MINISTRY OF EDUCATION AND SCIENCE OF UKRAINE
STATE UNIVERSITY
«UZHHOROD NATIONAL UNIVERSITY»
MEDICAL FACULTY 2
DEPARTMENT OF FUNDAMENTAL MEDICAL DISCIPLINES

"APPROVED"
Dean of the Medical Faculty 2
Prof. Kaliy V.V.
"29" June 2021

THE WORKING PROGRAM OF THE EDUCATIONAL DISCIPLINE MEDICAL BIOLOGY

Educational degree	**Master**
Studying direction	**22 "Health Care"**
Specialty	**222 "Medicine"**
Educational program	**General medicine**
Discipline status	**Required**
The language of instruction	**English**

Uzhhorod 2021

The Medical Biology working program for international students with English language of studying, the studing direction 22 "Health Care", specialty 222 "Medicine"

Authors: Sharga B.M., Associative Professor of the Department of Fundamental Medical Disciplines

The work program is approved at the meeting of the Department of Fundamental Medical Disciplines

Protocol № 7 from " 18 " june 2021

Head of the Department of

Fundamental Medical Disciplines _____ prof. Feketa V.P.

Approved by the Scientific and Methodical Commission of the Medical faculty

Protocol № 6 from " 29 " June 2021

Head of the Scientific and Methodical Commission _____ Malets N.B.

1. DESCRIPTION OF THE SUBJECT

<table>
<tr><td rowspan="2">Name of indicators</td><td rowspan="2">Branch of knowledge, studing direction, education degree</td><td colspan="2">Characteristics of the subject</td></tr>
<tr><td colspan="2">Full-time education</td></tr>
<tr><td rowspan="2">Credits – 5</td><td>Branch of knowledge
"Medical Biology"
(OK 8).</td><td colspan="2" rowspan="2">Regulatory (optional)</td></tr>
<tr><td>Studing direction
22 "Health Care"</td></tr>
<tr><td>Modules – 2</td><td rowspan="4">Speciality
222 "Medicine"</td><td colspan="2">Year of studing:</td></tr>
<tr><td>Submodules – 2</td><td colspan="2">1st</td></tr>
<tr><td>Individual research task _____</td><td colspan="2">Semester</td></tr>
<tr><td>The total number of hours – 1292</td><td>1st</td><td>2nd</td></tr>
<tr><td rowspan="11">Weekly hours in laboratory – 4</td><td rowspan="11">Education degree:
Master</td><td colspan="2">Lectures</td></tr>
<tr><td>10 hours</td><td>10 hours</td></tr>
<tr><td colspan="2">Practicals</td></tr>
<tr><td>510 hours</td><td>680 hours</td></tr>
<tr><td colspan="2">Laboratory classes</td></tr>
<tr><td>64 hours</td><td>86 hours</td></tr>
<tr><td colspan="2">Individual work</td></tr>
<tr><td>111 hours</td><td>145 hours</td></tr>
<tr><td colspan="2">Individual tasks: hours</td></tr>
<tr><td colspan="2">Types of evaluation: via MCQs quizzes, assays, presentations.</td></tr>
</table>

2. THE AIM OF THE EDUCATIONAL DISCIPLINE

Medical biology as an academic discipline: a) based on previously studied in secondary or high school subjects, such as General Biology, Human Biology b) ensures a high level of general biological training; c) provides students with a fundamentals for further assimilation of knowledge of relevant theoretical and practical clinical professional disciplines (medical chemistry, clinical immunology, embryology, epidemiology, internal medicine, surgery, etc.).

According to the Bologna Declaration, the organization of education is carried out by a credit-modular system. The program of "Medical Biology" is structured into 2 modules containing 6 thematic submodules.

The main goal for students is to gain useful knowledge from study of Medical biology, which they could apply in their professional work or use this knowledge as a theoretical basis in future biomedical studies.

According to the program, the students' study process includes: a) lectures b) laboratory works c) workshops, seminars d) individual work of students e) submodule and module controls f) consultations g) exam. Tests questions, case problems solving, identification of the macro- and micro- preparations and specimens of pathogens and vectors of parasitic diseases and other approaches will be applied during training of students. Controls of students' studies are prepared during and at the end of each of modules as multiple choice questions testing and final examination at the end of spring semester. Topics of lectures, laboratory works, workshops, etc. reveal issues relevant to different sections of Medical biology.

By learning Medical Biology, our students receive the knowledge, contributing to the theoretical multidisciplinary basis of their future profession. They learn theoretical topics and an array of biomedical methods, particularly, in cytology, genetics and parasitology, the human early development and hereditary syndromes genetics and diagnostics, parasites biology, the identification of human parasites and their vectors, remedies and eradication methods in general.

After completing the course students **must know**:

- the basic principles of Medical Biology
- the basics of life on the level of cell, tissue, organ, organisms and populations;
- the principles of modern biomedical techniques and methods of diagnostics.

At the end of the Medical biology studies students **must be able**:

- to determine the biological nature and mechanisms of diseases that result from changes in the environment and distinct them from genetical diseases.
- to identify a manifestation of general biological laws during human ontogenesis.
- to explain the lows of functioning of the human body at molecular and cellular levels.
- to explain the nature and mechanisms of manifestation in the phenotype of inherited human diseases.
- to make conclusions about the presence of parasitic infestations and define the cures and prevention of the diseases
- to carry out simple laboratory experiments and microscopy of cells and tissues;
- to carry out the methods for parasites identification;
- to solve genetic problems and predict the offsprings;
- to build and analyse the human pedigree and estimate the probability of diseased children;
- to analyse the caryotypes and estimate the numerical and structural aberrations causing disease and death.

3. THE COMPETENCES ACCORDING TO PROGRAM

Integral competences. Ability to solve typical and complex biomedical problems during learning and practical problems in a professional health care activity, particularly the genetic consulting, diagnostics or in a learning process that involves research and/or innovation and is characterized by the complexity and uncertainty of conditions and requirements. According to the program, the study of discipline promotes the formation of the following **general competences (GC)** in students:

GC 1. Ability to abstract thinking, analysis and synthesis.
GC 2. Ability to learn and master modern knowledge.
GC 3. Ability to apply knowledge in practical situations.
GC 4. Knowledge and understanding of the subject area and understanding of professional activity.
GC 5. Ability to adapt and act in a new situation.
GC 6. Ability to make informed decisions
GC 7. Ability to work in a team.
GC 8. Interpersonal skills.
GC 9. Ability to communicate in the state language both orally and in writing.
GC 10. Ability to communicate in a foreign language.
GC 11. Skills in the use of information and communication technologies.
GC 12. Definiteness and persistence in terms of tasks and responsibilities.
GC 13. Ability to act socially responsible and consciously.
GC 14. Ability to work carefully with the aim to preserve the natural environment.
GC 15. Ability to act on the basis of ethical considerations (motives).

Specialized competences

Ability to conduct epidemiological and statistical studies of population health
Ability to carry out sanitary and hygienic and preventive measures
Ability to plan preventive measures for parasitic diseases
Ability to carry out preventive measures against parasitic diseases in populations
Ability to work in genetic consulting and in genetic or parasitic disease diagnostics
Ability to carry cytological or other simple analyses for hereditary or parasitic diseases and interpret their results

4. PREREQUISITES FOR STUDY DISCIPLINE

Prerequisites for studying the discipline "Medical Biology" are basic knowledge in Biology from secondary school.

