FACULTY OF MEDICINE

STUDY PROGRAM MEDICINE

CHAIR OF BIOCHEMISTRY AND CLINICAL BIOCHEMISTRY

APPROVED
at the meeting of the Commission for Quality Assurance and Evaluation of the Curriculum in Medicine
Minutes No. 5 of 17.02.2025
Chairman _____
Pădure Andrei, PhD, professor

APPROVED
at the Council meeting of the Faculty of Medicine
Minutes No. 5 of 25.02.2025
Dean of Faculty _____
Plăcintă Gheorghe, PhD, associate professor

APPROVED
at the meeting of the Chair of Biochemistry and Clinical biochemistry
Minutes No. 7 of 15.01.2025
Head of chair, PhD, professor
Tagadiuc Olga _____

SYLLABUS

DISCIPLINE **CLINICAL BIOCHEMISTRY**

Integrated studies

Type of course: **Compulsory discipline**

Curriculum developed by:
Olga Tagadiuc, PhD, professor
Silvia Stratulat, dr. of med., associate professor
Ala Ambros, dr. of med., associate professor
Svetlana Protopop, dr. of med., associate professor
Tatiana Timercan, dr. of med., associate professor
Ecaterina Pavlovschi, dr. of med., associate professor

Chisinau, 2025

I. INTRODUCTION

- **General presentation of the discipline: place and role of the discipline in the formation of the specific competences of the professional / specialty training program**

  The discipline of Clinical Biochemistry aims to provide students with fundamental theoretical knowledge and general practical skills in medical biochemistry, essential for the professional activities of all healthcare professionals. Students will study the biochemical basis of the functioning of the human body, as well as specific organs and systems under physiological conditions, and the disruptions that occur in certain pathologies. The activities within the study of this discipline will develop students' abilities to work both individually and as part of a team, to formulate and solve problems, to analyze and interpret medical investigation results, to apply theoretical knowledge in medical practice, and to integrate information from various disciplines (both fundamental and clinical), among other skills.

- **Mission of the curriculum (aim) in professional training encompasses the study of:**
  a) the specific characteristics of the chemical composition of specific organs and tissues, as well as the fundamental metabolic processes that ensure their functionality under physiological conditions;
  b) alterations in the chemical composition of organs and tissues, alongside the fundamental metabolic processes that underlie the pathogenic mechanisms of organ and tissue dysfunction in pathological conditions;
  c) biochemical investigative methods of clinical relevance, fostering a systematic and rational approach to biochemical diagnostics, and cultivating the ability to critically analyze and accurately interpret laboratory data.

- **Languages of the discipline:** Romanian, English and Russian;

- **Beneficiaries:** students of the 3rd year, faculty of Medicine 2.

II. MANAGEMENT OF THE DISCIPLINE

Code of discipline		S.06.O.053	
Name of the discipline		**Clinical Biochemistry**	
Persons in charge of the discipline		Olga Tagadiuc, PhD, professor Silvia Stratulat, dr. of med., associate professor Ala Ambros, dr. of med., associate professor Svetlana Protopop, dr. of med., associate professor Tatiana Timercan, dr. of med., associate professor Ecaterina Pavlovschi, dr. of med., associate professor	
Year	**III**	Semester/Semesters	**VI**
Total number of hours, including:			**90**
Lectures	**30**	Practical/laboratory hours	**15**
Seminars	**15**	Self-training	**30**
Form of assessment	**E**	Number of credits	**3**

III. TRAINING AIMS WITHIN THE DISCIPLINE

At the end of the discipline study the student will be able to:

- **at the level of knowledge and understanding:**

– describe the specific characteristics of the chemical composition of vital organs and tissues.
– identify the fundamental metabolic processes that ensure the viability of vital organs and tissues.
– explain the influence of various factors (environmental, vitamins, pharmaceutical preparations, toxins) on the composition and metabolism of vital organs and tissues.
– clarify the molecular mechanisms of disorders underlying key syndromes and diseases.
– interpret the primary laboratory biochemical diagnostic methods.
– distinguish normal values and physiological variations of key biochemical parameters.
– describe patient preparation for biochemical laboratory investigations, methods for biological sample collection, storage, and transportation, and identify potential causes of errors.

