

Topic 18 Reproduction. Ontogenesis. Regeneration. Transplantation

Types of reproduction: asexual, sexual, and virginal (parthenogenesis). Structure of gametes. Fertilization. Human reproduction. Ontogenesis: types, stages. Embryonic development of human. Differentiation. Gene regulation during ontogenesis. Experimental investigations of embryonic development. Interaction of blastomeres. Embryonic induction. Cleavage and its disorders (polyembryony, twins). Critical periods of development. Teratogenesis. Teratogenic factors of environment. Minamata disease. Congenital defects of development. Classification of defects: hereditary, exogenous, and multifactorial; gametopathies, blastopathies, embryopathies, and fetopathies. Periods of postembryonic development of human. Influence of hormones. Aging. Theories of aging. Biological rhythms: day-night, circadian, seasonal, and circannual; their importance. Types of regeneration (physiological, reparative, epimorphic, morphallactic). Transplantation of tissues and organs. Types of transplantation. Graft rejection

Topic 19 Human Genetics. Twin Studies, Dermatoglyphics, Pedigree Analysis

Methods of genetic investigations. Humans as a specific subject for genetic study: disadvantages and advantages. Twin studies. Concordance and discordance, coefficient of heredity. Dermatoglyphics. Dermal ridge patterns. Pedigree analysis: purposes, rules for pedigree construction, symbols, methods of pedigree analysis. Modes of inheritance of traits, criteria of inheritance of rare nuclear genes.

Topic 20 Single-Gene Disorders

Classification of hereditary diseases: single-gene disorders, chromosome disorders, multifactorial disorders, and mitochondrial disorders. Human molecular diseases (single-gene disorders). Classification of molecular diseases: disorders caused by defects in carbohydrate metabolism, in amino acid metabolism, in protein metabolism, in copper metabolism; enzymopathies; hemoglobinopathies; storage diseases. Phenylketonuria, hemoglobinopathies (sickle-cell anemia, thalassemia), hemophilia, color blindness, brachydactyly, and achondroplasia: genetic characteristics and mode of inheritance. Laboratory diagnostics of gene disorders. Molecular diagnostics; polymerase chain reaction. Screening

Topic 21 Chromosome Disorders. Genetic Counseling

Chromosome mutations: structural and numerical chromosome aberrations, their mechanisms. Abnormal chromosomes. Mutations in sex and somatic cells, their importance. Mosaicism. Chromosome disorders (Down syndrome, Patau syndrome, Edwards syndrome, Klinefelter syndrome, Turner syndrome [Shereshevsky-Turner syndrome], trisomy X, cat's cry syndrome [cri du chat syndrome]), their main symptoms, laboratory diagnostics. Translocation Down syndrome. Cytogenetic method: karyotyping; normal and abnormal karyotypes. Detection of X- and Y-chromatin as a tool of diagnostics of some hereditary diseases. Genetic counseling. Prevention of inherited and congenital malformations. Prenatal diagnostics of hereditary diseases.

Topic 22 Population Genetics

Population genetics: subject and purposes. A species, a population, human population. Characteristics of population. Isolation, its role in speciation. Idealized population. Hardy-Weinberg law. Influence of mutations, selection and migration on the genetic structure of a population. Genetic drift. Founder effect. Types of mating in populations in the nature, their influence on a population. Inbreeding: causes and consequences. Usage of the Hardy-Weinberg equilibrium in medicine for analysing of the genetic structure of human populations.

Module 5. Human Ecology. Medical Parasitology

Topic 23 Ecology and Biosphere. Poisonous organisms

Ecology. Environment. Abiotic and biotic factors. Ecosystem. Human and biogeocenosis. Anthropogenic ecosystems; agrocenosis. Pharmaceutical drugs in food chains. Human ecology. Influence of anthropogenic factors on health. Stress. Adaptation of human to difficult environmental conditions. Biosphere, its structure and evolution. Anthropogenic migration of elements in environment. Ozone layer. Poisonous fungi, plants, and animals.

Topic 24 Introduction to Parasitology. Protozoans. Sarcodina

Principles of classification of living beings. Binary nomenclature. Introduction to medical parasitology. Origin and evolution of parasitism. Ways of penetration of parasites into a host. Classification of parasites. Classification of hosts. Classification of vectors. Interaction between parasites and hosts. Characteristics and classification of protozoans (Protozoa). Phylum Sarcomastigophora, Class Rhizopoda (Lobosea). *Entamoeba histolytica*, *Entamoeba coli*, *Entamoeba gingivalis*. Distribution, morphology, life cycle of *Entamoeba histolytica*, ways of invasion, pathogenicity; laboratory diagnostics, and control of amebiasis. Different features of *Entamoeba histolytica* and *Entamoeba coli*.

Topic 25 Flagellates

Characteristics of flagellates. The structure of a flagellum. *Giardia lamblia* [*G. intestinalis*, *G. duodenalis*; *Lamblia intestinalis*]: distribution, morphology, life cycle, ways of invasion, pathogenicity. Laboratory diagnostics and control of giardiasis [lambliaosis, lambliosis]. 8 Trichomonads: *Trichomonas vaginalis*, *Trichomonas hominis* [*T. intestinalis*] and *T. tenax*. Distribution, morphology, life cycle of *Trichomonas vaginalis*, ways of invasion, pathogenicity; laboratory diagnostics, and control of trichomoniasis. *Leishmania tropica* (old name: *L. tropica minor*), *L. major* (old name: *L. tropica major*), *L. donovani*, and *L. infantum*: distribution, morphology, life cycle, ways of invasion, pathogenicity. Laboratory diagnostics and control of cutaneous and visceral leishmaniases. *Trypanosoma brucei gambiense*, *T. brucei rhodesiense*, and *T. cruzi*: distribution, morphology, life cycle, ways of invasion, pathogenicity. Laboratory diagnostics and control of trypanosomiases. Endemic diseases and diseases with natural focus. Transmissible diseases.