5. EXPECTED LEARNING RESULTS

In accordance to the program "Medical Biology", the study of the discipline should ensure the achievement by applicants for higher education the following planned results of study (PRS):

Planned results of study	Code of PRS
Evaluate information based on the results of laboratory studies.	PRS 2
Highlight the leading clinical symptom or syndrome. Establish a preliminary and clinical diagnosis. Conclude disease inheritance based on pedigree analysis	PRS 3

Expected learning outcomes (ELO) that must be achieved by the recipients of education after completing the course "Medical Biology":

ELO	Expected learning outcomes of the discipline	Code of PRS
ELO 1	Ability to estimate on the basis of laboratory data of genetic disorders from the blood system (sickle cell anemia, Tay-Sachs disease, etc.)	PRS 2
ELO 2	Ability to estimate on the basis of laboratory data the parasitic diseases in the blood system (malaria, leishmaniasis, trypanosomyasis, etc.)	PRS 2
ELO 3	Ability to estimate on the basis of laboratory data the parasitic diseases in the urinary system (trichomoniasis, schistosomiasis etc.)	PRS 2
ELO 4	Ability to estimate on the basis of laboratory data the protest and worm parasitic diseases in the gastro-intestinal system (*Balantidium*, *Giardia*, *Entamoeba,* etc.).	PRS 2
ELO 5	Ability to identify the pathology of the gastrointestinal tract, liver and kidney and other organs caused by worm parasites *Fascila, Taenia, Heminolepis,* etc.).	PRS 3
ELO 6	Ability to identify the main evidences of typical pathological processes (inflammation, hypoxia, calcification, resting structures development, stages of parasites, development tumors as results of parasitism).	PRS 3
ELO 7	Ability to identify the main evidences of genetic disorders, as well as quantitative and qualitative changes in chromosomes of the cells.	PRS 3
ELO 8	Ability to interpret the causes of hereditary and parasitary mechanisms of symptoms (e.g., sickle cell disease, lysosomal diseases, mitochondrial diseases, hypercholesterolemia, parasitary cancers, calcification, intracellular parasitism effects, etc.).	PRS 3

6. DIAGNOSTICS AND ASSESSMENT CRITERIA OF LEARNING RESULTS

Assessment tools and methods for demonstrating learning outcomes

Means of assessment and methods of demonstrating the results of training in the discipline are:

ELO 1. - test tasks, theoretical questions, situational task (medical history, general blood test, pedigree analysis for human diseases).

ELO 2. - test tasks, theoretical questions, diagnosis and characterization of major genetic diseases on the level of human cell, tissues organs and organism.

ELO 3. - test tasks, theoretical questions, situational problem (medical history, general urine analysis for parasites and their eggs, biochemical analysis).

ELO 4. - test tasks, theoretical questions, diagnostics and characterization of major parasites of human gastro-intestinal tract.

ELO 5. - test tasks, theoretical questions, analysis of laboratory results of human material.

ELO 6. - test tasks, theoretical questions on parasites cycles, laboratory methods of research.
ELO 7. - test tasks, theoretical questions, identification and interpretation of the cause and mechanisms of development of genetic syndromes, caryotype analysis.
ELO 8. - test tasks, theoretical questions, interpretation of clinical situational problems, instrumental and laboratory methods and experimental results.

7. MEDICAL BIOLOGY PROGRAM

Fall Semester. Module 1. Cell biology and early embryogenesis

Submodule 1. Cell, tissue and organ levels of life organization

Specific goals:

- To interpret the concept of the essence of life to date and determine the place of humans in the system of nature.
- To classify biological systems and levels of life.
- To interpret the meaning of processes occurring at the molecular genetic and cellular level of life organization to understanding the pathogenesis of hereditary, physical, cancer, inflammatory infections and other human diseases.
- To learn morphological properties of cell and treat disturbances of the basic principles of its operation at the origin of pathological processes in humans.
- To interpret the human karyotype and principles of chromosomes classification.
- To learn molecular mechanisms of realization of genetic information in the cell and its regulation in pro- and eukaryotes.
- To analyze changes in cells and their structures during the life cycle and importance of mitosis.
- Explain mechanisms of meiosis, their biological significance.
- To interpret the significance of modern cell culture methods for biomedicine.
- Identify types of regeneration and its ways, characteristics and importance of regenerative processes in the human system of homeostasis.
- Classify types of tissue transplantation in humans and correlate the process of transplantation in humans with the system of immunity.

Topic 1. Introduction to Medical Biology. Structural and functional organization of the cells. Optical systems in biological research.

Medical Biology as a science of the basics of human life, studying fundamental laws of heredity, variability, individual and evolutionary development and morphological and physiological adaptations of humans to the conditions of natural and social environment. The current state of developments in MB. Place of MB in medical education.

The essence of life, its forms, fundamental properties of living things. Evolutionary predefined structural levels of life organization, levels of life and the basic biological phenomena that characterize them. Place of humans in the organic world. The significance of physical, biological and social phenomena in human life.

Optical systems in biomedical research. Microscopy. Light microscope structure and function. Techniques of micro preparation and study of objects in light microscopy. Other types of microscopy. Basic optical techniques and equipment for quantitative evaluations in the laboratory. Biological sensors in medicine.

Topic 2. Morphology of cells. Structural components of the cytoplasm and nucleus

Eukaryotic cells: Structural and functional organization. The chemical composition of cells. Macro- and micronutrients. Water and hydrogen bonds in the processes of cell activity. Organic compounds. Types of biological molecules in living organisms. Cytoplasm and cytoskeleton. Cytoplasmic streaming. Cytoplasmic organelles: membranous and nonmembranous, purpose and principles of operation. Inclusions in the cells. The nucleus as an informational center of a cell. Structure of the nucleus at the interphase. Chromosomal and genomic levels of hereditary material. Chromatin:

euchromatin, heterochromatin. Methods of cell structure and functions studies. Prokaryotic cells: membranous and non-membranous organelles. Structure of prokaryotic cell wall. Differences between animal, plant and fungal cells. Nobel prizes in Physiology or Medicine for cell biology studies.

Topic 3. Cell membranes. Transport of substances through plasma membrane. Cell as an open system. Assimilation and dissimilation. Cell membranes, their structure and functions. The principle of cellular compartmentalization. The receptors of the cells. Flow of matter and energy in the cell. Stages of energy metabolism. Energy supply to the cell. Mitochondria. ATP. The energy distribution into cells.

Topic 4. Cell cycle. Divisions of cells. Reproduction at the cellular level. The organization of the cells over time. The cell cycle. Cell division: amitosis, mitosis. Endomitosis and polytene chromosomes. Changes in the cells and their structures during mitotic (cell) cycle (interphase and mitosis). The growth of the cells. Growth factors. Mitotic activity of tissues. Mitotic abnormalities, somatic mutations.

Topic 5. Cell, tissue and organ growing techniques, regeneration and transplantation.

Living cells outside the body. Cloning of cells. Human cells hybridization for science and medical treatments.

Cell, tissue and organ cultures. Types and ways of regeneration. Types of tissue transplantation in humans. Role of cell surface antigens in transplantation. Biotechnological approaches for *in vitro* and *in vivo* tissue and organ development.

Topic 6. Molecular basis of heredity. The characteristic of nucleic acids. The organization of the information flow in a cell.

Nucleic acids as genetic information carriers. Characterization of nucleic acids, DNA and RNA, spatial organization, species-specific role in the storage and transfer of genetic information. DNA replication. Mutations and their mechanisms. Maintaining genetic stability of the cells: DNA repair. The information flow in the cell.

Topic 7. The structure of the gene in pro- and eukaryotes. Processes of realization of the genetic information.

