MINISTRY OF EDUCATION AND SCIENCE OF UKRAINE

SUMY STATE UNIVERSITY

Medical Institute

Department of Biophysics, Biochemistry, Pharmacology and Biomolecular Engineering

CLINICAL BIOCHEMISTRY

Higher education level	The Second
Major: study programme	222 Medicine: Medicine, 228 Pediatrics: Pediatrics

Approved by Quality Council of the Institute
(Faculty)
Protocol dated _____№ _____

Chairman of the Quality Council of the Institute
(Faculty)

DATA ON REVIEWS AND APPROVAL

Author

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Review of the course descriptor	_____ _____
Considered and approved at the meeting of the Department of Biophysics, Biochemistry, Pharmacology and Biomolecular Engineering	Protocol dated _____№ _____ Head of the Department _____

Data on the review:

Year	№ Annex with the description of amendments made	Amendments considered and approved			
		Approved by the work group of study programme, protocol №	Head of the study programme, signature	Approved by the Department, date and protocol №	Head of the Department

SYLLABUS

1. General information on the course

Full course name	Clinical Biochemistry
Full official name of a higher education institution	Sumy State University
Full name of a structural unit	Medical Institute. Department of Biophysics, Biochemistry, Pharmacology and Biomolecular Engineering
Author(s)	Chorna Inna Valentynivna, Hrebenyk Liudmyla Ivanivna, Primova Liudmyla Oleksandrivna
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	18 weeks across 7 semester or 18 weeks across 8 semester
Workload	The scope consists of 5 credits ECTS, 150 hours, including 36 hours of work with lecturer (36 hours of laboratory work), 114 hours of self-study.
Language(s)	English

2. Place in the study programme

Relation to curriculum	Elective course available for study programmes "Medicine", "Pediatrics"
Prerequisites	Biological and Bioorganic Chemistry, Human Physiology, Pathophysiology
Additional requirements	There are no specific requirements
Restrictions	There are no specific restrictions

3. Aims of the course

The aim of the discipline is to provide students with knowledge about typical changes in metabolic processes in the most common pathologies and skills of using modern algorithms of biochemical research to achieve effective interpretation of the results in diagnosing, monitoring and predicting disease with bioethics and academic integrity.

4. Contents

Module 1. Clinical biochemistry: theoretical principles and practical approaches.

Topic 1 Biochemical tests in clinical medicine.

Application of biochemical analyzes in diagnosis, screening, prognosis and monitoring of diseases. Types of biological material. General requirements for sampling for analysis. General requirements for sample analysis and presentation of results. Interpretation of analysis results. Specificity, sensitivity and prognostic value of biochemical analyzes. Errors in laboratory diagnostics. New directions of development of clinical diagnostic laboratories. Prospects for the development of biochemical methods of non-invasive diagnostics. Monitoring of medicines. Screening for the presence of pharmacological drugs in the body.

Topic 2 Determination of indicators of protein metabolism and non-protein blood nitrogen in normal and pathology.

Characteristics of methods of proteins research (electrophoresis, immunoelectrophoresis, chromatography). Technique and conditions for performing electrophoresis of blood serum proteins. Graphical presentation of the results obtained. Clinical significance of the determination of the total blood serum proteins. Characteristics of the main blood fractions of proteins. The concept of disproteinaemias, paraproteinaemias, M-gradient, and Bence Jones proteins. Characteristics of proteinuria. Uroproteinograms. Nonprotein nitrogen of blood. Classification of azotemias. Clinical significance for the definition of the rest nitrogen components in blood (urine, free amino acids, creatine, creatinine, indican, ammonia, uric acid).

Topic 3 Clinical enzymology. Biochemical bases of enzymodiagnostics.

Application of enzymes in clinical practice. Enzymodiagnostic. Classification of the plasma enzymes. Types of changes in activity of blood enzymes in cases of different pathologies. General characteristic of the enzymes which are of diagnostic significance: alkaline and acid phosphatases, transaminases, gamma-glutamyl transpeptidase, lactate dehydrogenase, creatine kinase, amylase, choline esterase, sorbitoldehydrogenase, transamidinase. Changes in enzymatic activity during diseases of liver, heart, muscles, bones, kidneys, pancreas, oncological diseases. Enzymes of other biological fluids and tissues. General principles of estimation of enzymatic activity in blood serum. Units of activity of enzymes. Disadvantages of enzyme analysis.

Topic 4 Laboratory tests and biochemical diagnosis of disorders of lipid and lipoprotein metabolism.

General characteristics of tryacylglycerol, cholesterol and phospholipids. Classification of fractioning methods and metabolism of lipoproteins. Laboratory research of lipids and lipoproteins metabolism. Result interpretation. Disorders of lipid metabolism (fatty liver, obesity, atherosclerosis). Classification, characteristics, clinical and laboratory diagnosis of dyslipoproteinemias. Pharmacological correction and monitoring of hyperlipoproteinemia treatment.

Topic 5 Clinical and laboratory diagnosis of carbohydrate metabolism disorders.