Topic 26 Sporozoans. Infusorians. Methods of Diagnostics of Protozoan Diseases

Characteristic, structure and reproduction of Sporozoa. Malarial plasmodia *Plasmodium vivax*, *P. ovale*, *P. malariae*, and *P. falciparum*: medical geography, morphology and life cycle, mode of infection, pathogenic influence, association between temperature of the patient and the stage of plasmodium development. Laboratory diagnostics and control of malaria. *Toxoplasma gondii*: medical geography, morphology, life cycle, ways of infection, pathogenic influence. Laboratory diagnostics and control of toxoplasmosis. Characteristic of infusorians. Nuclear dualism. Sexual process in infusorians. *Balantidium coli*: medical geography, morphology and life cycle, ways of infection, pathogenic influence. Laboratory diagnostics and control of balantidiasis. Methods of laboratory diagnostics of diseases caused by parasitic protozoa. Material that is used for diagnostics of protozoan diseases.

Topic 27 Flatworms. Flukes: *Fasciola hepatica*, *Opisthorchis felinus*, *Clonorchis sinensis*, *Dicrocoelium dendriticum*, and *Metagonimus yokogawai*

Classification of Plathelminthes. General characteristic of the phylum Plathelminthes and class Flukes. Role of covering (tegument). Systems of organs. Developmental stages, morphology of larvae. Parthenogony. Changing of hosts. Adaptation of parasites to hosts. Liver fluke *Fasciola hepatica*, Siberian liver fluke *Opisthorchis felinus*, Chinese liver fluke *Clonorchis sinensis*, lancet fluke *Dicrocoelium dendriticum* [*D. lanceatum*], and *Metagonimus yokogawai*: medical geography, morphology and life cycle, mode of invasion, pathogenic influence. Laboratory diagnostics and prevention of fascioliasis, opisthorchiasis, clonorchiosis, dicrocoeliasis (dicrocoeliosis) and metagonimiasis

Topic 28 Flukes: *Paragonimus ringeri*, *Schistosoma* spp., and *Nanophyetus salmincola*. Tapeworms: *Diphyllobothrium latum*

Lung fluke *Paragonimus ringeri* [*P. westermani*]; blood flukes – *Schistosoma mansoni*, *S. haematobium*, and *S. japonicum*; *Nanophyetus salmincola* [*Trogloremma salmincola*]: medical geography, morphology and life cycle, mode of invasion, pathogenic influence. Laboratory diagnostics and prevention of paragonimiasis, schistosomiasis and nanophyetiasis. Comparative characteristic of flukes. General characteristic of tapeworms. Types of larvae: solid larvae and fluid-filled cysts. The changes in morphology associated with transition to parasitism. Broad tapeworm [fish tapeworm, late tapeworm, Swiss tapeworm] *Diphyllobothrium latum*: medical geography, morphology and life cycle, mode of invasion, pathogenic influence. Laboratory diagnostics and prevention of diphyllobothriasis.

Topic 29 Cyclophyllidean Tapeworms

Beef tapeworm [unarmed tapeworm] *Taenia saginata* [*Taeniarhynchus saginatus*], pork tapeworm [armed tapeworm] *Taenia solium*, dwarf tapeworm *Hymenolepis nana*: medical geography, morphology and life cycle, mode of invasion, pathogenic influence. Laboratory diagnostics and prevention of beef tapeworm infection, pork tapeworm infection, cysticercosis, and hymenolepiasis. Differential diagnosis of taeniid infestations. Dog tapeworm [caseworm] *Echinococcus granulosus* and *Echinococcus multilocularis* [*Alveococcus multilocularis*]: medical geography, morphology and life cycle, mode of invasion, pathogenic influence. Laboratory diagnostics and prevention of echinococcosis and alveococcosis. Special treatment of echinococcosis and alveococcosis, which is associated with biology of causative agents. Comparative characteristic of tapeworms according to their danger.

Topic 30 Oviparous Nematodes

General characteristic of roundworms. Special features of life cycles of nematodes associated with molting of larvae. Aromorphoses in roundworms' evolution. Giant intestinal roundworm [maw worm] *Ascaris lumbricoides*, whipworm *Trichuris trichiura* [*Trichocephalus trichiurus*], old world hookworm [assassin worm, tunnel worm] *Ancylostoma duodenale*, new world hookworm *Necator americanus*, dwarf threadworm *Strongyloides stercoralis*, and pinworm [seatworm, threadworm] *Enterobius vermicularis*: medical geography, morphology and life cycle, mode of invasion, pathogenic influence. Migration of larvae. Special features of life cycle of dwarf threadworm. Laboratory diagnostics and prevention of ascariasis, trichuriasis [trichocephaliasis, trichocephalosis], ancylostomiasis, necatoriasis, strongyloidosis and enterobiasis. Treatment and prophylactic measures in the case of enterobiasis

Topic 31 Viviparous Nematodes. Methods of Diagnostics of Helminthoses. Segmented Worms: Medicinal Leech