- **at the application level:**

– assess the clinical and diagnostic utility of specific biochemical investigations in evaluating organ and tissue dysfunctions.
– evaluate the usefulness of certain biochemical investigations in diagnosing specific conditions.
– systematically and rationally recommend specific biochemical laboratory tests based on the patient's presumptive or confirmed diagnosis.
– accurately interpret the results of biochemical investigations.

- **at the integration level:**

– appreciate the significance of Clinical Biochemistry in the context of General Medicine.
– evaluate the correlations between Clinical Biochemistry and other clinical disciplines.
– highlight the connections and interdependence between structural, metabolic, and clinical biochemistry.
– assess the progression of physiological metabolic processes and their disruptions, which lead to various pathologies.
– correlate the biochemical molecular pathogenic mechanisms of diseases with the laboratory biochemical diagnostic methods appropriate for each specific case.

IV. PROVISIONAL TERMS AND CONDITIONS

A solid foundation in Chemistry and Biology, acquired during pre-university education, is essential, as well as comprehensive knowledge in Anatomy, Histology, Human Physiology, and Biochemistry, obtained during university studies.

Additionally, students must possess skills in using the internet for locating necessary study materials and conducting individual work, as well as proficiency in processing documents, tables, and presentations.

V. THEMES AND ESTIMATE ALLOCATION OF HOURS

Lectures, practical hours/ laboratory hours/seminars and self-training

No. d/o	Subject	Number of hours		
		Lectures	Practical hours	Self-training
1.	Importance of clinical biochemistry for specialists. Clinical laboratory testing.	2	2	2
2.	Biochemistry of blood. Plasma proteins: Methods of separation, quantification, and interpretation of serum protein variations. Basics of interpreting pathological enzyme variations. Diagnostic role of plasma non-protein nitrogen compounds.	2	2	2
3.	Fluid-Coagulant Balance and laboratory exploration of its disorders	2	2	2
4	Water, Electrolytes and Acid-Base Balance and laboratory exploration of its disorders	2	2	2
5	Pathochemistry and laboratory exploration of renal disorders	2	2	2
6	Calcium and phosphate homeostasis and laboratory exploration of its disorders. Osteoarticular disorders.	2	2	2
7	Concluding test No. 1.		2	2
8	Laboratory investigation of plasma lipids and lipoproteins. Primary and secondary dyslipidemias.	3	2	2
9	Disorders of carbohydrate metabolism. Exploration of carbohydrate metabolism.	3	2	2
10	Pathochemistry of thyroid gland disorders	3	2	2
11	Pathochemistry of adrenal cortex and reproductive system disorders	3	2	2
12	Pathochemistry and diagnosis of liver disorders	3	2	2
13	Biochemistry of neural transmission	3	2	2
14	Concluding test No. 2.		2	2
15	Evaluation of students' individual work		2	2
Total		**30**	**30**	**30**

VI. PRACTICAL SKILLS PURCHASED AT THE END OF THE COURSE

- demonstrate the clinical-diagnostic utility of specific biochemical investigations in evaluating organ and tissue dysfunctions.
- assess the relevance of certain biochemical investigations in diagnosing specific conditions.
- systematically and rationally analyze biochemical laboratory investigations based on the patient's presumptive or confirmed diagnosis.
- accurately interpret the results of biochemical investigations.