Disorders of digestion and absorption of carbohydrates: symptoms, clinical and laboratory diagnostics. Diabetes melitus (DM): aetiology, pathogenesis, pathophysiological and clinical symptoms, diagnostics, treatment and its monitoring. Metabolic complication of diabetes. Hyperglycemic states: causes, metabolic breaches, clinical and laboratory diagnostics. Glucosuria. Hypoglycemic states: causes, metabolic breaches, clinical and laboratory diagnostics. Hypoglycemic syndromes.

Topic 6 Diagnostic criteria of disturbance of water, sodium, potassium metabolism. Determination of acid-base balance.

Distribution and role of water, sodium and potassium. Mechanisms of regulation of water-salt metabolism. Homeostasis of water and sodium. Laboratory assessment of water and sodium level. Breaches of water-salt metabolism: dehydration, hyperhydration, hyponatraemia, hypernatraemia (causes, clinical symptoms). Determination of blood osmolarity. Homeostasis of potassium. Breaches of potassium metabolism: hypokalemia, hyperkalemia (causes, clinical symptoms, laboratory diagnostics). Homeostasis of hydrogen ions, its regulation. Blood buffer systems. Breaches in homeostasis of hydrogen ions: acidosis, alkalosis. Results interpretation after determining of acid-dace balance. Clinical and laboratory assessment of hydrogen ions level.

Topic 7 Clinical-laboratory diagnostics of disorders of hemoproteins, porphyrines and iron metabolism.

Hemoproteins, hemoglobin and hemoglobinopathias. Pathological derivates of haemoglobin. Metabolism of porphyrines, metabolism of regulation. Synthesis of haem. Disorders of porphyrines metabolism: porphyrias, porphyrinurias. Metabolism of iron. Pathologies of metabolism. Qualitative test of Mayzer and Granin by exposing in the urine the components of porphyrines, porphobilinogen. Reznik's and Fedorov's semiquantitative method of determination of coproporphyrines concentration in urine. Determination of haemoglobin by hemoglobincyanide method. Clinical- diagnostic value of determination of biochemical parameters of blood and urine in disorders of hemoprotein metabolism.

Topic 8 Clinical-laboratory diagnosis of nucleotides metabolism disorders.

Metabolism of purine nucleotides. Sources of urates excretion. Metabolism of uric acid. Hyper- and hypouricaemia. Disorders of purine nucleotides. Pathogenesis of gout. Pyrimidine nucleotides metabolism. Lesch–Nyhan syndrome. Inherited xanthanuria. Disorder of pyrimidine nucleotides metabolism. Inherited orotoaciduria. Laboratory researches under disorder of nucleotides metabolism. Clinical value of determination of uric acid, free adenyl nucleotides, components of the cyclase system. Biochemical methods of correction of pathology of nucleotides metabolism.

Topic 9 Clinical-laboratory diagnostics of hypothalamus, hypophysis, adrenal and sexual glands disorders.

General description of hormones of anterior and posterior lobes of hypophysis, adrenal and sexual glands. Laboratory diagnostics of disorders of functions of pituitary gland. Methods and diagnostic value for determination of steroid profile of urine. Laboratory tests for the exposure of hypo- and hyperfunction of adrenal glands. Laboratory researches for disorder of functions of sexual glands. Principles of methods for determining the concentration of hormones in the blood and other biological fluids.

Topic 10 Clinical-laboratory diagnostics of functional activity of thyroid and parathyroid glands. Biochemical investigation of disorders of calcium, phosphates and magnesium metabolism.

General description of hormones of thyroid gland: metabolism, biochemical and physiology effects, regulation of secretion. Diseases of thyroid gland, its laboratory diagnostics, screening method. General characteristics of hormones of parathyroid glands. Disorders of function of parathyroid glands, its laboratory diagnostics. Metabolism of calcium, phosphates, magnesium, its regulation. Disorder of calcium, phosphates and magnesium metabolism. Disorders of metabolism in bone tissue: rickets, osteomalacia, Paget's disease. Algorithm for conducting biochemical analyzes in disorders of calcium, phosphorus, magnesium metabolism.

Topic 11 A clinical estimation of biochemical indexes is at liver and biliary tract diseases.

Basic functions of liver. Metabolism of bilirubin. Biochemical methods of estimation of liver functions: tests which characterise the metabolic functions of liver; enzymes as functional tests of liver; tests which characterise detoxication and excretory functions of liver. Syndrome classification of liver function tests. Functional biochemical description of basic nosological forms of diseases of the hepatobiliary system. Algorithm inspections patients with pathology of the hepatobiliary system and laboratory tests which are used on the different stages of diagnostics. Laboratory diagnostics of the inherited desorders of metabolism of bilirubin and other diseases of liver. Biochemical changes in the liver under the action of hepatotoxic substances and the principles of methods for diagnosing changes that occur.

Topic 12 A clinical estimation of biochemical indexes in kidneys diseases.

Features of metabolism in kidneys in a norm and at pathology. Biochemical kidneys functions tests: filtration, glomerular state and tubular function. Organ-specific enzymes in diagnostic of kidneys diseases. Research of proteins spectrum of blood and urine at pathology of kidneys. Proteinurias. Clinical laboratory diagnostics of basic nosology forms of kidneys diseases.

Topic 13 Disorders of gastrointestinal tract functions, their diagnostics and diet therapy.