Pork worm [trichina] *Trichinella spiralis*: medical geography, morphology and life cycle, mode of invasion, pathogenic influence. Natural and synanthropic foci of trichinosis. Laboratory diagnostics and prevention of trichinosis [trichinelliasis, trichinellosis, trichiniasis]. Rodents and methods of deratization. "Larva migrans disease": *Toxocara canis* and *Ancylostoma braziliense*. Dragon worm [guinea worm, Medina worm, serpent worm] *Dracunculus medinensis*, Bancroft's filaria *Wuchereria bancrofti*, *Brugia malayi*, blinding filaria *Onchocerca volvulus*, eye worm *Loa loa*, *Dirofilaria immitis* and *D. repens*: medical geography, morphology and life cycle, mode of invasion, pathogenic influence. Circadian rhythm of larvae of filariae. Laboratory diagnostics and prevention of dracunculiasis [dracunculosis, dracontiasis] and filariases (bancroftian filariasis [bancroftosis], brugian filariasis (Malayan and Timorian filariases), onchocerciasis [onchocercosis], loiasis [loaiasis], and dirofilariasis). Special features of diagnostics and treatment of dracunculosis. Transmissible helminthoses and helminthoses characterized by natural foci. Mollusks, arthropods and chordates as intermediate hosts of helminths. Importance of arthropods in the life of nematodes. The principles and procedures of microscopic diagnostic methods for investigation of excrements, water, soil, etc. Scatological analysis: method of native smear, Kato's technique, F

Topic 32 Arthropods. Arachnids. Ticks and Mites

General characteristic of Arthropods. Classification of the phylum Arthropoda and the class Arachnida. Special features of morphology, feeding, and reproduction of arachnids. Poisonous arachnids (scorpions, spiders). Karakurte *Latrodectus tredecimguttatus*, black widow spider *Latrodectus mactans*, wolf spider *Lycosa* sp. Medical importance of ticks and mites as vectors of causative agents of diseases. Ticks that are vectors of diseases: systematics, life cycles, hosts. Transovarial way of transmission of causative agents. Ixodid ticks (hard ticks, ticks of the Ixodidae family): taiga tick *Ixodes persulcatus*, castor-bean tick *I. ricinus*, brown dog tick *Rhipicephalus sanguineus*, Pacific Coast tick *Dermacentor occidentalis*, and *Hyalomma marginatum*. Argasid ticks (soft ticks, ticks of the Argasidae family): *Ornithodoros* spp. Mites of the Gamasoidea superfamily, Dermanyssidae family: tropical rat mite *Ornithonyssus bacoti* and house mouse mite *Allodermanyssus sanguineus*. Diseases that are transmitted by ticks and mites. Mites of the order Acariformes as causative agents of diseases. The Sarcoptidae family: itch mite [mange mite] *Sarcoptes scabiei* – morphology, life cycle, pathogenic influence, diagnosis and prevention of scabies [sarcoptic mange]; Norwegian scabies [Norwegian itch]. The Demodicidae family: follicle mite *Demodex folliculorum* – morphology, pathogenic influence, diagnosis and prevention of demodicosis [demodectic mange].

Topic 33 Insects: Lice, Cockroaches, Bugs, and Fleas

General characteristic of the class Insecta. Special features of morphology, feeding, and reproduction of in-sects. Types of mouthparts and types of legs of insects. Progressive and regressive changes in the organization of insects depending on habitat. Types of development of insects (with complete and incomplete metamorphosis); development of an insect in a pupal form. 10 Lice: morphology, life cycle, feeding. Head louse *Pediculus humanus capitis* [*Pediculus capitis*], clothes louse *Pediculus humanus humanus* [*Pediculus humanus corporis*, *Pediculus vestimenti*], and crab louse [pubic louse] *Phthirus pubis* [*Phthirus inguinalis*]. Medical importance of lice; modes of invasion of a man with transmitted diseases. Control of lice. Cockroaches, bugs (bed bugs and triatomine bugs), and fleas: morphology, development cycles, and modes of feeding. German cockroach *Blattella germanica*, oriental cockroach *Blatta orientalis*. Bed bug [bedbug] *Cimex lectularius* and big bedbug [giant bed bug] *Triatoma sanguisuga*. Human flea *Pulex irritans* and rat flea *Xenopsylla cheopis*. Medical importance of cockroaches, bugs and fleas, their role as infection vectors; modes of invasion of a man with diseases. Control of cockroaches, bugs, and fleas.

Topic 34 Dipterans. Medical Importance of Arthropods

General characteristic of the order Diptera. Differences between flies and mosquitoes. Blood-sucking insects: characteristic, importance as intermediate hosts of helminths and vectors of infectious diseases. Dermatozoonoses. Control of flies that are mechanical vectors of diseases. Medical importance of arthropods.

5. Intended learning outcomes of the course

After successful study of the course, the student will be able to:

LO1	Explain patterns of manifestations of human body's activity at molecular, biological and cellular levels
LO2	Predict genotypes and phenotypes of offspring by using information about parents' genotypes; calculate the probability that a child will have a certain trait if we know parental genotypes; calculate the likelihood of a trait in the offspring depending on the penetrance of the gene
LO3	Construct a pedigree and analyze it
LO4	Explain the nature and mechanisms of manifestation of human hereditary diseases in the phenotype
LO5	Diagnose pathogens and vectors of parasitic pathogens on macro- and micropreparations
LO6	Make a preliminary conclusion about the presence of parasitic invasions in a person and identify measures for the prevention of diseases
LO7	Knowledge and understanding of the subject area and professional activity comprehension
LO8	Ability to use information and communication technologies
LO9	Ability to learn, master modern knowledge, and apply the knowledge in practice

6. Role of the course in the achievement of programme learning outcomes

Programme learning outcomes achieved by the course.

For 222 Medicine:

PO16	To plan and implement a system of sanitary and preventive measures against the occurrence and spread of diseases among the population.
PO17	To search for the necessary information in the professional literature and databases; to analyze, evaluate, and apply this information. To apply modern digital technologies, specialized software, statistical methods of data analysis to solve complex health problems.
PO19	To assess environmental impact on public health.