IV. OBJECTIVES AND CONTENT UNITS

Objective	Content units
Topic 1. Importance of clinical biochemistry for specialists. Clinical laboratory testing.	
• To define the clinical laboratory testing. • To know the objects of biochemical laboratory research. • To identify the phases of laboratory investigations. • To detail the content and specific procedures for each phase. • To recognize and identify errors in biochemical laboratory testing, their causes, and prevention methods. • To apply the standard biochemical diagnostic profiles individually. • To explain the clinical-diagnostic value of biochemical markers.	1. Clinical laboratory testing: purpose, objects of analysis, and phases. 2. Factors influencing test results: a) Internal factors (age, sex, race, physiological state). b) External factors (collection time, diet, smoking, stress, medications). 3. Pre-analytical phase of the clinical laboratory testing: planning, patient preparation, sample collection, processing, storage, and transportation. 4. Analytical phase of the clinical laboratory testing: major laboratory methods (spectrophotometry, nephelometry, turbidimetry, luminescence, ELISA, etc.), sensitivity, specificity, reproducibility. 5. Post-analytical phase of the clinical laboratory testing: evaluation, validation, clinical relevance, reference values. 6. Causes of errors in different diagnostic stages and prevention strategies.
Topic 2. Biochemistry of blood. Plasma proteins: Methods of separation, quantification, and interpretation of serum protein variations. Basics of interpreting pathological enzyme variations. Diagnostic role of plasma non-protein nitrogen compounds.	
• To know the role and characteristics of plasma proteins. • To apply practical methods for protein measurement and separation. • To interpret the pathological plasma protein variations and major anomalies in electrophoresis. • To define acute-phase inflammation proteins and tumor marker proteins. • To classify the plasma enzymes functionally. • To know the organ-specific enzymes (liver, myocardium, brain, kidneys, muscles, bones). • To explain plasma dysenzymia mechanisms. • To evaluate the enzyme diagnostics in various conditions. • To analyze non-protein nitrogen	1. Chemical composition and functions of blood. 2. Nitrogenous organic substances in blood plasma: a) Plasma proteins: prealbumin, albumin, globulins (α1-antitrypsin, α2-macroglobulin, fibrinogen, transferrin, ceruloplasmin, haptoglobin, immunoglobulins). Methods for protein quantification and separation. Variations in protein fractions in pathology. b) Acute phase proteins in inflammation and their role in paraclinical diagnosis (C-reactive protein, high-sensitivity C-reactive protein, fibrinogen, ferritin, hepcidin, ceruloplasmin). c) Plasma enzymes: functional classification. Mechanisms of plasma dysenzymia. d) Key plasma enzymes with diagnostic significance in myocardial infarction, liver diseases, gastrointestinal disorders, muscle

Objective	Content units
compounds, fractions in normal and pathological states. • To differentiate the mechanisms of retention and production azotemia.	and bone damage, and malignancies. 3. Non-protein nitrogenous compounds.
Topic 3. Fluid-Coagulant Balance and laboratory exploration of its disorders	
• To define the concepts of primary and secondary hemostasis. • To explain the role of the vascular component in primary hemostasis. • To differentiate the structural and functional characteristics of platelets and identify their quantitative and qualitative anomalies. • To illustrate the extrinsic and intrinsic pathways of coagulation. • To interpret the principles regulating fluid-coagulant balance. • To evaluate the causes, sequence of pathogenic metabolic mechanisms, and metabolic changes leading to primary and secondary hemostatic disorders. • To systematically and rationally apply the biochemical investigations in assessing the fluid-coagulant balance. • To accurately assess the changes in the coagulation profile (coagulogram). • To evaluate the hemostatic biochemical alterations based on clinical manifestations and administered treatment	1. Concepts of hemostasis: role and stages. 2. Primary hemostasis: a) vascular component involvement (role of vascular endothelium and subendothelial structures). b) structural and functional characteristics of platelets. c) primary hemostasis exploration: bleeding time, platelet aggregation tests, and von Willebrand factor assays. d) quantitative (thrombocytopenia, thrombocytosis, thrombocythemia) and qualitative (inherited and acquired) platelet anomalies. 3. Secondary hemostasis: a) coagulation factors and cofactors. b) extrinsic and intrinsic coagulation pathways. c) coagulation exploration: prothrombin time (PT), activated partial thromboplastin time (aPTT), thrombin time (TT), coagulation time, and fibrinogen quantification. d) genetic anomalies affecting coagulation factors. 4. Anticoagulant mechanisms: antithrombin III, heparin cofactor II, tissue factor pathway inhibitors, protein Z and its inhibitor, protein C system (protein C, protein S, thrombomodulin, and endothelial protein C receptor). 5. Fibrinolysis: a) general scheme of the fibrinolytic system. b) fibrinolysis exploration: lysis time of diluted blood clots, D-dimer quantification. c) genetic and acquired fibrinolysis disturbances. 6. Concepts of anticoagulant and antiplatelet therapy.
Topic 4. Water, electrolytes and acid-base balance and laboratory exploration of its disorders	
• To define the concepts of diffusion, osmosis, filtration, osmolarity, osmolality, tonicity, oncotic pressure, and hydrostatic pressure. • To know the role, properties, quantity, and distribution of water and	1. Pathochemistry of quantitative and qualitative disorders in water and electrolyte homeostasis: a) role, quantity, and distribution of water and electrolytes in the body. Forces coordinating water and electrolyte movement between compartments. Control of water homeostasis.