Disorders and examination of stomach function. Determination of general acidity, general hydrochloric acid, combined hydrochloric acid and free hydrochloric acid in one portion of gastric juice. Clinical-diagnotic value of separate indexes of gastric secretion. Examination of pancreas function. Algorithms for assessing intestine function using biochemical research methods. Hormonal regulation of the gastrointestinal tract and assessment of changes in endocrine regulation in pathological conditions of the body. Metabolic principles of treatment of the most common pathologies of the gastrointestinal tract. Role of vitamins, microelements in a medical diet.

Topic 14 Clinical biochemistry of the inherited metabolic diseases.

Influence of mutagenic factors on structure of the genome, adjusting of its transcription and translation. The horizontal and vertical passing to heredity and transformation of its violations in a disease. Anomalous metabolic processes in organs and tissues of organism and biochemical tests for diagnostics of the inherited pathologies. Inherited violations of exchange of carbohydrates, their clinic-laboratory diagnostics. Inherited violations of exchange of lipids, their clinic-laboratory diagnostics. Inherited violations of protien metabolism their clinic-laboratory diagnostics. Prenatal diagnostics of the inherited metabolic diseases. Possibilities of genetic analysis in diagnostics of the inherited metabolic diseases. Biochemical principles of treatment of the inherited metabolic disturbances.

Topic 15 Clinical biochemistry of oncologic diseases. Genetic basics of proliferation. Mechanisms of regulation of inherited information transfer and their violation. Hypothesis about the origin of malignant growth. Paraneoplasticity endocrine syndromes, pluriglandular syndromes, their laboratory diagnostics. Metabolic complications of oncologic diseases. Markers of tumours: determination and clinical interpretation of research results.
Topic 16 Biochemical aspects of diagnostics of extreme age diseases. Metabolism of carbohydrates, hormones, proteins, lipids during pregnancy, for newborn children, for children and elderly people. Norm of biochemical indexes for geriatric patients and children. Screening programs for children and elderly people. Illnesses of child's age, features of their laboratory diagnostics. Diseases of the elderly, features of their laboratory diagnosis, interpretation of results. Laboratory tests in pregnant women and infants.
Topic 17 Clinical and laboratory diagnosis of diseases of the cardiovascular system, connective system and respiratory system. The role of laboratory research in identifying the causes and forms of hypertension. Causes of development and laboratory diagnosis of atherosclerosis. The role of laboratory research in the diagnosis of heart disease. Laboratory tests of rheumatic process activity. Clinical and laboratory diagnosis of connective tissue diseases. Laboratory diagnosis of respiratory diseases.
Topic 18 Final modular control. Testing on the content of the discipline (in accordance with the regulations of the differential credit).

5. Intended learning outcomes of the course

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

LO1	Select the optimal set of biochemical tests to diagnose the most common pathologies.
LO2	Assess the severity of metabolic changes in the body using the results of biochemical analyzes of body fluids.
LO3	Interpret to obtain the results of biochemical studies and use them to diagnose the most common pathologies.
LO4	Evaluate and use information about possible metabolic changes in the human body, their causes and consequences.
LO5	Use professional terminology in practice.

7. Teaching and learning activities

7.1 Types of training

Topic 1. Biochemical tests in clinical medicine.

pr.tr.1 "Biochemical tests in clinical medicine." (full-time course)

Use of biochemical analyzes in diagnosis, screening, prognosis and monitoring of diseases. General requirements for sampling for analysis. General requirements for sample analysis and presentation of results. Interpretation of analysis results. Specificity, sensitivity and prognostic value of biochemical analyzes. Errors in laboratory diagnostics. New directions of development of clinical diagnostic laboratories. Prospects for the development of biochemical methods of non-invasive diagnostics. Monitoring of medicines. Screening for the presence of pharmacological drugs in the body. Carrying out of practical employment provides carrying out of instructing on technics of work at work in biochemical diagnostic laboratory, use of interactive virtual simulation (viewing of a film) about the organization of modern biochemical laboratory.

Topic 2. Determination of indicators of protein metabolism and non-protein blood nitrogen in normal and pathology.

pr.tr.2 "Determination of indicators of protein metabolism and non-protein blood nitrogen in normal and pathology." (full-time course)

Characteristics of protein research methods (electrophoresis, immunoelectrophoresis, chromatography). Sequence of operations and conditions of electrophoresis of serum proteins. Graphical expression of research results. Clinical significance of determination of total serum protein. Characteristics of the main protein fractions of blood. The concept of dysproteinemia, paraproteinemia, M-gradient, Bence-Jones proteins. The concept of proteinuria. Uroproteinograms. Non-protein blood nitrogen. Classification of azotemias. Clinical significance of determining the components of residual blood nitrogen (urea, free amino acids, creatine, creatinine, indican, ammonia, uric acid). Conducting a practical lesson involves performing a laboratory study "Determination of total serum protein by biuret method" and analysis of the results."