7. Teaching and learning activities

7.1 Types of training

<p>Topic 1. Introduction to Medical Biology</p> <p>pr.tr.1 "Introduction to Medical Biology" (full-time course)</p> <p>Medical biology as a science of the basics of human activity, studying the laws of heredity, variability, individual and evolutionary development and morpho-physiological and social adaptation of the person to environmental conditions in association with its biosocial essence.</p>
<p>Topic 2. Biology as a Science. Light Microscopy</p> <p>lect.1 "Cytological Basis of Heredity. Classical Genetics" (full-time course)</p> <p>Methods of biological research. Microscopic method. Optical systems in biological research. Cell theory. Cell structure. Prokaryotes and eukaryotes, plant and animal cells, unicellular and multicellular organisms. Viruses. Cell cycle in eukaryotes: interphase and M phase. The biological significance of mitosis. Mitotic activity of tissues. Control of the cell cycle. Growth factors. Cell specialization and differentiation. Special types of cell division: amitosis and schizogony. Structure of the nucleus in interphase. Chromatin structure. Chromatin types: euchromatin, heterochromatin, and sex chromatin. Types of chromosomes: mitotic (metaphase), polytene, and lampbrush chromosomes. Structure of the mitotic chromosome. Endomitosis, polyteny. Karyotype. Characteristics and classification of human chromosomes. Karyogram, idiogram. Normal and abnormal chromosomes. Genetics, its subject, objectives, and a brief history. Main terms used in genetics. Classical objects in genetics. Principles of genetic analysis. Mendel's experiments with one trait. Law of dominance and law of segregation. Rules used for writing of schemes of crosses; steps used for solving genetic problems. Dihybrid cross: law of independent assortment. Polyhybrid cross. Allelic genes. Interaction of allelic genes: complete dominance, incomplete dominance, codominance, overdominance. Teaching is carried out in the form of multimedia lectures.</p> <p>pr.tr.2 "Biology as a Science. Light Microscopy" (full-time course)</p> <p>Acquaintance with methods of biological researches. The special place of man in the system of the organic world. Get acquainted with the rules of working with a microscope (lighting installation, the transition to high magnification). Get acquainted with the laboratory equipment (slides and coverslips, Petri dishes, dissecting needles) and the rules of preparation of micropreparations. work with preparation of preparation of fibers of cotton wool.</p>
<p>Topic 3. Cell Structure</p>

<p>pr.tr.3 "Cell Structure" (full-time course)</p> <p>Classroom work with microscopes: to prepare and consider a preparation of human hair at low and high magnification; consider a permanent human blood product; consider a permanent preparation of animal tissue - frog blood.</p>
<p>Topic 4. Cell Division. Gametogenesis</p>
<p>pr.tr.4 "Cell Division. Gametogenesis" (full-time course)</p> <p>Examine a specimen and a photo of mitotic cell fission of a rootlet of an onion. Examine a specimen of spermatozoids of a guinea pig. Examine a specimen of spermatozoids of a cock. View a specimen of a section of rat testis.</p>
<p>Topic 5. Chromatin, Chromosomes, and Karyotype</p>
<p>pr.tr.5 "Chromatin, Chromosomes, and Karyotype" (full-time course)</p> <p>Examine a specimen of polytene chromosomes of mosquitoes (chironomid midge). View microphotos of metaphase chromosomes with differential staining (G-banding) and chromosomes stained by fluorescent dyes. Examine schematically human chromosomes, which are classified according to Denver's system.</p>
<p>Topic 6. Mendel's First and Second Laws. Monohybrid Cross</p>
<p>pr.tr.6 "Mendel's First and Second Laws. Monohybrid Cross" (full-time course)</p> <p>Rules used for writing of schemes of crosses; steps used for solving genetics problems. Learn the rules of writing and the procedure for solving crossbreeding problems. Solving problems according to Medell's laws.</p>
<p>Topic 7. Mendel's Third Law. Types of Crosses. Lethal Genes</p>
<p>pr.tr.7 "Mendel's Third Law. Types of Crosses. Lethal Genes" (full-time course)</p> <p>Learn the rules of writing and the procedure for solving crossbreeding problems. Solving problems according to Medell's laws.</p>
<p>Topic 8. Interaction of Allelic Genes. Multiple Allelism. Blood Groups</p>
<p>pr.tr.8 "Interaction of Allelic Genes. Multiple Allelism. Blood Groups" (full-time course)</p> <p>Types of interaction of allelic genes. Solving problems in genetics for complete dominance, incomplete dominance, codominance, superdominance (superdominance). Study of human blood groups. Inheritance of human blood groups by antigenic systems AB0, MN and rhesus factor. Rhesus conflict. Solving problems on the topic of interaction of allelic genes.</p>
<p>Topic 9. Interaction of Nonallelic Genes</p>
<p>pr.tr.9 "Interaction of Nonallelic Genes" (full-time course)</p> <p>Non-allelic genes. Solving problems in the classroom on complementarity, epistasis, polymerism. Qualitative and quantitative features. Polygenic signs; polymer genes.</p>
<p>Topic 10. Gene Linkage. Chromosome Mapping</p>

pr.tr.10 "Gene Linkage. Chromosome Mapping" (full-time course)

Morgan's experiments with linked genes as evidence of chromosomal theory of heredity. Morgan's law. Coupling groups. Crossingover, its mechanism, cytological evidence, biological significance. Genetic chromosome maps (coupling maps), purpose and methods of their compilation. Compilation of cytological maps of eukaryotic chromosomes, units of distance between genes. Problem solving.

Topic 11. Genetics of Sex. Sex Linkage. Cytoplasmic Inheritance

pr.tr.11 "Genetics of Sex. Sex Linkage. Cytoplasmic Inheritance" (full-time course)

Dominant and recessive X-linked inheritance, Dutch inheritance. Hemizygous genes. Gender-related human diseases: hemophilia, color blindness, muscular dystrophy, phosphate-diabetes (rickets independent of vitamin D). Cytoplasmic inheritance. Problem solving.

Topic 12. Genotype and Phenotype

pr.tr.12 "Genotype and Phenotype" (full-time course)

Solving problems in the classroom on penetrance, expressiveness, pleiotropy. Gender and heredity. Variability, its forms and manifestations at the organismal level. Genocopies and phenocopies.