Objective	Content units
electrolytes in the main body compartments. • To demonstrate the mechanisms involved in the regulation of water and electrolyte homeostasis. • To apply the formulas for calculating osmolality and osmolar gap. • To define the concepts of acid-base balance, buffer systems, metabolic and respiratory acidosis/alkalosis (compensated and decompensated). • To know the roles and functioning mechanisms of buffer systems, red blood cells, lungs, kidneys, liver, and gastrointestinal tract. • To know the reference values and physiological variations of acid-base parameters. • To identify the causes and demonstrate the mechanisms involved in acid-base imbalances. • To apply the Henderson-Hasselbalch equation and the formula for calculating the anion gap. • To integrate laboratory results with clinical data to resolve case studies.	b) sodium homeostasis control. Disorders of water and sodium metabolism. c) potassium homeostasis. Disorders of potassium metabolism (hypokalemia and hyperkalemia). 2. Diagnosis of hydro-electrolyte disorders and pathochemical treatment principles. 3. Physiological and biochemical mechanisms regulating acid-base balance. 4. Acid-base balance parameters and their physiological and pathological variations: based on age, time of day, digestion phases, and physical activity. 5. Metabolic and respiratory acidosis and alkalosis.
Topic 5. Pathochemistry and Laboratory Exploration of Renal Disorders	
• To define the clearance, reabsorption, secretion, and non-ionic diffusion. • To know the nephron's structure and functions. • To demonstrate the mechanisms of urine formation, concentration, and dilution. • To apply the Cockcroft-Gault formula to calculate GFR for differentiating renal insufficiencies. • To define the key nephrological syndromes (renal tubular acidosis, nephrotic and nephritic syndrome, acute and chronic renal failure, nephrolithiasis). • To explain the causes and pathophysiological mechanisms of renal disorders. • To recognize the laboratory investigations for assessing renal	1. Elements of renal structure. Renal functions. Determinants of glomerular filtration. Pathochemistry of quantitative and qualitative disorders of glomerular filtrate. 2. Exploration of glomerular filtration: glomerular filtration rate (GFR), plasma creatinine, urea, and cystatin C. Interpretation of laboratory results. 3. Tubular functions. Pathochemistry of functional-morphological tubular disorders. Mechanisms of water reabsorption, urine concentration, and dilution. 4. Exploration of Tubular Functions: a) urinary excretion of amino acids and glucose. b) concentration/dilution urine tests. c) urinary acidification tests. 5. Proteinurias: prerenal, renal, and postrenal. Causes and laboratory differentiation. 6. Pathochemistry of Nephrological Syndromes: a) renal tubular acidosis, Alport syndrome, etc. b) nephrotic syndrome.