Topic 3. Clinical enzymology. Biochemical bases of enzymodiagnostics.

pr.tr.3 "Clinical enzymology. Biochemical bases of enzymodiagnostics." (full-time course)

The use of enzymes in clinical practice. Enzymodiagnostics. Classification of blood plasma enzymes. Types of changes in the activity of blood enzymes in various pathologies. General characteristics of enzymes, the definition of which has diagnostic value: alkaline and acid phosphatases, transaminases, gamma-glutamyltranspeptidase (GGTP), lactate dehydrogenase (LDH), creatine kinase (CK), amylase, cholinesterase, sorbitol, dehydrogenase. Changes in enzyme activity in diseases of the liver, heart, muscles, bones, kidneys, pancreas, cancer. Enzymes of other biological fluids and tissues. General principles for determining the activity of enzymes in blood serum. Units of enzyme activity. Disadvantages of enzyme analysis. Conducting a practical lesson involves the use of the case method and group work on their discussion.

Topic 4. Laboratory tests and biochemical diagnosis of disorders of lipid and lipoprotein metabolism.

pr.tr.4 "Laboratory tests and biochemical diagnosis of disorders of lipid and lipoprotein metabolism." (full-time course)

General characteristics of triacylglycerols, cholesterol and phospholipids. Classification of fractionation methods and lipoprotein (LP) metabolism. Laboratory studies of lipid and lipoprotein metabolism. Interpretation of results. Disorders of lipid metabolism (fatty liver, obesity, atherosclerosis). Classification, characteristics, clinical and laboratory diagnosis of dyslipoproteinemias. Pharmacological correction and monitoring of hyperlipoproteinemia treatment. The practical lesson involves an interactive virtual simulation (watching a movie) with further discussion.

Topic 5. Clinical and laboratory diagnosis of carbohydrate metabolism disorders.

pr.tr.5 "Clinical and laboratory diagnosis of carbohydrate metabolism disorders." (full-time course)

Disorders of digestion and absorption of carbohydrates: symptoms and clinical and laboratory diagnosis. Diabetes mellitus (DM): etiology, pathogenesis, pathophysiological and clinical manifestations, diagnosis, treatment, treatment monitoring. Metabolic complications of diabetes. Hyperglycemic conditions: causes, metabolic disorders and clinical and laboratory diagnosis. Glucosuria. Hypoglycemic conditions: causes, clinical manifestations, clinical and laboratory diagnosis. Hypoglycemic syndromes. Conducting a practical lesson involves performing laboratory work "Determination of blood glucose by orthotoluidine method" and discussion of the results. The case-method and team-based learning will be used in the practical lesson.

Topic 6. Diagnostic criteria of disturbance of water, sodium, potassium metabolism. Determination of acid-base balance.

pr.tr.6 "Diagnostic criteria of disturbance of water, sodium, potassium metabolism. Determination of acid-base balance." (full-time course)

Distribution and role of water, sodium and potassium. Mechanisms of regulation of water-salt metabolism. Homeostasis of water and sodium. Laboratory assessment of water and sodium status. Disorders of water-salt metabolism: dehydration, hyperhydration, hyponatremia, hypernatremia (causes, clinical manifestations). Determination of blood osmolarity. Potassium homeostasis. Potassium metabolism disorders: hypokalemia, hyperkalemia (causes, clinical manifestations, laboratory diagnosis). Homeostasis of hydrogen ions, its regulation. Blood buffer systems. Violation of homeostasis of hydrogen ions: acidosis, alkalosis. Interpretation of the results of determining the acid-base balance. Clinical and laboratory assessment of hydrogen ion status. Conducting a practical lesson involves the use of a virtual interactive simulation (watching a movie) with subsequent discussion.

Topic 7. Clinical-laboratory diagnostics of disorders of hemoproteins, porphyrines and iron metabolism.

pr.tr.7 "Clinical-laboratory diagnostics of disorders of hemoproteins, porphyrines and iron metabolism." (full-time course)

Hemoproteins, hemoglobin and hemoglobinopathies. Pathological derivatives of hemoglobin. Metabolism of porphyrins, regulation of metabolism. Heme synthesis. Disorders of porphyrin metabolism: porphyria, porphyrinuria. Iron metabolism. Metabolic pathologies. Qualitative test of Mayzer and Granin for the detection of porphyrin and porphobilinogen precursors in urine. Reznik's and Fedorov's semiquantitative method of determination of coproporphyrines. Determination of hemoglobin by hemoglobin cyanide method. Clinical and diagnostic value of determining the biochemical parameters of blood and urine in disorders of hemoprotein metabolism. The practical lesson will include laboratory tests: "Qualitative test of Mayzer and Granin for detection of urinary precursors of porphyrins, porphobilinogen" and "Reznik's and Fedorov's semiquantitative method of determination of coproporphyrines" with further discussion of research results.

Topic 8. Clinical-laboratory diagnosis of nucleotides metabolism disorders.

pr.tr.8 "Clinical-laboratory diagnosis of nucleotides metabolism disorders." (full-time course)

Metabolism of purine nucleotides. Sources of urate excretion. Uric acid metabolism. Hyper- and hypouricemia. Disorders of purine nucleotide metabolism. Pathogenesis of gout. Lesch-Nyhan syndrome. Hereditary xanthinuria. Disorders of pyrimidine nucleotide metabolism. Hereditary orotoaciduria. Laboratory studies in disorders of nucleotide metabolism. Clinical significance of determination of uric acid, free adenyl nucleotides, components of the cyclase system. Biochemical principles of basic methods of correction of pathology of nucleotide metabolism. The practical lesson involves the use of an interactive virtual simulation (watching an educational film) with further discussion.