The structure of the gene in pro- and eukaryotes. Splicing of mRNA.Structural genes, regulatory, tRNA, rRNA. The gene as the unit of genetic function. Genetic code and its properties. Transcription. Processing, splicing.

Translation (initiation, elongation, termination). Post-translational modification of proteins.

Topic 8. Regulation of gene expression. Regulation of gene expression in pro- and eukaryotes. Organization of the eukaryotic genome.

Submodule 2. Organism as a level of life. Karyotype, reproduction and chromosomal numerical or structural abberations.

Specific goals:

- Classify variability as the fundamental properties of living matter.

- Explain the significance of mutations and mutagenic factors (mutagens) of different nature in the emergence of chromosomal and monogenic human diseases.

- Correlate the impact of mutagenic, carcinogenic and teratogenic substances with certain genotypes of people.

- To interpret the features of human reproduction and its biological and social nature.

- Explain the mechanism of gametogenesis and interpret typical distinctive features ovo- and spermatogenesis.

- Identify the features of human embryonic development and explain the meaning of the genetic control of the human body.

- Correlate critical periods of embryogenesis of humans with congenital malformations of teratogenic origin.

- To discuss problems in differentiation on molecular, genetic, cellular and tissue levels.

- Correlate human tumor types, depending on the type of tumor growth.

- Apply biogenetic laws in its interpretation of the future to determine onto phylogenetic causes of congenital defects in a person.

Topic 9. Organization of genetic information on the level of an organism.

Organization of genetic information on the level of organisms. Chromosome: structure and functions. Mitochondrial chromosomes and plasmids. Mitochondrial diseases.

Topic 10. Chromosomes and human karyotype. Realization of the inherited information. Genome, chromosome and gene mutations.

Karyotype: morphological and functional characterisation and classification of human chromosomes. Idiogram. Kinds of chromosomes. Chromosomal analysis. Nucleolus as chromosomes derivative and its role in the formation of ribosomes.

Cytogenetic method. The classification of hereditary diseases. Chromosomal diseases caused by change in number or structure of chromosomes, essence of cytogenetic mechanisms. Karyotyping methods. Analysis of karyotypes of patients with hereditary diseases. Determination of X- and Y-sex-chromatin as a method of diagnosis of hereditary diseases.

Monogenic (molecular) human diseases. Diseases caused by a change in the molecular structure of gene. Molecular diseases of carbohydrate, amino acid, protein, lipide and mineral metabolism. The mechanism of occurrence and the principles of laboratory prenatal diagnostics of monogenic diseases. Genetic engineering. Biotechnology. The concept and reality of gene therapy.

Topic 11. Meiosis. Gametogenesis. Fertilization and early stages of human embryogenesis. Modern assisted reproductive technologies

Biological features of human reproduction. Gametogenesis. Fertilization. Reproduction as a genetic mechanism to ensure continuity between generations. Features of human reproduction in connection with its biological and social nature. Meiosis. Gametogenesis. Fertilization in humans - recovery diploid number of chromosomes, increase the diversity of genes in the offspring.

Early stages of human embryogenesis. Modern assisted reproductive technologies.

Molecular genetic mechanisms of ontogenesis. Precondition of birth defects. Abnormalities of ontogeny and their place in human pathology. Ontogenesis: types, periods, stages. The stages of embryonic development. Differentiation onto molecular-genetic, cellular and tissue levels.

Congenital malformations. Classification: heritable, exogenous, multifactorial, hametopatic, blastopatic, embriopatic, fetopatic. Regulation of gene function in ontogenesis. Experimental study of embryonic development. Problem of determination and interaction blastomeres. Embryonic induction. Regulation in the process of fragmentation and its disorders (twins, defects, deformity). Critical periods of development. Teratogenesis. Teratogenic environmental factors.

Spring Semester. Module 2. Basics of Genetics and Medical Parasitology

Submodule 3. Genetics. The basics of heredity and variation.

Specific goals:

- *To learn basics of medical genetics and identify signs of Mendelian inheritance.*
- *Illustrate inheritance of Rh-factor*
- *Illustrate inheritance of M, N blood group antigen system AB0 as a manifestation of multiple allelism.*
- *Differentiate interactions between allelic and non-allelic gene expression characteristics under various types of inheritance.*
- *Apply chromosomal theory of heredity knowledges to determine the manifestation in the descendants of both autosomal and sex-linked diseases.*
- *Interpret the genetic mechanism of sex determination and sex-linkage*
- *Conduct analysis of genealogical pedigrees of families with hereditary diseases.*
- *Identify share of heredity and environment in the manifestation of pathological signs in person using the method of twins.*
- *Classify chromosomal disease in humans, depending on the type and kinds of mutations causing the syndromes.*
- *Analyse karyotype of patient and estimate diagnosis of chromosomal diseases (karyotyping, determination of X- and Y-sex chromatin).*

- Interpret achievements of gene and cell therapy of inherited diseases.
- Explain the importance of genetic load problems in humans.
- Apply knowledge of the genetic essence of the law of genes and genotypes equilibrium in populations to determine their genetic structure.
- To interpret the contemporary theories and mechanisms of ageing and longevity issues.
- Interpret the meaning of human ecology and public health, sustainable management of natural resources.
- To interpret social and biological aspects of adaptation to living conditions of the population and forming adaptive ecotypes for people.
- Explain the synthetic theory of evolution and evolution of human
- Interpret the concept of the biosphere as a natural system, part of which is mankind.

Topic 12. Mendel's laws. Mono-, di-, polyhybrid and polygenic inheritance.

The manifestations of the basic laws of Gregor Mendel.

Genetics: subject and tasks, stages of development; basic terms and concepts of genetics. Principles of histological analysis. Test cross and its practical application. Lethal genes. Deviations from expected offsprings ratios. Di- and polyhibryd inheritance.

Dominant and recessive types of inheritance of normal and pathological human traits. The interim nature of inheritance in humans. Polygenic inheritance of traits in humans. Genetics of blood groups. Inheritance of blood group antigenic systems for AB0 and MN. Rh factor. Rhesus conflict. Immunogenetics, subject task. Tissue and species specific proteins, their antigenic properties.

Topic 13. Interaction of allelic genes.

Interaction of allelic genes. Allelic gene interaction (complete dominance, incomplete dominance and over-dominance or superdominance, co-dominance) and non-allelic genes (complementary interaction, epistasis, polymerism).

Topic 14. Non-allelic genes interaction. Pleiotropy.

Interaction of nonallelic genes. The phenomenon of pleiotropy. Multiple allelism.
Primary and secondary pleiotropy. The series of multiple alleles.

Topic 15. Chromosomal theory of heredity. Genetics of a sex.

Chromosomal theory of heredity. Genetics of sex. Inheritance of gender. Genetic mechanisms of gender determination in humans and their abnormalities. Bisexual nature of man. The problem of redefining gender. Psychosocial aspects.

Inheritance sex-linked human diseases. Treats linked to and dependent on gender. Hemizygotic state. Symptoms linked to sex, their patterns of inheritance.

Topic 16. Genetic linkage and crossing-over. Genetic linkage and crossing-over. Features inheritance group linkage. The mechanism of crossing-over, cytological evidence, biological significance. Genetic maps of chromosomes. Methods for mapping human chromosomes. The current state of human genome research. Non-chromosomal heredity. Three- parent babies.

