**Course program**

**“Medical Biochemistry”**

1. **The name of the educational program in which the discipline is read.**

The course of Medical Biochemistry is provided within the framework of higher education program for the students of the Department of Biology, specialty 06.03.01 – “Biology”, undergraduate level.

1. **Overall complexity**

The total complexity of the discipline is 5 credit units, 180 hours. The program of the discipline provides 18 h lectures, 36 h practical and 99 h independent work with an examination as an intermediate control.

1. **The place of discipline in the structure of the educational program.**

The course of Medical Biochemistry is a part of the basic block of disciplines. It is based upon knowledge and skills obtained during the studying of chemistry, cytology, histology, biochemistry and genetics.

1. **The goal of the course.**

The main goal of the course is to study the molecular mechanisms of disease pathogenesis, as well as to get basic knowledge of molecular diagnostics and clinical biochemistry.

1. **Results required to obtain in the end of the course:**

In accordance with the federal state educational standard of higher education in the direction of training 06.04.01 Biology (master’s degree level) discipline "Medical Biochemistry" is aimed at the formation of the following competencies:

readiness to use fundamental biological ideas in the field of professional activity for setting and solving new problems

the ability to independently analyze available information, identify fundamental problems, set a task and carry out field and laboratory biological research in solving specific problems using modern equipment and computing tools, be responsible for the quality of work and scientific accuracy of the results

the ability to plan and implement professional activities (in accordance with the orientation (profile) of the graduate program)

the ability to apply the methodological foundations of design, field and laboratory biological, environmental research, use of modern equipment and computing systems (in accordance with the direction (profile) of the Master’s program)

In result of the course studying a student should:

**Know:**

* Basic principles of cell metabolism and its regulation.
* Molecular mechanisms of pathogenesis of different diseases.
* Place of biochemical and molecular biological methods within general system of clinical laboratory diagnostics.

**To be able to:**

* Analyze the results of biochemical investigations, which take place in clinical practice.
* Provide pathological and pathophysiological assessment of clinical biochemical data.

**Have skills:**

* Use the laboratory equipment and carry out biochemical analyses.
1. **Discipline content**

The course of Medical Biochemistry consists of the following modules:

**Module 1. Introduction to medical biochemistry**

Place of medical biochemistry within biological and medical sciences. Aims and problems of medical biochemistry.

**Module 2. Molecular mechanisms of diabetes development**

Autoimmune destruction of pancreas B-cells, Insulin resistance, Consequences of hyperglycemia, ketone bodies and ketoacidosis, diabetic coma

**Module 3. Role of reactive oxygen species in pathogenesis of diseases**

Free radicals, Reactive oxygen species (ROS): sources and types. Superoxide radical, hydroxyl radical, singlet oxygen. Physiological role of nitrogen oxide. Targets of ROS. Protective mechanisms of cells against ROS, Methods of ROS analysis, The effect of ROS on gene expression, Rose of ROS in pathogenesis of vascular diseases. Role of oxidative injury in chromatin remodeling and gene transcription regulation in connection with pathogenesis of inflammatory diseases and chronic diseases of lungs, Role of ROS in ageing and senescence.

**Module 4. Protein folding disorders**

General principles of protein folding. Sickle-cell anemia. Favism (glucose-6-phosphate dehydrogenase deficiency). Amyloidosis. Neurodegenerative diseases: Huntington's disease, Parkinson's disease, Prions, Alzheimer’s disease, Amyotrophic lateral sclerosis (ALS).

**Module 4. Gene therapy**

Vectors, Targeting, Gene therapy of cancer, Gene therapy of vascular diseases, Gene therapy of other diseases.

**Module 5. Biochemical mechanisms of alcoholism**

Exogenous ethanol metabolism. Alcohol and genetics, Alcohol and liver, Alcohol and neurotransmitter system, Reinforcement effect: increase of tolerance to alcohol and formation of dependence. Alcohol and immune system. Alcohol and hormones, Alcohol and vascular system. The effect of alcohol on drug metabolism. Biochemical screening.

**Module 6. Anemia**

Hemoglobin biosynthesis. Porphyrins. Asiderotic anemia, Sideroblastic anemia, Megaloblastic anemia, Hemolytic anemia

**Module 7. Molecular mechanisms of bone formation and resorption. Osteoporosis**

Bone tissue as a type of connective tissue. Bone as an organ of skeletal system, Cells responsible for bone formation and resorption: osteoblasts and osteoclasts. Role of estrogens in osteoporosis, Role of calcium, vitamin D and parathyroid hormone in bone turnover.

**Module 8. Biochemical principles of carcinogenesis**

Malignant and benign tumors. Principles of molecular cell signaling. Cell cycle control. Oncogenes, Role of telomeres and telomerase in pathogenesis of cancer. Adhesion, Vascularization, Metastases. Cancer therapy.

**Module 9. Immune response to an infection**

Autoimmune diseases. Structure and function of antibodies. Antibody diversity. T-cells and cellular response, Perforin-granzyme mechanism of apoptosis. AIDS. Use of Western-blot analysis for diagnostics of HIV.

**Module 10. Role of the cytochrome P450 in drug metabolism**

General strategy of drug metabolism in human organism. Cytochrome P450 subfamily. Structure, mechanism of enzymatic activity and reactions catalyzed by cytochrome P450. Induction of cytochrome P450 activity of drugs. Clinical value of cytochrome P450 upregulation. Genetic polymorphism of cytochrome P450 and side effects of drugs. CytP450 and drug interaction. CytP450 and hepatotoxicity.

**Module 11. DNA as a universal diagnostic tool**

Restrictases, Genomic libraries, PCR: classical PCR, RT-PCR, qPCR, digital drop PCR (ddPCR). Human Genome Project. Gene sequencing, New generation sequencing (NGS). Microarray assay.

**Forms of control**

The program of the course implies following types of control:

* The current monitoring of knowledge in the form of oral test (colloquium, interview)
* Writing of essays and making reports.
* Mid-term monitoring in the form of testing
* Intermediate control in the form of exam.