Topic 9. Clinical-laboratory diagnostics of hypothalamus, hypophysis, adrenal and sexual glands disorders.

pr.tr.9 "Clinical-laboratory diagnostics of hypothalamus, hypophysis, adrenal and sexual glands disorders." (full-time course)

General characteristics of hormones of the anterior and posterior pituitary, adrenal and gonadal glands. Laboratory diagnosis of pituitary dysfunction. Methods and clinical diagnostic value of determination of steroid profile of urine. Laboratory tests to detect hypo- and hyperfunction of the adrenal glands. Laboratory studies of dysfunction of the gonads. Principles of methods for determining the concentration of hormones in the blood and other biological fluids. The practical lesson involves the use of case-method and principles of team-based learning.

Topic 10. Clinical-laboratory diagnostics of functional activity of thyroid and parathyroid glands. Biochemical investigation of disorders of calcium, phosphates and magnesium metabolism.

pr.tr.10 "Clinical-laboratory diagnostics of functional activity of thyroid and parathyroid glands. Biochemical investigation of disorders of calcium, phosphates and magnesium metabolism." (full-time course)

Biochemical assessment of disorders of calcium, phosphate and magnesium metabolism. General characteristics of thyroid hormones: metabolism, biochemical and physiological effects, regulation of secretion. Thyroid diseases, their laboratory diagnosis, screening. Biochemical principles of diagnosis of thyroid diseases. General characteristics of parathyroid hormone. Dysfunction of the parathyroid glands, their laboratory diagnosis. Biochemical methods for assessing the functioning of the parathyroid glands. Metabolism of calcium, phosphorus, magnesium, its regulation. Disorders of calcium, phosphorus and magnesium metabolism. Metabolic disorders in bone tissue: rickets, osteomalacia, osteoporosis, Paget's disease. Algorithm for conducting biochemical analyzes in disorders of calcium, phosphorus, magnesium metabolism. The practical lesson involves the use of a virtual interactive simulation (watching a training film) and discussion of cases using team-based learning technology.

Topic 11. A clinical estimation of biochemical indexes is at liver and biliary tract diseases.

pr.tr.11 "A clinical estimation of biochemical indexes is at liver and biliary tract diseases." (full-time course)

Clinical evaluation of biochemical parameters in diseases of the liver and biliary tract. The main functions of the liver. Bilirubin metabolism. Biochemical methods for assessing liver function: samples that characterize the metabolic function of the liver; enzymes as functional tests of the liver; tests characterizing the detoxifying and excretory functions of the liver. Syndrome classification of liver function tests. Functional biochemical characteristics of the main nosological forms of diseases of the hepatobiliary system. Algorithm for examination of patients with pathology of the hepatobiliary system and laboratory tests used at different stages of diagnosis. Laboratory diagnosis of hereditary disorders of bilirubin metabolism and other liver diseases. Biochemical changes in the liver under the action of hepatotoxic substances and the principles of methods for diagnosing changes that occur. The organization of practical training provides discussion of bags, carrying out virtual laboratory work "Determination of concentration of bilirubin in blood".

Topic 12. A clinical estimation of biochemical indexes in kidneys diseases.

pr.tr.12 "A clinical estimation of biochemical indexes in kidneys diseases." (full-time course)

Features of metabolism in the kidneys in norm and pathology. Biochemical tests of renal function: filtration, glomerular state and tubular function. Organ-specific enzymes in the diagnosis of renal pathologies. Investigation of the protein spectrum of blood and urine in renal pathology. Proteinuria. Clinical laboratory diagnosis of the main nosological forms of kidney disease. The organization of practical training involves laboratory work using an automatic analyzer to determine the basic biochemical parameters of urine, followed by discussion of the results of the study.

Topic 13. Disorders of gastrointestinal tract functions, their diagnostics and diet therapy.

pr.tr.13 "Disorders of gastrointestinal tract functions, their diagnostics and diet therapy." (full-time course)

Disorders and studies of gastric function. Determination of general acidity, general hydrochloric acid, combined hydrochloric acid and free hydrochloric acid in one portion of gastric juice. Clinical and diagnostic value of determining individual indicators of gastric juice. Biochemical methods for studying the functions of the pancreas. Algorithms for assessing intestine function using biochemical research methods. Hormonal regulation of the gastrointestinal tract and assessment of changes in endocrine regulation in pathological conditions of the body. Metabolic principles of treatment of the most common pathologies of the gastrointestinal tract. The role of vitamins and trace elements in medical nutrition. The practical lesson involves the use of a virtual interactive simulation (watching an educational film) with further discussion.