Topic 17. Hereditary diseases. Methods of studying human heredity. Fundamentals of Medical Genetics. Human as a specific object of genetic analysis. Methods of human heredity studies. Genealogical method. The rules of construction of family trees. Analysis of pedigrees. Twins method. Determining the influence of genotype and environment in the manifestation of symptoms in pathology. Penetration and Expressivity. Dermatoglyphics. Biochemical, immunological and somatic cell hybridization techniques.

Topic 18. Human variability as property of life and the genetic phenomenon. Population genetics.

Variability in humans as a genetic phenomenon: phenotypic and genotypic variability. Modifications and reaction norm. Long–time modifications. Statistical patterns of modificational variability. Combinative variability and its source. Mutational variability in humans and its phenotypic expression.

Natural mutagenesis induced mutagenesis. Mutagens: physical, chemical, biological. Genetic monitoring. Genetic risk of pollution. The concept of antimutagens and co-mutagens. The law of homologous series of genetic variability, its practical value.

Population genetics methods. The Law of permanence of genetic structure of ideal populations. Using the Hardy-Weinberg equation in medicine to determine the genetic structure of human populations.

Medical and genetic aspects of the family. Medical genetic consulting and its importance. Prevention of hereditary and congenital diseases. Prenatal diagnostics of hereditary and congenital diseases.

Topic 19. The synthetic theory of evolution, human ecology and biosphere.

Synthetic theory of evolution. Features of action of evolutionary factors in human populations. The doctrine of macro- and microevolution. Biogenetic law. Human population structure. The origin of man. The human race as a reflection of adaptations in human development.

Human ecology and biosphere. Environment as an ecological concept. Types of environments. Factors environment. The unity of organisms and environment. Healthy (comfortable) and unhealthy (uncomfortable), extreme environments. Adequate and inadequate environmental conditions. Adaptation of people to extreme conditions. The influence of anthropogenic factors of environmental pollution on human genetics.

Submodule 4. Parasitology. Medical biology of protists.

Specific goals:

- *Define the concept of "parasitism", "source of infestation", "transfer factor"or "vector" "pathogens invasions."*
- *Classify parasites to obligate and facultative, permanent and temporary, host specific and non-specific, external and internal or ecto- and endoparasite, extracellular and intracellular stages*
- *Interpret morphological adaptation to parasitism.*
- *To distinct transmissible or natural foci parasites*
- *Identify final, intermediate, obligate, facultative and reservoir hosts of the protists.*
- *Explain the impact of current global migration on distribution of parasite populations.*
- *To carry out the methods of laboratory diagnostics of parasites*
- *Interpret biological principles to combat vector-borne diseases and diseases with natural sources.*

Topic 20. Biological bases and medical issues of parasitism.

Introduction to medical parasitology. Medical and biological basics of parasitism. Medical parasitology. The origin and evolution of parasitism. Principles of classification of parasites. The principles of interaction between the parasite and the host. Morphological adaptation of parasites. The concept of intensity and extensiveness of invasion. Prominent scientists-parasitologists.

Topic 21. *Protista* as human parasites. Phylum *Sarcomastigophora*. Class *Lobosea*.

Sarcomastigophora, class of amoebae (*Lobosea*). Dyzenteria (*Entamoeba histolytica*), intestinal amoeba (*Entamoeba coli*), oral opportunistic amoeba (*Entamoeba gingivalis*). Geography, morphology and cycles of development, ways of infestation, laboratory diagnostics and differentiation of *Entamoeba histolytica* from non-pathogenic *Entamoeba coli*, *E. hartmanni*, *E. dispar*, *Endolimax nana* and *Iodamoeba bütschlii*, prevention of amebiasis.

Topic 22. Representatives of *Zoomastigophora* as human parasites.

The class of 'animal flagellates' (*Zoomastigophora*) as human parasites. Geography, morphological features, cycles of development, ways of infection, laboratory diagnostics and prophylaxis of giardiasis (*Giardia lamblia*), urogenital trichomoniasis (*Trichomonas vaginalis*), leishmaniasis (*Leishmania* species), African trypanosomiasis and Chagas disease (*Trypanosoma* species).

Topics 23. Phyllae *Apicomplexa* and *Ciliophora*. Representatives of the classes *Sporozoa* and *Ciliata* as human parasites.

Apicomplexa as human parasites. Coccidia: cyst forming coccidia, the *Sarcocystis* species and *Toxoplasma*. Monoxenic coccidia, the *Cyclospora*, *Cystoisospora*.

Monoxenic cryptosporidia, the *Cryptosporidium*. Hematozoa, the *Babesia* and *Plasmodium* species.

Ciliophora. Balantidiasis (*Balantidium coli*).

Medical geography, morphological and functional particularities, cycles of development, ways of infection, laboratory diagnostics, prevention of infections caused by parasitic *Apicomplexa* and *Ciliophora.*

Submodule 5. Medical helminthology

Specific goals:

- *Interpret the helminthology terms and morphological adaptation of helminth parasites.*
- *Explain the impact of current global migration on population distribution of helminths.*
- *Identify final, intermediate and reservoir hosts of worms.*
- *Identify methods of laboratory diagnosis of helminths, based on localization and life cycles of helminths.*
- *Correlate cycles of helminth infection and ways of infestation by helminth and estimation of means for preventing the disease in them.*
- *To identify the helmintiasis agent in human*

Topic 24. Phylum *Platyhelminthes*. Flukes (*Trematoda*) as human pathogens. *Paragonimus westermani* - lung fluke, *Dicrocoelium* species – bile duct flukes, *Opisthorchis felineus- cat liver fluke, Clonorchis sinensis* - Chinese liver fluke, *Fasciola hepatica* - liver fluke, *Fasciolopsis* Buski – intestinal fluke, *Schistosoma* species – blood flukes as human diseases agents. Medical geography, morphological characteristics, life cycles, ways of infection, pathogenic effect. Laboratory diagnosis and prevention of the parasitic infestations.

Topic 25. Phylum *Platyhelminthes*. Tapeworms (*Cestodes*) as human pathogens. *Hymenolepis nana, Echinococcus species, Diphyllobothrium latum, Taenia solium, Taeniarhynchus saginatus,* as human diseases agents.

Medical geography, morphological characteristics, development cycles, ways of infestation, conservation, pathogenic effect, laboratory diagnosis Medical geography, morphological characteristics, development cycles, the ways of infestation, pathogenic effect, laboratory diagnosis and prevention of diphyllobothriasis, echinococcosis, taeniasis, beef tapeworm infection, hymenolepiasis. Conservation, pathogenic effect, laboratory diagnosis

Topic 26. Roundworms (*Nemathelminthes*). Phylum *Nematoda.* Species *Ascaris lumbricoides, Anisakis simplex, Ancylostoma duodenale, Enterobius vermicularis, Necator americanus, Strongyloides stercoralis, Trichinella spiralis, Trichuris trichiura, Loa Loa, Wuchereria Bancrofti* and other human parasites.

Medical geography, morphological characteristics, development cycles, ways of infestation, pathogenic effect, laboratory diagnosis and prevention of these parasitic infections.

Topic 27. Laboratory diagnostics of helminthoses. The principles and contents of the main macro- and micro helmintoscopic study methods in feces, water, soil, biopsy materials and others. Particularities of the eggs of flat and round worms, the parasites of humans.

Submodule 6. Medical Entomology

Specific goals:

- *Interpret the concept of specific vectors of infectious diseases.*
- *Compare the importance of arthropods as disease agents and vectors of pathogens.*
- *Correlate between transmission of the disease agents and their prevalence in populations of people.*

Topic 28. *Arthropoda* as pathogens and vectors of pathogens.

Arachnids (*Arachnoidea*). Ticks and mites (*Acarina*).