Objective	Content units
function, reference values, and physiological variations. • To demonstrate the mechanisms leading to renal dysfunction symptoms (edema, hypertension, proteinuria, hematuria, etc.). • To apply the laboratory biomarker results for early identification of acute renal injury (AKI) and differentiation of chronic kidney disease (CKD) stages. • To integrate the laboratory results with clinical data for pathophysiological diagnosis.	c) nephritic syndrome. d) acute renal failure (ARF) and chronic renal failure (CRF). e) diabetic, toxic, and drug-induced nephropathies. 7. Diagnosis of renal dysfunction: The "Renal Investigations" profile in blood. Chemical composition of urine. Abnormal components in urine. Urinary sediment. 8. Exploration of endocrine-humoral and metabolic functions of the kidney. 9. Renal lithiasis: Chemical composition of stones. Causes and stages of lithogenesis. Precipitating factors. Laboratory exploration and pathogenetic treatment principles. 10. Pathogenetic principles of treating renal dysfunctions.
Topic 6. Calcium and phosphate homeostasis and laboratory exploration of its disorders. Osteoarticular disorders.	
• To know the chemical composition and mineral phase of the bone. • To recognize the structural peculiarities of collagen and non-collagenous bone proteins. • To identify the lipids, nucleic acids, organic acids, and enzymes present in bone tissue. • To know the major minerals and trace elements in bone tissue. • To assess bone remodelling stages and regulation. • To identify the dietary sources and absorption mechanisms for calcium and phosphate. • To know the distribution, plasma values, and functions of calcium and phosphate. • To differentiate the forms of calcium in plasma and identify physiologically active forms. • To evaluate the hormonal mechanisms involved in calcium-phosphate homeostasis. • To distinguish the disorders related to parathyroid function, calcitonin secretion, and calcium/phosphate metabolism.	1. Bone as a biological material. Proteins, lipids, nucleic acids, organic acids and enzymes in bone tissue. The mineral phase. 2. Bone tissue remodeling: stages, regulation. 3. Calcium and phosphate metabolism: a) Calcium. Dietary sources. Mechanisms of calcium absorption. Factors influencing calcium absorption (pH, diet composition, fatty acids, carbohydrates and organic acids, phytic acid, oxalates, fiber, phosphates, Ca:P ratio, vitamin D, individual health status, and age). Distribution in the human body. Normal plasma values. Functions, types of calcium in plasma. b) Phosphate: dietary sources, distribution in the human body, normal plasma values in children/adults, absorption, functions. c) Mechanisms involved in phospho-calcium homeostasis: Parathyroid hormone, calcitriol, calcitonin, and other hormones. Disorders of parathyroid gland function (primary, secondary, tertiary hypoparathyroidism, pseudohypoparathyroidism, hyperparathyroidism). Calcitonin secretion disorders. d) Disorders of calcium and phosphate metabolism: Hypercalcemia, hypocalcemia, hyperphosphatemia, hypophosphatemia.

Objective	Content units
• To analyze the biochemical markers of bone formation and resorption. • To apply the biochemical methods to investigate disorders of bone metabolism. • To explain the biochemical mechanisms and perform differential diagnosis of metabolic bone diseases. • To integrate the biochemical knowledge of bone disorders into related clinical disciplines.	4. Biochemical markers of bone metabolism. a) Bone formation markers (osteogenesis): Bone-specific alkaline phosphatase (thermolabile), osteocalcin, procollagen type I propeptides. b) Bone resorption markers: Hydroxyproline, hydroxylysine, collagen cross-links (pyridinoline, deoxypyridinoline), N-telopeptide, type I collagen with carboxyterminal peptide, CrossLaps, tartrate-resistant acid phosphatase. c) Investigation of bone metabolism disorders. 5. Metabolic bone diseases. Osteoporosis, osteomalacia, Paget's disease, bone metastases, primary hyperparathyroidism, secondary hypoparathyroidism. 6. Osteoporosis: local, generalized, primary, secondary, senile. Influence of estrogens on bone tissue. Classification of osteoporotic syndromes. Medications and factors inducing osteoporosis. General principles of osteoporosis treatment.
Topic 7. Laboratory investigation of plasma lipids and lipoproteins. Primary and secondary dyslipidemias.	
• To define the concepts of lipids, lipoproteins, apolipoproteins, primary and secondary dyslipidemias, hyperlipidemias, hypolipidemias, hypercholesterolemia, and hypertriglyceridemia. • To know the principles of plasma lipoprotein classification and the classification of primary and secondary dyslipidemias. • To differentiate the causes leading to the development of primary and secondary hyperlipidemias. • To logically explain the sequence of pathogenetic metabolic mechanisms of primary and secondary dyslipidemias. • To know the biochemical laboratory methods for investigating plasma lipids and lipoproteins. • To rationally apply the tests for investigating lipid metabolism and master the diagnostic algorithm for dyslipidemias. • To accurately assess the modifications	1. Plasma lipoproteins: Structure, role, and separation methods. Apoproteins, proteins, enzymes, and receptors involved in lipoprotein metabolism. 2. Major lipoproteins: chylomicrons, very low-density lipoproteins (VLDL), low-density lipoproteins (LDL), high-density lipoproteins (HDL). 3. Minor and Pathological Lipoproteins: Intermediate-density lipoproteins (IDL), lipoprotein(a) [Lp(a)], lipoprotein X (LPX), beta-VLDL. 4. Determination of plasma lipids and lipoproteins: triglycerides, total cholesterol, LDL cholesterol, HDL cholesterol, apoproteins. Factors influencing lipid parameters. 5. Isolated hypercholesterolemias: familial hypercholesterolemia, sitosterolemia. 6. Isolated hypertriglyceridemias: familial hyperchylomicronemia. 7. Combined hyperlipidemias: familial combined hyperlipidemia, dis-beta-lipoproteinemia. 8. Hypolipidemias: A-beta-lipoproteinemia and hypo-beta-lipoproteinemia.