Topic 13. The Structure of Nucleic Acids. DNA Repair

lect.2 "The Structure of Nucleic Acids. DNA Repair. DNA Replication" (full-time course)

DNA as the genetic material. Central dogma of molecular biology. Nucleotide structure. Purines and pyrimidines. Ribose and deoxyribose. Ribonucleotides and deoxyribonucleotides. Energy-rich bond. Primary, secondary, and tertiary structure of DNA. RNA molecules. Phosphodiester and hydrogen bonds. Chargaff's rules. Changes in DNA structure. DNA repair systems. Xeroderma pigmentosum. DNA replication: mechanism, enzymes. Replication in prokaryotes and eukaryotes. Okazaki fragments. Proofreading mechanisms. Transcription of a prokaryotic gene: mechanism. Structure of a prokaryotic gene: the promoter, the structural part, and the terminator.

pr.tr.13 "The Structure of Nucleic Acids. DNA Repair" (full-time course)

Changes in DNA structure. DNA repair systems. Xeroderma pigmentosum. Solve problems.

Topic 14. DNA Replication. Transcription

lect.3 "Transcription. Translation. Regulation of Gene Expression" (full-time course)

Transcription of a prokaryotic gene: mechanism. Structure of a prokaryotic gene: the promoter, the structural part, and the terminator. Structure and transcription of eukaryotic genes. Exons and introns. RNA processing: capping, splicing, polyadenylation, cutting, and base modifications. Influence of antibiotics on transcription. Reverse transcription. Primary, secondary, tertiary, and quaternary structure of a protein. Peptide and disulfide bonds. The genetic code and its properties. Translation, its stages (activation of amino acids, initiation, elongation, and termination). Colinearity. Influence of antibiotics on translation. 6 Regulation of gene activity on the chromatin level. Transcriptional level of gene regulation. An operon in prokaryotes; the lac and trp operons. Translational level of gene regulation. Posttranslational modifications of proteins. Methods of investigation of genes and genomes. DNA sequencing. The structure of prokaryotic and eukaryotic genes. Structural and regulatory genes, genes for tRNAs and rRNAs. Genomes of viruses, bacteria, and eukaryotes. Transposable genetic elements. Human genome. Gene engineering. Biotechnology. Gene therapy.

pr.tr.14 "DNA Replication. Transcription" (full-time course)

Structure and transcription of eukaryotic genes. Exons and introns. RNA processing: capping, splicing, polyadenylation, cutting, and base modifications. Influence of antibiotics on transcription. Solve problems.

Topic 15. Translation. Gene Regulation

pr.tr.15 "Translation. Gene Regulation" (full-time course)

Regulation of gene activity on the chromatin level. Transcriptional level of gene regulation. An operon in prokaryotes; the lac and trp operons. Translational level of gene regulation. Posttranslational modifications of proteins. Solve problems.

Topic 16. Genes and Genomes. Horizontal Gene Transfer

lect.4 "Genes and Genomes. Mutations. Population Genetics" (full-time course)

Methods of investigation of genes and genomes. DNA sequencing. The structure of prokaryotic and eukaryotic genes. Structural and regulatory genes, genes for tRNAs and rRNAs. Genomes of viruses, bacteria, and eukaryotes. Transposable genetic elements. Human genome. Gene engineering. Biotechnology. Gene therapy. Horizontal gene transfer: bacterial conjugation, bacterial transformation, and transduction; their importance for science and practice. Conjugation in infusorians. Sex factor in bacteria. Construction of genetic maps of prokaryotes. Classification of mutations. Gene and chromosome mutations. Variation caused by mutations. Molecular mechanisms of mutations. Induced mutagenesis. Physical, chemical, and biological mutagens. Genetic monitoring. Population genetics: subject and purposes. A species, a population, human population. Characteristics of population. Isolation, its role in speciation. Idealized population. Hardy-Weinberg law. Influence of mutations, selection and migration on the genetic structure of a population. Genetic drift. Founder effect. Types of mating in populations in the nature, their influence on a population. Inbreeding: causes and consequences. Usage of the Hardy-Weinberg equilibrium in medicine for analysing of the genetic structure of human populations

pr.tr.16 "Genes and Genomes. Horizontal Gene Transfer" (full-time course)

Methods of investigation of genes and genomes. DNA sequencing. Solve problems.

Topic 17. Mutations
pr.tr.17 "Mutations" (full-time course) Classification of mutations. Gene and chromosome mutations. Variation caused by mutations. Molecular mechanisms of mutations. Solve problems.
Topic 18. Reproduction. Ontogenesis. Regeneration. Transplantation
pr.tr.18 "Reproduction. Ontogenesis. Regeneration. Transplantation" (full-time course) Types of regeneration (physiological, reparative, epimorphic, morphallactic). Transplantation of tissues and organs. Types of transplantation. Graft rejection. Solve problems. Consideration of questions; discussion.
Topic 19. Human Genetics. Twin Studies, Dermatoglyphics, Pedigree Analysis
pr.tr.19 "Human Genetics. Twin Studies, Dermatoglyphics, Pedigree Analysis" (full-time course) Methods of genetic investigations. Humans as a specific subject for genetic study: disadvantages and advantages. Twin studies. Concordance and discordance, coefficient of heredity. Dermatoglyphics. Dermal ridge patterns. Pedigree analysis: purposes, rules for pedigree construction, symbols, methods of pedigree analysis. Modes of inheritance of traits, criteria of inheritance of rare nuclear genes. Solve problems
Topic 20. Single-Gene Disorders
pr.tr.20 "Single-Gene Disorders" (full-time course) Classification of hereditary diseases: single-gene disorders, chromosome disorders, multifactorial disorders, and mitochondrial disorders. Human molecular diseases (single-gene disorders). Classification of molecular diseases: disorders caused by defects in carbohydrate metabolism, in amino acid metabolism, in protein metabolism, in copper metabolism; enzymopathies; hemoglobinopathies; storage diseases. Solve problems.
Topic 21. Chromosome Disorders. Genetic Counseling
pr.tr.21 "Chromosome Disorders. Genetic Counseling" (full-time course) Chromosome disorders (Down syndrome, Patau syndrome, Edwards syndrome, Klinefelter syndrome, Turner syndrome [Shereshevsky-Turner syndrome], trisomy X, cat's cry syndrome [cri du chat syndrome]), their main symptoms, laboratory diagnostics. Translocation Down syndrome. Solve problems. Consideration of questions; discussion.
Topic 22. Population Genetics
pr.tr.22 "Population Genetics" (full-time course) Usage of the Hardy-Weinberg equilibrium in medicine for analysing of the genetic structure of human populations. Solve problems.
Topic 23. Ecology and Biosphere. Poisonous organisms