Mites. Mites that affect human by their feeding. Mites associated with cutaneous reactions. *Sarcoptes scabiei*, the scabies agent. House dust mites *Dermatophagoides farinae* (American house dust mite), *D. microceras, D. pteronyssinus* (European house dust mite), *Euroglyphus maynei* (Mayne's house dust mite). Effect of house mites on humans as allergens and stimulators of asthma in people affected by respiratory diseases.Straw itch mite (*Pyemotes ventricosus*). Chiggers (*Eutrombicula alfreddugesi*).

Follicle mite (*Demodex folliculorum*). Otoacariasis (*Otobius* species, *Otodectes cynotis, Dermanyssus gallinae, Sancassania* (*Caloglyphus*) *berlesei, Chortoglyphus arcuatus, etc.*). Chicken mite (*D. gallinae*) and pruritus, allergic dermatitis and rash in humans. Northern fowl mite (*Ornithonyssus sylvarium*), tropical rat mite *(O. bacoti).* House mouse mite (*Liponissoides sanguineus*). Grain mite (*Acarus siro* (L.). Oak leaf itch Pyemotes herfsi, grocer's itch, snake mite, and Psoroptes.

Cheyletiella parasitovorax and mild pruritic dermatitis in human.

Ticks. American dog tick (*Dermacentor variabilis*), Rocky Mountain wood tick(*D. andersoni*) and other ticks, aible to cause paralysis in human. Brown dog tick (*Rhipicephalus sanguineus*). Lone star tick (*Amblyomma americanum*). Deer tick (*Ixodes scapularis*). Fowl tick (*Argas persicus*). Spinose ear tick (*Otobius megnini*). Relapsing fever ticks (*Ornithodorus* spp.). Rodent tick (*Ornithodorus hermsi*).

Morphology, nutrition and reproduction. Arachnids as pathogens and vectors of human pathogens.

Overview of parasitic mites and ticks as vectors of serious human diseases, e.g., rickettsial pox (mite *Liponissoides sanguineus*); scrub typhus (mite *Leptotrombidium deliense*); Lyme disease (ticks *Ixodes scapularis, I. ricinus, I. pacificus* and *I. persulcatus*); tick-borne meningoencephalitis (*I. scapularis, I. ricinus* and *I. persulcatus*); Colorado tick fever (*Dermacentor andersoni*); tularemia (ticks *Amblyomma, Dermacentor, Haemaphysalis, Ixodes*); *Dermacentor* and *Haemaphysalis* species, the vectors of *Rickettsia sibirica,* North Asian tick typhus agent; tick-borne relapsing fever (vectors–soft-bodied ticks *Ornithodoros* or *Carios erraticus*); babesiosis (*Ixodes scapularis*); ehrlichiosis (vectors - ticks *Amblyomma americanum, Ixodes scapularis*), etc.

Poisonous arachnids (scorpions, spiders). Scorpions from the family *Buthidae* (including *Leiurus quinquestriatus*, *Hottentotta* spp., *Centruroides* spp. and *Androctonus* spp.) that contain venom that is deadly to humans. Symptoms, prevention of bites and treatments. Prospects for use of biologically active compounds from scorpions.

The world's deadliest spiders: funnel-web spiders (family Dipluridae). Redback spider (*Latrodectus hasselti*), red widow spider (*L. bishopi*), brown widow spider *L. geometricus*), black widow spider (*L. mactans*). Wolf spider (family Lycosidae). Yellow sac spider (*Cheiracanthium inclusum*). Brazilian wandering spiders (*Phoneutria fera* and *P. nigriventer*). Brown recluse spider (*Loxosceles reclusa*). Prevention of bites, symptoms of bites and treatment.

Topic 29. Class *Insecta*: lice (*Anoplura*), fleas (*Aphaniptera*), bugs (*Hemiptera*), cockroaches (*Blattodea*), the pathogens and vectors of human pathogens.

Head louse (*Pediculus humanus capitis*), the body louse (*Pediculus humanus*) and the crab or pubic louse (*Pthirus pubis*). Fleas. Cat flea (*Ctenocephalides felis felis*), dog flea (*C. canis*), human flea (*Pulex irritans*). The sand flea, chigoe or jigger flea (*Tunga penetrans*). Flea-borne diseases. Bedbug (*Cimex lectularius*), tropical bedbug (*Cimex hemipterus*). Cockroaches. Asian cockroach (*Blattella asahinai*), American cockroach (*Periplaneta americana*), the Oriental cockroach (*Blatta orientalis*), the Florida woods cockroach (*Eurycotis floridana*), and the German cockroach (*Blattella germanica*).

Morphology, nutrition and life cycles of medically important insects. Medical importance of lice, fleas, bedbugs, cockroaches as vectors of infectious diseases. Prevention and control.

Topic 30. Class *Insecta*: *Diptera* - Mosquitoes and flies of medical importance.

Mosquitoes. Family *Culicidae.* Representatives of subfamilies *Anophelinae* and *Culicinae* as vectors of human parasites. Flies and sandflies. Family *Tabanidae*,
subfamilies *Chrysopsinae*, *Pangoniinae*, *Tabaninae.* Family *Oestridae*,
Subfamily *Cuterebrinae*, *Dermatobia hominis* – human Botfly. Midges of subfamily *Phlebotominae* (sand fly) of family *Psychodidae* and *Simuliidae* (black fly). Genera of *Simuliidae*, *Simulium, Prosimulium, Austrosimulium, Cnephia*, containing species that feed on people. Biting midges (*Ceratopogonidae*). Sandflies (family *Tabanidae*), family *Ceratopogonidae*. Sandfly as an autogenous reproducer. Their significance as intermediate hosts of helminths and carriers of human diseases. Sandfly genera of the subfamily *Phlebotominae* as the primary vectors of leishmaniasis and pappataci fever. Sand flies of the genus *Lutzomyia* as vectors of leishmaniasis in the New World; sand flies of the genus *Phlebotomus* as vectors of leishmaniasis in the Old World. Treatments against sand flies and flies.

8. THE STRUCTURE OF THE SUBJECT

Fall Semester. Module 1. Cell biology and early embryogenesis

№	Topics	Lectures	Laboratory works or practical classes	Individual students' work
	Submodule 1. Cellular, tissue and organ level of life organization			
1	Medical Biology Introduction. Cell structure and functional organization. Non-membranous organelles. Optical systems in biomedical research. Modern microscopic techniques.	2	14	10
2	Morphology of cells. Structural components of the cytoplasm and nucleus	2	4	5
3	Cell membranes. Transport of substances through plasma membrane.		4	5
4	Cell cycle. Divisions of cells. Reproduction at the cellular level.	2	4	5
5	Cell, tissue and organ growing techniques, regeneration and transplantation.		8	5
6	Molecular basis of heredity. The characteristic of nucleic acids. The organization of the information flow in a cell.		2	5
7	The structure of the gene in pro- and eukaryotes. Processes of realization of the genetic information.		4	5
8	Regulation of gene expression.		2	5
	Submodule 1 control test			2
	Submodule 2. Organism as a level of life. Karyotype, reproduction and chromosomal numerical, structural abberations or gene mutations.			
9	Organization of genetic information on the level of organism.	2	4	5
10	Chromosomes and human karyotype. Realization of the inherited information. Genome chromosome and gene mutations.		10	5
11	Meiosis. Gametogenesis. Fertilization and early stages of human embryogenesis. Modern assisted reproductive technologies		8	10
	Submodule 2 control test			2
	Short assay and PowerPoint presentation			40
	Module 1 final test			2
	Total for module 1	10	64	111