Objective	Content units
in plasma lipids and lipoproteins in cardiovascular and metabolic pathologies. • To justify the dietary recommendations and hypolipidemic treatments based on the biochemical mechanisms underlying dyslipidemia development. • To apply the acquired knowledge to solve clinical cases related to the diagnosis and treatment of corresponding diseases. • To integrate the information on the biochemical aspects of dyslipidemias and apply it to related clinical disciplines (cardiology, endocrinology, internal medicine, etc.).	9. Decreased HDL cholesterol: Tangier disease, LCAT deficiency. 10. Increased HDL cholesterol: CETP deficiency. 11. The role of lipoproteins in atherosclerosis. atherogenic dyslipidemia. 12. Biochemical principles of hypolipidemic treatment.
Topic 8. Disorders of carbohydrate metabolism. Exploration of carbohydrate metabolism.	
• To describe the structure, synthesis, regulation, mechanisms of action, and metabolic effects of hormones involved in carbohydrate metabolism. • To differentiate and explain the mechanisms regulating postprandial and interprandial glycemia. • To distinguish the pathogenesis and metabolic disturbances in type 1 and type 2 diabetes mellitus. • To illustrate the biochemical mechanisms responsible for hyperglycemia and hypoglycemia. • To systematically and rationally apply tests for the diabetes diagnosis. • To accurately assess the changes in biochemical indices and laboratory tests in diabetes mellitus. • To explain the logical chain of metabolic disturbances in diabetic complications. • To interpret the biochemical mechanisms of metabolic syndrome. • To accurately evaluate the changes in biochemical indices in metabolic syndrome.	1. The role of the endocrine pancreas and hormonal control in maintaining glucose homeostasis. Regulation of postprandial and interprandial glycemia. 2. Pathochemistry of physiological and pathological glycemic variations: a) hypoglycemia: diagnostic algorithm for investigating hypoglycemia in adults. b) hyperglycemia. 3. Diabetes mellitus: a) definition and classification of diabetes mellitus. b) pathogenic mechanisms and metabolic changes in type 1 and type 2 diabetes mellitus. c) screening and diagnosis of diabetes mellitus (fasting glucose, postprandial glucose, glycated hemoglobin [HbA1c], C-peptide, serum insulin, pancreatic autoimmunity markers). d) pathochemistry of diabetic complications: diagnostic value of measuring ketone bodies, lactic acid, and protein glycation. 4. Metabolic Syndrome. Etiopathogenesis and pathophysiology of metabolic syndrome: screening, diagnosis, and evaluation.
Topic 9. Pathochemistry of thyroid gland disorders	
• To describe in detail the metabolism of iodine in the body.	1. Thyroid hormones: a) structure,