Topic 14. Clinical biochemistry of the inherited metabolic diseases.

pr.tr.14 "Clinical biochemistry of the inherited metabolic diseases." (full-time course)

Influence of mutagenic factors on the structure of the genome, regulation of its transcription and translation. Horizontal and vertical transmission of heredity and the transformation of its violation into a disease. Abnormal metabolic processes in organs and tissues of the body and their corresponding biochemical tests as a basis for the diagnosis of hereditary pathologies. Hereditary disorders of carbohydrate metabolism, their clinical and laboratory diagnosis. Hereditary disorders of lipid metabolism, their clinical and laboratory diagnosis. Hereditary disorders of protein metabolism, their clinical and laboratory diagnosis. Prenatal diagnosis of hereditary metabolic diseases. Possibilities of genetic analysis in the diagnosis of hereditary metabolic diseases. Biochemical principles of treatment of hereditary metabolic disorders. The practical lesson involves the use of interactive virtual simulations (watching educational films) with further discussion.

Topic 15. Clinical biochemistry of oncologic diseases.

pr.tr.15 "Clinical biochemistry of oncologic diseases." (full-time course)

Molecular basis of proliferation. Mechanisms of regulation of hereditary information transfer and their violation. Hypotheses about the occurrence of malignant growth. Paraneoplastic endocrine syndromes, pluriglandular syndromes, their laboratory diagnosis. Metabolic complications of cancer. Biochemical markers of tumors: definition and clinical interpretation of research results. The organization of the practical lesson involves the use of the case-method and the use of educational virtual simulations (educational films).

Topic 16. Biochemical aspects of diagnostics of extreme age diseases.

pr.tr.16 "Biochemical aspects of diagnostics of extreme age diseases." (full-time course)

Metabolism of carbohydrates, lipids, proteins, hormones during pregnancy, in newborns, children and the elderly. The question of the norm of biochemical parameters in geriatric patients and children. Screening programs for children and the elderly. Diseases of childhood, features of their laboratory diagnosis. Diseases of the elderly, features of their laboratory diagnosis, interpretation of results. Laboratory tests in pregnant women and infants. The practical lesson involves the use of interactive virtual simulations (watching educational films) with further discussion.

Topic 17. Clinical and laboratory diagnosis of diseases of the cardiovascular system, connective system and respiratory system.

pr.tr.17 "Clinical and laboratory diagnosis of diseases of the cardiovascular system, connective system and respiratory system." (full-time course) The role of laboratory research in identifying the causes and forms of hypertension. Causes of development and laboratory diagnosis of atherosclerosis. The role of laboratory research in the diagnosis of heart disease. Laboratory tests of rheumatic process activity. Clinical and laboratory diagnosis of connective tissue diseases. Laboratory diagnosis of respiratory diseases. The organization of the practical lesson involves the use of basic principles of case-method and team-based learning.
Topic 18. Final modular control.
pr.tr.18 "Final modular control." (full-time course) The organization of a practical lesson involves a test control of students' knowledge in accordance with the content of the discipline.

7.2 Learning activities

LA1	Virtual laboratory works performance
LA2	Performing situational tasks
LA3	Performance and presentation of laboratory work results
LA4	E-learning in the Mix.SumDU system
LA5	Discussion of cases
LA6	Preparation for current and final control
LA7	Multimedia presentations preparation
LA8	Watching movies
LA9	Preparation for practical classes
LA10	Solving situational problems

8. Teaching methods

Course involves learning through:

TM1	Analysis of specific situations (case-study)
TM2	Research work
TM3	Case method
TM4	Brainstorming
TM5	Educational discussion / debate

The practical classes provide for the use of real clinical situations (cases), which are discussed in groups of students. In presenting the results of the work, elements of edutainment are used. The teaching process focuses on research, synthesis and analysis of information, including the discussion of cases and laboratory work. The use of technological techniques of brainstorming allows you to activate thinking and develop skills of rapid response in problematic situations.

The organization of training allows students to improve communication skills, ability to work and study in a team, promotes creativity and self-organization, allows to form critical and analytical thinking, forms a sense of responsibility and self-confidence.

9. Methods and criteria for assessment

9.1. Assessment criteria

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

9.2 Formative assessment

FA1	Oral and / or written interview, solving situational problems, current computer testing

9.3 Summative assessment

SA1	Current control measures: oral examination or assessment of written work, problem solving, testing.
SA2	Compilation of the final test modular control

Form of assessment:

7 semester		**200 scores**
SA1. Current control measures: oral examination or assessment of written work, problem solving, testing.		**120**
		120
SA2. Compilation of the final test modular control		**80**
		80
8 semester		**200 scores**
SA1. Current control measures: oral examination or assessment of written work, problem solving, testing.		**120**
		120
SA2. Compilation of the final test modular control		**80**
		80

Form of assessment (special cases):

7 semester	**200 scores**

SA1. Current control measures: oral examination or assessment of written work, problem solving, testing.		**120**
	In case of quarantine restrictions of interrogation, performance of virtual laboratory works, solution of a clinical case, current testing are carried out in a remote mode with use of a platform Mix.Sumdu.edu.ua,Google meet.	120
SA2. Compilation of the final test modular control		**80**
	In case of quarantine restrictions, modular testing is performed remotely using the platform Mix.sumdu.edu.ua.	80
8 semester		**200 scores**
SA1. Current control measures: oral examination or assessment of written work, problem solving, testing.		**120**
	In case of quarantine restrictions of interrogation, performance of virtual laboratory works, solution of a clinical case, current testing are carried out in a remote mode with use of a platform Mix.Sumdu.edu.ua,Google meet.	120
SA2. Compilation of the final test modular control		**80**
	In case of quarantine restrictions, modular testing is performed remotely using the platform Mix.sumdu.edu.ua.	80