Module 1. Cell biology and early embryogenesis

№	Lectures	Hours
	Submodule 1. Cellular level of life organization	
1	Medical Biology Introduction. Cell structure and functional organization. Non-membranous organelles. Molecular basis of heredity.	2
2	Structure and functional organization of membranous organelles.	2
3	Optical systems in biomedical research. Modern microscopic techniques.	2
4	Cell Cycle. Mitosis. Karyotyping. Hereditary diseases.	2
	Submodule 2. Cells cycle, divisions, fertilization and early embryogenesis	
5	Meiosis. Gametogenesis. Fertilization and early stages of human embryogenesis. Modern assisted reproductive technologies.	2
	Module 1 total hours for lectures	10

Module 1. Cell biology and early embryogenesis

№	Laboratory lessons	Hours
	Submodule 1. Cellular, tissue and organ level of life organization	
1	Structure and functions of cells and their non-membranous organelles.	2
2	Structure and functional organization of membranous organelles.	2
3	Functional significance of biological membranes. Transport through plasma membrane and within the cells.	2
4	Spectrophotometry and photoelectrocolorimetry.	2
5	Light microscopy. Bright field. Dark field. Phase contrast.	2
6	Use an ocular micrometer for calibration of objects and for measurement of the size of microscopic objects.	2
7	Estimation of the objective linear magnification and microscopic object size using ocular screw micrometer.	2
8	The estimation of the number of cells in suspension or culture using hemocytometer.	2
9	Transmission electron microscopy (TEM).	2
10	Scanning electron microscopy (SEM).	2
11	Scanning transmission electron microscopy (STEM) and other modern microscopic techniques.	2
12	Tissue engineering and organ growing methods *in vitro* and *in vivo* for transplantation.	2
13	Hanging drop method for cell movement observation and culturing of cells and organoids.	2
14	Estimation of number of cells in culture or suspension using hemocytometer.	2
15	Differentiation between living and dead eukaryotic cells by staining.	2
16	Cell cycle.	2
17	Division of the cells by mitosis. Mitotic recombination.	2
18	Molecular basics of heredity and genomes in prokaryotes and eukaryotes.	2
19	Replication, transcription and translation in prokaryotic cells.	2
20	Replication, transcription and translation in eukaryotic cells.	2
21	Regulation of gene expression in prokaryotic and eukaryotic cells.	2
	Submodule 2. Organism as a level of life. The basic laws of heredity and variation. Fundamentals of human genetics	
22	Human genome and karyotype. Syndromes resulted from wrong numbers of chromosomes.	2
23	Barr body observation in squamous epithelium cells from human throat lining.	2
24	Structural chromosomal mutations and diseases resulted from them.	2
25	Gene mutations and diseases resulted from them.	2
26	Peripheral blood smear for detection of sickle cells anemia, the result of gene mutation.	2
27	Solubility test for mutant hemoglobin S detection	2
28	Gel-electrophoresis for mutant hemoglobin S detection	2
29	Meiosis. Meiotic recombination.	2
30	Gametogenesis and study of sperm and egg cells structure	2
31	Fertilization and early embryo development	2
32	Assisted reproductive technologies.	2
	Total hours for laboratory lessons	64

Spring Semester. Module 2. Basics of Genetics and Human Parasitology

№	Topic	Lectures	Laboratory or practical classes	Individual students' work
	Submodule 3. Genetics. The basic laws of heredity and variation.			
12	Mendel's laws: mono-, di-, polyhibrid and polygenic inheritance.	2	4	5
13	Interaction of allelic genes.		4	5
14	Non-allelic genes interaction. Pleiotropy.		4	5
15	Chromosomal theory of heredity. Genetics of a sex.		4	5
16	Genetic linkage and crossing-over.		4	5
17	Hereditary diseases. Methods of studying of human heredity.	2	4	5
18	Human variability as property of life and the genetic phenomenon. Population genetics.		4	5
19	The synthetic theory of evolution, human ecology and biosphere.			5
	Submodule 3 control test			2
	Submodule 4. Parasitology. Medical biology of protists.			
20	Biological bases and medical issues of parasitism.	2	4	5
21	*Protista* as parasites. Phylum *Sarcomastigophora*. Class *Lobosea*.		4	5
22	Representatives of *Zoomastigophora* as human parasites.		4	5
23	Phyllae *Apicomplexa* and *Ciliophora*. Representatives of the classes *Sporozoa* and *Ciliata* as human parasites.		6	5
	Submodule 4 control test			2
	Submodule 5. Medical helminthology			
24	Phylum *Platyhelminthes*. Flukes (*Trematoda*) as human.	2	6	5
25	Phylum *Platyhelminthes*. Tapeworms (*Cestoda*) as human pathogens.		6	5
26	Round worms (*Nemathelminthes*). Phylum *Nematoda.*		6	5
27	Laboratory diagnostics of helminthoses.		6	5
	Submodule 5 control test			2
	Submodule 6. Medical Entomology			
28	*Arthropoda* as pathogens and vectors of pathogens.	2	6	5
29	Class *Insecta*: lice (*Anoplura*), fleas (*Aphaniptera*), bugs (*Hemiptera*), cockroaches (*Blattodea*), the pathogens and vectors of human pathogens.		6	5
30	Class *Insecta*: *Diptera* - Mosquitoes and flies of medical importance.		4	5
	Submodule 6 control test			2
	Short assay and PowerPoint presentation			40
	Module 2 final test			2
	Total hours for module 2	10	30	145

Module 2. Basics of Genetics and Human Parasitology

№	Lectures	Hours
	Submodule 1. Fundamentals of Genetics and its medical issues	
1	G.Mendel's laws. Monogenic human diseases inheritance. Probability calculations in monohybrid and dihybrid crosses. Genetic linkage and mapping. Population genetics.	2
2	Genetic information realization on the organism's level. Interactions of genes.	2
	Submodule 2. Human parasites and their vectors	
3	Protists as human parasites.	2
4	Flat worms and round worms as human parasites.	2
5	Arthropods and insects as human parasites and vectors of diseases.	2
	Module 2 total hours for lectures	10