Objective	Content units
• To know the specific mechanisms of synthesis, secretion, storage, transport, and inactivation of T3 and T4. • To identify the specific receptors for T3 and T4 in tissues and organs, the signaling cascades triggered, and the subsequent modulated metabolic processes. • To classify the thyroid function disorders based on the secretion levels, glandular hypertrophy types, and the etiology of pathological conditions. • To define the causes of thyroid hypo- and hyperfunction. • To describe the logical sequence of metabolic disturbances in thyroid hypo- and hyperfunction, along with the mechanisms of organ and tissue damage. • To systematically and rationally apply the laboratory investigation methods for thyroid function in accordance with specific algorithms. • To accurately assess the changes in biochemical laboratory tests in thyroid dysfunctions. • To solve the clinical case studies.	b) biosynthesis, c) regulation of secretion, d) transport, e) metabolism, f) mechanism of action, g) metabolic effects. 2. Disorders of thyroid function (hyperthyroidism and hypothyroidism). 3. Laboratory diagnosis of thyroid function disorders: patient preparation, collection, processing, transportation and preservation of biological material. Evaluation methods and their interpretation. Factors that can influence the results.
Topic 10. Pathochemistry of adrenal cortex and reproductive system disorders	
• To describe the specific mechanisms of synthesis, secretion, storage, transport, regulation, and inactivation of steroid hormones. • To identify the specific receptors for steroid hormones in tissues and organs and explain the signaling cascades triggered and the subsequent metabolic processes and effects modulated. • To classify and differentiate the disorders of steroid hormone secretion based on secretion levels, types of glandular hypertrophy, and the etiology of the pathological state. • To describe in a logical sequence the chain of metabolic disturbances in hypo- and hypersecretion of corticosteroid and sex hormones. • To interpret the biochemical	1. Steroid hormones: structure, biosynthesis, regulation of secretion, transport, mechanism of action, effects, and metabolism. 2. Adrenogenital syndromes and the biochemical mechanisms involved in their development. 3. Adrenal pathology due to hormonal hypersecretion: Cushing's syndrome, its causes, metabolic disturbances, and laboratory diagnosis. 4. Adrenal pathology due to hormonal hyposecretion or receptor dysfunction: Addison's disease, its causes, pathogenic mechanisms, metabolic disturbances, and laboratory diagnosis. 5. Female sex hormones: structure, biosynthesis, regulation of secretion (ovarian cycle), transport, metabolism, and actions. 6. Evaluation of ovarian function: laboratory diagnosis of female gonadal disorders.

Objective	Content units
mechanisms of organ and tissue damage in the pathology of corticosteroid and sex hormones. • To systematically and rationally indicate investigations for the diagnosis of adrenal and gonadal disorders. • To assess steroid hormone imbalances and metabolic changes based on biochemical laboratory investigations. • To solve clinical case studies.	7. Female gonadal dysfunctions: hypogonadism and metabolic changes associated with menopause. 8. Male sex hormones: structure, biosynthesis, regulation of secretion, transport, metabolism, and actions. 9. Evaluation of testicular function: laboratory diagnosis of male gonadal disorders. 10. Male gonadal dysfunctions: primary and secondary hypogonadism.
Topic 11. Pathochemistry and diagnosis of liver disorders	
• To define the lobule, acinus, and hepaton, and describe their metabolic specificities. • To classify the hepatic enzymes and explain the diagnostic value of their classes and individual representatives. • To distinguish between physiological variations in hepatic enzyme activity with diagnostic value and those caused by hepatic and extrahepatic diseases. • To systematically and rationally indicate enzymatic investigations in the diagnosis of liver diseases and their differentiation from extrahepatic conditions. • To understand the liver's role in the homeostasis of protein, carbohydrate, and lipid metabolism in the body. • To identify laboratory markers of hepatic homeostatic function. • To apply the markers of hepatic homeostatic function in the biochemical diagnosis of liver and extrahepatic diseases. • To describe the biochemical pathogenic mechanisms of the gallstone disease and the treatment principles based on these mechanisms. • To differentiate hereditary and acquired types of jaundice based on changes in biochemical laboratory indices. • To evaluate the pathways of detoxification/inactivation of certain substances in the liver and the organ damage mechanisms associated with	1. Liver Enzymes: a) classification, representatives, roles, and physiological variations in activity. b) mechanisms of enzyme dysfunction in hepatic diseases. c) pathological changes in liver enzymes in hepatic and extrahepatic diseases. d) diagnostic, prognostic, and treatment-monitoring value of liver enzymes. 2. The role of the liver in metabolism integration and maintaining human body homeostasis. The methods for investigating the integrative role of the liver and markers of metabolic disturbances in the hepatic diseases. 3. Mechanisms of bile excretion and its regulation. The disorders of bile excretion and associated pathologies. The methods for investigating the bile excretion and diagnostic markers of interest. 4. General and hepatic detoxification mechanisms: Stages of liver detoxification (oxidative and conjugative). Hepatotoxicity associated with detoxification mechanisms, including drug-induced hepatotoxicity. Markers of hepatotoxicity. 5. Biochemical syndromes specific to hepatic diseases. Laboratory markers of each syndrome and their diagnostic value. 6. Markers of Hepatic Malignancies.