Rating of students' academic performance is assessed according to the traditional 4-point system. The calculated arithmetic mean scores for testing and the theoretical part are recalculated into points at the end of the semester by multiplying by a factor (9.6 - for testing, 14.4 - for the theoretical part). The sum of all points obtained for the semester is the result of assessing the current academic performance of students. The amount of points for semester's academic performance must be at least 72.0. Students who received less than 72 points on their academic performance during the study of the discipline must increase their score to the specified minimum score through additional testing. The final module control is carried out by testing in accordance with the content of the discipline. The result of success for the semester - a test that a student can receive if the conditions of the regulations as the sum of points for the current success and the final module control. Incentive points are added to the assessment of the discipline for the implementation of an individual research project (defense of student academic work 12 points, presentation at the conference 5 points, poster presentation at the conference 4 points, abstracts at the conference 3 points). The total score in the discipline may not exceed 200 points.

10. Learning resources

10.1 Material and technical support

MTS1	Laboratory equipment and reagents: spectrophotometer, thermostat, water bath, scales, spirits, fume cupboards, automatic mini-analyzers to determine the main parameters of blood and urine, solutions of chemical reagents.
MTS2	Devices: projectors, screens, smart boards.
MTS3	Library funds
MTS4	Computers and software to support distance learning and virtual labs.

MTS5	Technical means (educational films)

10.2 Information and methodical support

Essential Reading	
1	William Marshall, Marta Lapsley, Andrew Day, Kate Shipman. Clinical Chemistry. – Elsevier, 2020, - 432 p.
Supplemental Reading	
2	Nessar Ahmed. Clinical Biochemistry (Fundamentals of Biomedical Science). - Oxford University Press; 1st edition, 2011. - 714p.
3	Michael W. King. Integrative Medical Biochemistry: Examination and Board Review. - McGraw-Hill Education / Medical; 1st edition, 2014. - 912p.
4	Ramasamyiyer Swaminathan. Handbook of Clinical Biochemistry. - World Scientific Publishing Company; 2nd edition, 2011. - 816p.
Web-based and electronic resources	
5	INTERNATIONAL JOURNAL OF MEDICAL BIOCHEMISTRY https://internationalbiochemistry.com/covers/2021-3.pdf
6	Biotechnology and Applied Biochemistry https://iubmb.onlinelibrary.wiley.com/journal/14708744

COURSE DESCRIPTOR

№	Topic	Total, hours	Lectures, hours	Workshops (seminars), hours	Labs, hours	Self-study of the material, hours	Individual tasks, hours
full-time course form of study							
Module 1. Clinical biochemistry: theoretical principles and practical approaches.							
1	Biochemical tests in clinical medicine.	2	0	2	0	0	0
2	Determination of indicators of protein metabolism and non-protein blood nitrogen in normal and pathology.	9	0	2	0	7	0
3	Clinical enzymology. Biochemical bases of enzymodiagnostics.	9	0	2	0	7	0
4	Laboratory tests and biochemical diagnosis of disorders of lipid and lipoprotein metabolism.	9	0	2	0	7	0
5	Clinical and laboratory diagnosis of carbohydrate metabolism disorders.	9	0	2	0	7	0
6	Diagnostic criteria of disturbance of water, sodium, potassium metabolism. Determination of acid-base balance.	9	0	2	0	7	0
7	Clinical-laboratory diagnostics of disorders of hemoproteins, porphyrines and iron metabolism.	9	0	2	0	7	0
8	Clinical-laboratory diagnosis of nucleotides metabolism disorders.	9	0	2	0	7	0
9	Clinical-laboratory diagnostics of hypothalamus, hypophysis, adrenal and sexual glands disorders.	9	0	2	0	7	0
10	Clinical-laboratory diagnostics of functional activity of thyroid and parathyroid glands. Biochemical investigation of disorders of calcium, phosphates and magnesium metabolism.	9	0	2	0	7	0
11	A clinical estimation of biochemical indexes is at liver and biliary tract diseases.	9	0	2	0	7	0
12	A clinical estimation of biochemical indexes in kidneys diseases.	9	0	2	0	7	0
13	Disorders of gastrointestinal tract functions, their diagnostics and diet therapy.	9	0	2	0	7	0
14	Clinical biochemistry of the inherited metabolic diseases.	9	0	2	0	7	0
15	Clinical biochemistry of oncologic diseases.	9	0	2	0	7	0
16	Biochemical aspects of diagnostics of extreme age diseases.	9	0	2	0	7	0

№	Topic	Total, hours	Lectures, hours	Workshops (seminars), hours	Labs, hours	Self-study of the material, hours	Individual tasks, hours
17	Clinical and laboratory diagnosis of diseases of the cardiovascular system, connective system and respiratory system.	9	0	2	0	7	0
18	Final modular control.	4	0	2	0	2	0
Total (full-time course form of study)		*150*	*0*	*36*	*0*	*114*	*0*