Module 2. Basics of Genetics and Medical Parasitology

№	Laboratory lessons	Hours
	Submodule 1. Fundamentals of Genetics and its medical issues	
1	Solution of problems in Genetics. Mendelian inheritance of human traits. Monohybrid Genetics.	4
2	Solution of problems in Genetics. Mendelian inheritance of human traits. Dihybrid Genetics.	4
3	Genes interaction. Dominance, incomplete dominance, co-dominance and lethal alleles. Solution of problems.	4
4	Non-allelic genes interaction. Modifier genes. Epistasis. Complementation. Suppressor and Duplicate genes. Polygenic inheritance. Solution of problems.	4
5	Sex determination and sex linkage. Solution of problems.	4
6	Genetic linkage and mapping. Solution of problems.	4
7	Population Genetics. Solution of problems.	4
	Submodule 2. Human parasites and their vectors	
8	*Protozoa* as human intestinal parasites. *Apicomplexa* : *Sarcocystis, Toxoplasma.*	2
9	*Protozoa* as human intestinal parasites. *Cyclospora, Cystoisospora, Cryptosporidium.*	2
10	*Protozoa* as blood parasites: *Hematozoa*, the *Babesia* species	2
11	*Protozoa* as blood parasites: malaria *Plasmodium* species.	2
12	*Protozoa* as intestinal parasites *Flagellata: Giardia intestinalis and Ciliata, Ciliophora: Balantidium coli.*	2
13	*Protozoa* as intestinal parasites *Amoebas: Entamoeba histolytica.*	2
14	*Protozoa* as human parasites. *Flagellata*: *Leishmania species.*	2
15	*Protozoa* as human parasites. *Flagellata*: *Trypanosoma* species, *Trichomonas vaginalis.*	2
16	*Protozoa* as human parasites. *Flagellata*: *Trichomonas vaginalis.*	2
17	Nematoda-roundworms as human parasites: *Anisakis simplex*, *Ascaris lumbricoides*, *Enterobius vermicularis.*	2
18	Nematoda-roundworms as parasites: *Necator americanus*, *Ancylostoma duodenale.*	2
19	Nematoda-roundworms as human parasites: *Loa loa*, *Wuchereria bancrofti.*	2
20	Nematoda-roundworms as parasites: *Strongyloides stercoralis*, *Trichuris trichiura.*	2
21	Trematoda-flukes as parasites: *Fasciola hepatica*, *Fasciolopsis buski*, *Clonorchis sinensis.*	2
22	Trematoda-flukes as human parasites: *Clonorchis sinensis.*	2
23	Trematoda-flukes as human parasites: *Schistosoma* species infecting human.	2
24	Trematoda-flukes as human parasites: *Paragonimus westermani*	2
25	*Cestoda.* The tapeworms as human parasites: *Echinococcus species* as diseases agens.	4
26	*Cestoda.* The tapeworms as human parasites: *Taenia saginata, Taenia solium*	2
27	*Cestoda.* The tapeworms as parasites: *Diphyllobothrium latum, Hymenolepis nana.*	2
28	*Arthropoda* as pathogens and vectors of pathogens: ticks and mites (*Acarina*).	2
29	Insects as human parasites and vectors of diseases: mosquitoes, flies and sandflies.	2
30	Insects as human parasites and vectors of diseases: lice (*Anoplura*), fleas (*Aphaniptera*).	2
31	Insects as parasites and vectors of diseases: bugs (*Hemiptera*), cockroaches (*Blattodea*).	2
32	Simple laboratory methods for identification of parasites in human faces.	2
33	Simple laboratory methods for identification of parasites in human urine.	2
34	Simple laboratory methods for identification of parasites in human blood smears.	2
35	Molecular biology methods for diagnostics of parasitary diseases.	2
	Module 2 total hours for laboratory works	86

9. Individual work

Individual students work is performed by studing from text-books, information obtained on lectures, laboratory lessons and materials from Internet and scientific literature on the topics, writing of assays and preparing of presentations.

№	Module 1	Hours	Evaluation
1.	Preparation for laboratory classes - theoretical preparation and practical skills from lessons.	65	Current control on laboratory classes. ECTS rating.
2.	Short assay	20	max score 5
3.	PowerPoint presentation	20	max score 5
4.	Submodule 1 control test	2	ECTS rating
5.	Submodule 2 control test	2	ECTS rating
6.	Module 1 final test	2	ECTS rating
	Total	111	

№	Module 2 topics	Hours	Evaluation
1.	Preparation for laboratory classes - theoretical preparation and practical skills from lessons.	95	Current control on laboratory classes. ECTS rating.
2.	Short assay	20	max score 5
3.	PowerPoint presentation	20	max score 5
4.	Submodule 3 control test	2	ECTS rating
5.	Submodule 4 control test	2	ECTS rating
6.	Submodule 5 control test	2	ECTS rating
7.	Submodule 6 control test	2	ECTS rating
8.	Module 2 final test	2	ECTS rating
	Total	145	

As a part of individual work, each student must select one question (from listed below or from laboratory lessons section) for preparation as short, 500 words long assay (≈ 1 page, single spacing Times New Roman, 12pt with standard margins) and PowerPoint presentation (no more than 25 slides).

Cell biology, Early embryogenesis, Genetics

2. Medical biology as a science.
3. Structural and functional organization of the cells. Eucaryotic and procaryotic, animal and plant cells.
4. Cell organelles.
5. Models of plasma membranes.
6. Transport across membranes.
7. Cell adhesion-Based Therapy
8. Artificially made viable cell
9. Tissue engineering *in vitro*
10. Prospects for new human organs growing in human body
11. Molecular bases of heredity.
12. Morphology of chromosomes and human caryotype
13. Realization of the inherited information.
14. Reproduction at the cellular level.
15. Genome and chromosome mutations.
16. Chromosomes and human caryotype.
17. Reproduction at the cellular level.
18. Genome and chromosome mutations.
19. Central dogma of biology.
20. The organization of the information flow in a cell.
21. The characteristic of nucleic acids.

22. The exon-intron organization of genome eukaryotes.
23. The organization of genome of prokaryotes.
24. Processes of realization of the genetical information.
25. Organization of information flow in cell.
26. The control of gene expression.
27. Molecular mechanisms of human variability.
28. Cell cycle. Divisions of cells.
29. Artificially made viable cell.
30. Rybozymes.
31. Virology objects
32. Organization of genetic information on the level of organism.
33. Interactions of genes.
34. Chromosomal theory of heredity.
35. Genetics of a sex.
36. Human variability as property of life and the genetic phenomenon.
37. Features of the human genetics.
38. Exhibition of the basic laws of the inheritance on the example of attributes, that transfer under Mendel's laws.
39. Gene interaction of one allelic pair.
40. Non-allelic genes interaction.
41. Pleiotropy.
42. Chromosomal theory of heredity.
43. Autosomal linkage.
44. Crossing-over.
45. Genetics of a sex.
46. Variation in human and its kinds.
47. Bases of human genetic.
48. Method of studying of human heredity.
49. Hereditary diseases.
50. Methods of medical genetics: genealogical and bigeminal (method of twins).
51. Chromosomal diseases.
52. Cytogenetic method.
53. Dermatoglyphics.
54. Molecular and genetic mechanisms of ontogenesis.
55. Modern aspects of regeneration and transplantation.
56. Biological mechanisms of homeostasis maintenance in organism.
57. Molecular illnesses.
58. Biochemical and DNA- diagnostics.
59. Population- statistics method.
60. Medical genetic consultation.
61. Reproduction is the basic feature of living organisms.
62. Gametogenesis.
63. Fertilization.
64. Features of prenatal period of human development.
65. Precondition of birth defects.
66. Amniocentesis.
67. Screening for genetic diseases
68. Identification of Disease Genes.
69. Mutagens.
70. Mutations and cancer.
71. Topography of chromosomes.
72. Types of changes in chromosome structure.

73. Euploidy.
74. Aneuploidy.
75. Spontaneous mutations.
76. Induced mutations.
77. The relationship between mutagens and carcinogens.
78. Biological repear mechanism.
79. Methods of diagnostics in medical genetics.
80. Gene therapy models: Liver and Lung Diseases
81. Gene therapy model: Cancer and Authoimmune Diseases
82. Gene therapy model: Hematopoetic Diseases
83. Gene therapy model: Circulated Gene Product
84. Therapeutic Ribozymes
85. Synthetic theory of evolution.
86. Population structure of human.
87. Human ecology.