pr.tr.23 "Ecology and Biosphere. Poisonous organisms" (full-time course)

Human ecology. Influence of anthropogenic factors on health. Stress. Adaptation of human to difficult environmental conditions. Biosphere, its structure and evolution. Anthropogenic migration of elements in environment. Ozone layer. Poisonous fungi, plants, and animals. Consideration of questions; discussion.

Topic 24. Introduction to Parasitology. Protozoans. Sarcodina

lect.5 "General Issues of Parasitology. Protozoans. Flatworms" (full-time course)

Principles of classification of living beings. Binary nomenclature. Introduction to medical parasitology. Origin and evolution of parasitism. Ways of penetration of parasites into a host. Classification of parasites. Classification of hosts. Classification of vectors. Interaction between parasites and hosts. Characteristics and classification of protozoans (Protozoa). Characteristics of flagellates. The structure of a flagellum. Endemic diseases and diseases with natural focus. Transmissible diseases. Characteristic, structure and reproduction of Sporozoa. Methods of laboratory diagnostics of diseases caused by parasitic protozoa. Material that is used for diagnostics of protozoan diseases. Classification of Plathelminthes. General characteristic of the phylum Plathelminthes and class Flukes. Role of covering (tegument). Systems of organs. Developmental stages, morphology of larvae. Parthenogony. Changing of hosts. Adaptation of parasites to hosts. Comparative characteristic of flukes. General characteristic of tapeworms. Types of larvae: solid larvae and fluid-filled cysts. The changes in morphology associated with transition to parasitism. Broad tapeworm [fish tapeworm, late tapeworm, Swiss tapeworm] *Diphyllobothrium latum*: medical geography, morphology and life cycle, mode of invasion, pathogenic influence. Laboratory diagnostics and prevention of diphyllobothriasis.

pr.tr.24 "Introduction to Parasitology. Protozoans. Sarcodina" (full-time course)

Fill in the table - Protozoans – parasites of man. View *Amoeba* sp. under a microscope and draw. Designate nucleus, cytoplasm, and pseudopodium. Draw life cycle of *Entamoeba histolytica*.

Topic 25. Flagellates

pr.tr.25 "Flagellates" (full-time course)

Fill in the table Protozoans – parasites of man. Draw trophozoite and cyst of *Giardia lamblia*. Designate nuclei, flagella, parabasal body, and adhesive disk. Draw trophozoites of *Trichomonas hominis* and *T. vaginalis*. Designate nucleus, flagella, axostyle, undulating membrane, and peristome. Draw the scheme of life cycle of *Leishmania major*. View blood smear of a horse with dourine and draw two red blood cells and *Trypanosoma equiperdum* (causative agent of dourine). Designate trypanosome, nucleus, flagellum, undulating membrane, and erythrocyte.

Topic 26. Sporozoans. Infusorians. Methods of Diagnostics of Protozoan Diseases

pr.tr.26 "Sporozoans. Infusorians. Methods of Diagnostics of Protozoan Diseases" (full-time course)

Fill in the table Protozoans – parasites of man. View blood smear of a mouse infected by Plasmodium berghei. Find infected erythrocytes and draw normal red blood cell and infected erythrocytes (with different stages of trophozoites). Draw the scheme of life cycle of Plasmodium. Designate all stages. View the specimen of rabbit's liver and draw trophozoites of Eimeria stiedae. Pay attention to the size and shape of Eimeria cells. View the specimen of an infusorian Paramecium sp. and draw two trophozoites. Designate macronucleus. Pay attention that micronucleus is not visible in many cells.

Topic 27. Flatworms. Flukes: Fasciola hepatica, Opisthorchis felinus, Clonorchis sinensis, Dicrocoelium dendriticum, and Metagonimus yokogawai

pr.tr.27 "Flatworms. Flukes: Fasciola hepatica, Opisthorchis felinus, Clonorchis sinensis, Dicrocoelium dendriticum, and Metagonimus yokogawai" (full-time course)

Fill in the table Flatworms – parasites of man, write Latin names of parasites. Examine microscopic specimens of liver fluke, digestive and excretory systems of liver fluke (injected by ink). Find an acetabulum, a throat, branches of intestine in the alimentary system; central canal and tubules of secretory system. View native preparations of a liver infected by liver fluke, Siberian liver fluke, and lancet flukes (in formalin or ethanol). View and draw eggs of liver fluke, Siberian liver fluke, and lancet fluke. Pay attention to a ratio of their sizes, their shape, color, and envelope thickness. Find and designate a lid [operculum]. Draw the scheme of life cycle of liver fluke, indicate all stages; pay attention to morphology of larvae. 6) Examine a preparation of lancet fluke (objective lens 8

Topic 28. Flukes: Paragonimus ringeri, Schistosoma spp., and Nanophyetus salmincola. Tapeworms: Diphyllbothrium latum

pr.tr.28 "Flukes: Paragonimus ringeri, Schistosoma spp., and Nanophyetus salmincola. Tapeworms: Diphyllbothrium latum" (full-time course)

Fill in the table Flatworms – parasites of man, write Latin names of parasites. Draw eggs of lung fluke, Schistosoma haematobium, and S. mansoni (indicate terminal or lateral spine). Draw life cycle of lung fluke. View native preparations of fish tapeworm and cyclops. View and draw scolex, mature proglottid and egg of Diphyllbothrium latum. Draw life cycle of fish tapeworm. At the end of the lesson, fill in the table 7 that describes eggs of the studied worms.