	UNIVERISTY POLICIES FOR THE COURSE «Clinical Biochemistry» **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 **Major: Educational programme** 222 Medicine: Medicine, 228 Pediatrics: Pediatrics **Year of study** 2024 **Semester** 7, 8 semester **Mode of study** full-time course **Language of instruction** English
Teacher(s)	Chorna Inna Valentynivna, Hrebenyk Liudmyla Ivanivna, Primova Liudmyla Oleksandrivna
Contact	Primova L.O. l.primova@med.sumdu.edu.ua Hrebenyk L.I. l.hrebenyk@med.sumdu.edu.ua Chorna I.V. i.chorna@med.sumdu.edu.ua
Time and room for giving consultations	Offline consultation: room 303 and 314 every Monday from 3 to 4:20 pm https://biochem.med.sumdu.edu.ua/index.php?option=com_content&view=article&id=78&Itemid=91&lang=en
Links to online educational platforms	https://mix.sumdu.edu.ua/ Google Meet
Syllabus	http://pg.cabinet.sumdu.edu.ua/report/syllabus/1425430
Channels for maintaining contact with the group for receiving and working on materials	Announcements about the discipline will be posted on the website of the department https://biochem.med.sumdu.edu.ua/index.php?lang=en Channels of communication with the teacher: - teacher's email, - communication through a personal cabinet https://cabinet.sumdu.edu.ua , - Mix.SumDU platform https://mix.sumdu.edu.ua
POLICIES	
Attendance policy	Attendance is mandatory. Under objective circumstances (availability of permission from the dean's office) training can take place individually (online). To receive the credit or admission to the final modular lesson, the topics of all missed practical classes must be worked out for a positive mark.
Assessment policy	Rating of students' academic performance is assessed according to the traditional 4-point system. The calculated arithmetic mean scores for testing and the theoretical part are recalculated into points at the end of the semester by multiplying by a factor (9.6 - for testing, 14.4 - for the theoretical part). The sum of all points obtained for the semester is the result of assessing the current academic performance of students. The amount of points for semester's academic performance must be at least 72.0. Students who received less than 72 points on their academic performance during the study of the discipline must increase their score to the specified minimum score through additional testing. The final module control is carried out by testing in accordance with the content of the discipline. The result of success for the semester - a test that a student can receive if the conditions of the regulations as the sum of points for the current success and the final module control. Incentive points are added to the assessment of the discipline for the implementation of an individual research project (defense of student academic work 12 points, presentation at the conference 5 points, poster presentation at the conference 4 points, abstracts at the conference 3 points). The total score in the discipline may not exceed 200 points.
Deadlines and course retake policy	Deadlines and the number of reworks of the written exam are determined by the dean's office according to the schedule.
Assessment appeals policy	The results of the module and semester assessment are subject to appeal. A student must lodge an appeal to the director/dean on the day of certification or after announcing the results, but no later than the next working day. The appeal commission is established by the director/dean's order. The appeal commission's decision may change the grade in case of violations revealed during the attestation.
Academic integrity policy	Participants must complete all tasks according to the course requirements independently. Participants are not allowed to cheat during the written module or summative test. The assignments should not contain plagiarism, facts of fabrication, falsification, cheating. Manifestations of other types of academic dishonesty determined by the Academic Integrity policy are also unacceptable. If a teacher reveals violations of academic integrity by students during the course, the former have the right to take one of the following actions: - to reduce points by up to 40% for practical assignments; - to give recommendations for improving and resubmitting mandatory homework assignments with the reduction of points by up to 25%; - to not accept mandatory homework assignments without the right to resubmit; - set a date for retaking the written module or the summative test with a reduction of points by up to 15%; - to not allow to retake the written module or the summative test.

Alignment of learning outcomes with teaching and learning activities and assessment

Learning outcomes	Types of training	Learning activities	Teaching methods	Material and technical support	Methods and criteria for assessment
LO1	pr.tr.1-pr.tr.18	LA5, LA8, LA9, LA10	TM1, TM3, TM5	MTS2, MTS3, MTS5	SA1, SA2
LO2	pr.tr.2-pr.tr.18	LA1, LA2, LA3, LA4, LA5, LA6, LA7, LA8, LA9, LA10	TM1, TM3, TM5	MTS1, MTS2, MTS3, MTS4, MTS5	SA1, SA2
LO3	pr.tr.2-pr.tr.18	LA1, LA2, LA3, LA4, LA5, LA6, LA7, LA8, LA9, LA10	TM1, TM2, TM3, TM4, TM5	MTS1, MTS2, MTS3, MTS4, MTS5	SA1, SA2
LO4	pr.tr.2-pr.tr.18	LA1, LA2, LA3, LA5, LA6, LA8, LA9, LA10	TM1, TM2, TM3, TM4, TM5	MTS1, MTS2, MTS3, MTS4, MTS5	SA1, SA2
LO5	pr.tr.1-pr.tr.18	LA1, LA2, LA3, LA4, LA5, LA6, LA7, LA8, LA9, LA10	TM1, TM2, TM3, TM4, TM5	MTS1, MTS2, MTS3, MTS4, MTS5	SA1, SA2