Medical Parasitology

1. Biomedical bases of parasitism.
2. *Protozoa* as human parasites.
3. Amebiasis.
4. Giardiasis.
5. Phylum *Sarcomastigophora*. Class *Lobosea*.
6. Phylum *Apicomplexa*. Representatives of a class *Sporozoa* as parasites of human.
7. Representatives of a class *Zoomastigophora* as human parasites.
8. Malaria.
9. Phylum: *Ciliophora*. Representatives of a class *Ciliata* as human parasites.
10. *Pneumocystis carinii* pneumonia.
11. Leishmaniasis.
12. Trypanosomiasis.
13. Trichomoniasis.
14. Medical Helminthology.
15. Phylum *Plathyhelminthes*. Class Trematoda. Genus *Schistosoma*. *Fasciola hepatica*, as causative agents of human diseases.
16. Phylum *Plathyhelminthes*. Class *Trematoda*: Paragonimus westermani, *Dicrocoelium lanceatum, Opisthorchis felineus, Clonorchis sinensis* as human diseases agents.
17. Class *Cestoidea*: *Taenia saginata, Taenia solium* as human diseases agents.
18. Cestodes (Tapeworms): *Hymenolepis nana, Echinococcus granulosus, Echinococcus multilocularis, Diphyllobothrium latum* as human diseases agents.
19. Phyllum *Nemathelminthes*. Class *Nematoda* (Roundworms). *Ascaris lumbricoides, Ancylostoma duodenale, Necator americanus, Strongyloides stercoralis* as human diseases agents.
20. Phylum: *Nemathelminthes* Nematodes (Roundworms) *Trichinella spiralis, Enterobius vermicularis, Trichuris trichiura* as human diseases agents.
21. The laboratory diagnostic of helmintes.
22. Medical arachnoentomology.
23. Arthropods as disease agents and vectors of infections.
24. Class *Insecta*. Lice, fleas, bugs as causative agents and vectors of human diseases.
25. Order *Diptera*. Flies and mosquitoes as causative agents and carries of causative agents of human diseases.
26. Modern methods of diagnostics in parasitology.

10. Teaching methods

1. Illustrative and explanatory method – students acquire knowledges at a lecture using educational or instructional materials. Students perceive and comprehend the facts, assessments, conclusions and remain within the reproductive (reproducing) thinking. This method is widely used in high school to transfer large amounts of information.

2. The reproductive method (useful for studying samples of blood, urine, instrumental research).

Knowledge learned from the sample or rules under which students work is algorithmic in nature that is performed by instructions, rules similar to the model shown. Organized activities for students to digest the knowledge. It uses a variety of exercises, laboratory and practical work, programmable control, and various forms of self-control. It is used in conjunction with information receptive methods (prior to the reproductive). Together, they contribute to the formation of knowledge, skills and abilities in the students to form the basic mental operations (analysis, synthesis, transfer, classification).

3. The method of problem presentation.

Teacher presents the problem formulated cognitive tasks based on different sources and means, then together with students develops a way to solve the problem. This is achieved through the disclosure of arguments, comparing points of view, and different approaches. With this method, students become witnesses and accomplices in scientific research; follow the logic of evidence, the movement of teacher`s thought. For the purpose of studying the subject in lectures and practical classes, teachers use mainly problem-oriented approaches, along with interactive methods of teaching.

4. Research method (for individual students work).

Students study literature sources, monitoring and perform other research actions. Tasks performed by using research methods should include all the elements of the independent research process (problem definition, rationale, assumptions, search for appropriate sources of relevant information, process of problem solving). This method is most fully manifested initiative, independence, creativity in research.

11. Evaluations

Current control is carried out in each class according to specific goals for each topic. In assessing students' educational activity should prefer standardized methods of control: testing, structured written work, a structured procedure for the control of practical skills.

The maximum score student can get for each module (or submodule) is 200, the minimum to pass the module (or submodule) is 120.

<table>
<tr><td rowspan="2">Total points for all types of studies</td><td rowspan="2">Rate ECTS</td><td colspan="2">Rate according to national scale</td></tr>
<tr><td>for exam, course project (work), practice</td><td>for credit</td></tr>
<tr><td>180 – 200</td><td>A</td><td>well</td><td rowspan="5">Accepted</td></tr>
<tr><td>164-179</td><td>B</td><td rowspan="2">fine</td></tr>
<tr><td>148-163</td><td>C</td></tr>
<tr><td>128-147</td><td>D</td><td rowspan="2">satisfactorily</td></tr>
<tr><td>120-127</td><td>E</td></tr>
<tr><td>70-119</td><td>FX</td><td>Unsatisfactorily with the possibility of re-passing</td><td>Unaccepted with the possibility of re-passing</td></tr>
<tr><td>0-69</td><td>F</td><td>unsatisfactorily with obligatory repeated studing of the subject</td><td>Unaccepted with obligatory repeated studing of the subject</td></tr>
</table>

In order to pass the module (or submodule) students must attend and receive positive marks for all the laboratory works in this module (or submodule) with a score of at least 120 for each. The objectivity of the current evaluation on lessons must be checked by writing the submodules and final module evaluation, which are compulsory for all students and cover theoretical and practical questions from laboratory lessons too. Answering 60% and more of questions correctly is considered a passing mark for final module test or for final exam writing. In case of submodule failure, students can rework it by writing the final module evaluation. One attempt is allowed to

rewrite the final module evaluation, if someone failed to get a positive mark from its first writing. There are no more reworks allowed, if failed again. In that case students must attend the final exam evaluation by writing. Two reworks are possible for final exam evaluation during examination session.

The valuation of discipline FX, assigned to students who were not enrolled at least in one module from discipline after completion of the study or have scored less than 120 for final module or exam. This allows further reworks. F- scored students (not completed the subject with at least one module or don't get minimum points for current educational activity module) must undergo re-training according to their individual educational plan.

All the assays and presentations will be evaluated in the "2-5" points approach. Best presentations (with maximum score "5") will be recommended for uploading on SlideShare website on the Internet. The marks for these individual works will be added to scores collected from the submodules evaluations writings.

13. Equipment.

We are using simple and safe student laboratory equipment (different kinds of light microscopes, spectrophotometry, photoelectric colorimeter, ionometers) and materials. We are using modern projectors for our presentations videos and many videos from Internet to illustrate the complicated methods and biological processes also. Students must come to laboratory lessons in their own white robes.

14. Methodological software

1. Medical Biology. Training text-book for the self-dependent work of students of medical and stomatological departments. Module 1. Biological peculiarities of the human vital functions. Bases of human genetics.- Ukrainian medical stomatological academy.-Poltava 2014.
2. http://www.umsa.edu.ua/lecture/medbiology/bioosobl_gittedia_eng.pdf (2) Medical Biology. Training text-book for the self-dependent work of students of medical and stomatological departments. Module 2. Organismic level of life organization. Bases of human genetics.- Ukrainian medical stomatological academy.-Poltava 2014. http://www.umsa.edu.ua/lecture/medbiology/orgrivorggittia_eng.pdf
3. http://www.biologydiscussion.com
4. https://www.khanacademy.org/

Recommended Literature:

Basic

1. Boyle M. , Senior K. Human Biology.- Collins Advanced Science.- 2008
2. Marsh C., Simms J. Higher Human Biology: Applying Knowledge and Skills .-Hodder Gibson.- 2016.-100 p.
3. Goodman, S.R. Medical Cell Biology, Academic press, Elsevier, 2007.- 320 p..
4. John R. Gosden Chromosome Analysis Protocols.- Methods in Molecular Biology.-Vol. 29, -Humana Press, 2010 p. - 509 p.
5. Griffiths A.J.F. et al. An Introduction to genetic Analysis – 5th Ed.- W.H. Freeman & Co.-1993.-840 p.
6. Kleinsmith L.J., Kish V.M. Principles of Cell & Molecular Biology, 2nd Ed. Harper Collins College Publishers, 1995.- 870 p.
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*Each protocol for laboratory work contains the list of references also.