Topic 29. Cyclophyllidean Tapeworms

pr.tr.29 "Cyclophyllidean Tapeworms" (full-time course)

Fill in the table Flatworms – parasites of man, write Latin names of parasites. View native preparations of Taenia proglottids and adult worms of Taenia and Hymenolepis nana. Draw scoleces and gravid proglottids of Taenia solium and Taenia saginata. Pay attention to the differences in morphology of the uteri (number of branches) and scoleces (the presence of rostellum with hooks). View and draw the egg (oncosphere) of Taenia spp. Draw life cycles of Taenia saginata and Taenia solium. View preparations of liver, lung and heart of the pig that is infected by Echinococcus granulosus. Draw life cycle of Echinococcus granulosus. At the end of the lesson, fill in the table 7 that describes eggs of the studied worms.

Topic 30. Oviparous Nematodes

lect.6 "Roundworms. Segmented Worms. Diagnosis of helminthiases. Arthropods" (full-time course)

General characteristic of roundworms. Special features of life cycles of nematodes associated with molting of larvae. Aromorphoses in roundworms' evolution. Rodents and methods of deratization. "Larva migrans disease": *Toxocara canis* and *Ancylostoma braziliense*. Transmissible helminthoses and helminthoses characterized by natural foci. Mollusks, arthropods and chordates as intermediate hosts of helminths. Importance of arthropods in the life of nematodes. The principles and procedures of microscopic diagnostical methods for investigation of excrements, water, soil, etc. Scatological analysis: method of native smear, Kato's technique.

pr.tr.30 "Oviparous Nematodes" (full-time course)

Fill in the table Roundworms – parasites of man, write Latin names of parasites. View native preparations of adult *A. lumbricoides*, *A. suum* and *Ascaridia galli* (causative agent of ascaridiosis in hens). View and draw the egg of *A. lumbricoides*. Draw cross section of *A. lumbricoides* female. Indicate cuticle, hypodermis, muscles, body cavity, intestine (the largest tube), excretory canals, uteri (with thick walls and eggs), oviducts, and ovaries (the smallest tubes without eggs). Draw the egg of *T. trichiura*. View female and draw the egg of *E. vermicularis*. At the end of the lesson, fill in the table 7 that describes eggs of the studied worms.

Topic 31. Viviparous Nematodes. Methods of Diagnostics of Helminthoses. Segmented Worms: Medicinal Leech

pr.tr.31 "Viviparous Nematodes. Methods of Diagnostics of Helminthoses. Segmented Worms: Medicinal Leech" (full-time course)

Fill in the table Roundworms – parasites of man, write Latin names of parasites. Draw encapsulated larva of *Trichinella spiralis* in muscles. Pay attention to the shape of the capsule and position of larva. Indicate larva, capsule, and muscles. Draw the scheme of the distribution of *T. spiralis* in the nature. Indicate the natural focus and the human-associated focus of the disease. Indicate ways of invasion of a man. View preparations of leeches. View native preparation of house mouse *Mus musculus*. Discuss problems of deratization (rodent control). Deratization is extermination of rats. It is a complex of measures, directed on elimination of synanthropic rodents. Synanthropic ecologically associated with humans, for example, synanthropic flies.

Topic 32. Arthropods. Arachnids. Ticks and Mites

pr.tr.32 "Arthropods. Arachnids. Ticks and Mites" (full-time course)

Fill in the table Medical importance of arthropods, write Latin names of parasites. Draw life cycle of *Ixodes* sp. Pay attention to the difference between larva, nymph, and imago. Draw the structure of mouth organs of *Ixodes* sp. Indicate hypostome, epistome, chelicerae, and pedipalps. View microscopic specimens of the larva of chicken mite *Dermanyssus gallinae* and native preparations of imagoes of hard ticks. Compare sizes of hungry female and female after blood sucking. Draw itch mite *Sarcoptes scabiei*.

Topic 33. Insects: Lice, Cockroaches, Bugs, and Fleas

pr.tr.33 "Insects: Lice, Cockroaches, Bugs, and Fleas" (full-time course)

Fill in the table Medical importance of arthropods, write Latin names of parasites. View microscopic specimens of head louse and its nits (eggs) attached to hair, specimen of crab louse. Draw hair with a nit. Pay attention to the shape of a nit and layer of glue that attaches a nit to hair. View stages of the development of cockroaches (ootheca with eggs, larva, nymph, and imago). Draw life cycle of a flea (imago and larva in detail). View microscopic specimens of rat flea, cat flea *Ctenocephalides felis*, and dog flea *C. canis*.

Topic 34. Dipterans. Medical Importance of Arthropods

pr.tr.34 "Dipterans. Medical Importance of Arthropods" (full-time course)

Fill in the table Medical importance of arthropods, write Latin names of parasites. View native preparations and microscopic specimens of larvae, pupae and imagoes of mosquitoes. Draw larvae and female heads of mosquitos. Designate head appendages. View native preparations of pupae of black flies, larvae of botflies, and imagoes of different flies. View and draw leg of a fly.

7.2 Learning activities

LA1	Annotation
LA2	E-learning in systems (Zoom, MIX-platform, Viber, Facebook, YouTube channel)
LA3	Execution of practical tasks
LA4	Self-study
LA5	Preparation for practical classes
LA6	Preparation for current and final control
LA7	Preparation of multimedia presentations
LA8	Completion of mandatory homework in the workbook
LA9	Work with textbooks and relevant information sources
LA10	Individual research project (student research paper, article, thesis)

8. Teaching methods

Course involves learning through:

TM1	Interactive lectures
TM2	Method of illustrations
TM3	Demonstration method
TM4	Team-based learning (TBL)
TM5	Research-based learning (RBL)
TM6	Educational discussion / debate

The course provides training in: TM 1. Lectures. TM 2. Practical classes, talks, discussions, solving situational tasks, testing. TM 3. Homework (solving genetic problems). TM 4. Demonstration of preparations of parasites and vectors of diseases, sketching of preparations, schemes of life cycles of parasites, filling tables. Lectures provide students with material that complements the textbook.

Independent learning will be facilitated by preparation for lectures, practical classes, homework.

The study of the discipline develops: ability to abstract thinking, analysis and synthesis; ability to learn, master modern knowledge and apply them in practical situations; ability to adapt and act in a new situation; ability to make informed decisions; work in a team; interpersonal skills; ability to use information and communication technologies; determination and persistence in terms of tasks and responsibilities; ability to preserve and multiply moral, cultural, scientific values

9. Methods and criteria for assessment

9.1. Assessment criteria

ECTS	Definition	National scale	Rating scale
	Outstanding performance without errors	5 (Excellent)	$170 \leq RD \leq 200$
	Above the average standard but with minor errors	4 (Good)	$140 \leq RD < 169$
	Fair but with significant shortcomings	3 (Satisfactory)	$120 \leq RD < 139$
	Fail – some more work required before the credit can be awarded	2 (Fail)	$0 \leq RD < 119$

9.2 Formative assessment

FA1	Individual oral interview, interview, oral comments of the teacher
FA2	Checking and evaluating the written solution of problems in genetics (homework)
FA3	Testing
FA4	Defense of an individual research project (speech at a conference, competition of scientific works)
FA5	Control of practical actions (skills)

9.3 Summative assessment

SA1	Evaluation of practical work, surveys, solving problems in genetics
SA2	Testing
SA3	Final control: exam (according to the regulations)
SA4	Defense of an individual research project (incentive activities, additional points)

Form of assessment:

1 semester	200 scores
SA1. Evaluation of practical work, surveys, solving problems in genetics	120
	120
SA2. Testing	80
	80
2 semester	212 scores

SA1. Evaluation of practical work, surveys, solving problems in genetics	120
	120
SA3. Final control: exam (according to the regulations)	80
	80
SA4. Defense of an individual research project (incentive activities, additional points)	12
	12

Form of assessment (special cases):

1 semester	200 scores
SA1. Evaluation of practical work, surveys, solving problems in genetics	120
In case of quarantine restrictions, evaluation of written works, surveys, problem solving are carried out remotely using the platform Mix.sumdu.edu.ua, Zoom, Google meet.	120
SA2. Testing	80
In case of quarantine restrictions, testing is performed remotely using the Mix.sumdu.edu.ua platform.	80
2 semester	212 scores
SA1. Evaluation of practical work, surveys, solving problems in genetics	120
In case of quarantine restrictions, evaluation of written works, surveys, problem solving are carried out remotely using the platform Mix.sumdu.edu.ua, Zoom, Google meet.	120
SA3. Final control: exam (according to the regulations)	80
In case of quarantine restrictions, testing is performed remotely using the Mix.sumdu.edu.ua platform.	80
SA4. Defense of an individual research project (incentive activities, additional points)	12
In case of quarantine restrictions, evaluation of written works, surveys, problem solving are carried out remotely using the platform Mix.sumdu.edu.ua, Zoom, Google meet.	12

TDistribution of points awarded to students per year: 1 Points for computer testing 50 2 Points for oral answers 60 3 Execution of drawings and filling in tables (work in class) 10 4 Total current estimates 120 5 Exam (final module control) 80 TOTAL sum of points 200

10. Learning resources

10.1 Material and technical support

MTS1	Information and communication systems
MTS2	Library funds

MTS3	Computers, computer systems and networks
MTS4	Microscopes, a set of micropreparations, wet preparations of parasites with formalin
MTS5	Multimedia, video and sound reproduction, projection equipment (projectors, screens)
MTS6	Software (to support distance learning)

10.2 Information and methodical support

Essential Reading	
1	Bazhora Yu. I. et al. Medical Biology. – Vinnytsia: Nova Knyha, 2019; 2018.
2	USMLE Step 1: Biochemistry and Medical Genetics: Lecture Notes / Eds. S. Turco, R. Lane, R.M. Harden. – New York: Kaplan, 2019.
3	Smirnov O. Yu. Test Items for Licensing Examination: "Krok-1 General Medical Training: Medical Biology" (For Medical Students). – Sumy: Sumy State University, 2016.
Supplemental Reading	
1	Smirnov O. Medical Biology: A Short Course. Vol. 1. 2 nd Ed. – Sumy: Korpunkt Publishers, 2011.
2	Smirnov O. Yu. Medical Biology: A Short Course. Vol. 2. – Sumy: SSU 18 Publishers, 2011.
3	Schools for health in Ukraine: Features and prospects / [A. Biesiedina, T. Berezhna, O. Yezhova] Ecology and human health. – Czestochowa: NUIFE, 2018. –S.191-201.
Web-based and electronic resources	
1	https://www.youtube.com/playlist?list=PLNywtSsAZfWSVUkpfr_F-_0Kk_hsx9YB
2	https://www.youtube.com/playlist?list=PLNywtSsAZfXsUBrdLd_EXoSDOEwef23R