Objective	Content units
these pathways. • To define the drug-induced hepatopathy and understand the mechanisms of pathological state development depending on the medication. • To know the markers of syndromes specific to hepatic pathologies (cytolytic, hepatoprival, inflammatory, and excretory-biliary) and their diagnostic value. • To systematically and rationally indicate sets of markers for hepatic function investigation. • To accurately assess the changes in biochemical laboratory tests in certain liver diseases. • To solve clinical case studies.	
Topic 12. Biochemistry of nerve transmission	
• To define the concepts of synapse, synaptic transmission, neurotransmitter, neuromodulator, pre- and postsynaptic action potential, ionotropic and metabotropic synaptic receptors, agonist, and competitive and non-competitive antagonist. • To know the main neuromediators, their classification and structure, mechanisms of neurotransmitter synthesis, storage, and release into the synaptic cleft, molecular mechanisms of mediator-receptor coupling, and signal transmission in postsynaptic cells. • To demonstrate the connection between hereditary and acquired defects in molecular structures involved in synaptic transmission (channelopathies, enzymopathies, proteinopathies, receptor defects) and certain neurological and psychiatric disorders. • To apply the knowledge acquired on this topic to solve clinical cases related to the diagnosis and treatment of corresponding diseases. • To integrate the biochemical	1. Specificities of the chemical and metabolic composition of nerve cells. 2. Structure of synapses and specificities of communication between nerve cells. 3. Structure and classification of neurotransmitters. 4. Cholinergic, monoaminergic, aminoacidergic, peptidergic, and purinergic neuromediators. 5. Synthesis, storage, release of neurotransmitters, removal of mediators from the synaptic cleft, synaptic receptors, and the biochemical mechanisms of neurotransmitter action at the postsynaptic level. 6. Pathologies associated with dysregulation in the synthesis, release, or action of various neurotransmitters or impairment of their receptors (Parkinson's disease, Alzheimer's disease, schizophrenia, depression, anxiety, migraine, myasthenia gravis, epilepsy).

Objective	Content units
information about neural transmission with knowledge from other fundamental disciplines (anatomy, histology, physiology) and apply it to related clinical disciplines (neurology, psychiatry, medical psychology).	
Evaluation of Individual Work	
Final Evaluation	

V. PROFESSIONAL (PC) AND TRANSVERSAL (TC) COMPETENCES AND STUDY FINALITIES

✓ **Professional competences (PC)**

- PC1. Knowledge, understanding, and use of the specific language of medical biochemistry.
- PC2. General knowledge of the main chemical compounds vital for the human body.
- PC3: Explanation of the main metabolic processes ensuring the viability of the organism and the mechanisms of the most significant disorders associated with major syndromes.
- PC6: Advanced knowledge of the chemical composition and metabolism of organs and tissues under physiological and pathological conditions.

✓ **Transversal competences (TC1)**

- Autonomy and responsibility in professional activity.
- Adherence to rigorous and efficient work practices, demonstrating a responsible attitude toward fulfilling professional tasks, while upholding ethical values and norms, as well as adhering to current legislation.
- Promotion of logical reasoning, practical applicability, evaluation, and self-evaluation in decision-making processes.

✓ **Study finalities**

Upon completion of the course, students will be able to:

- Understand the molecular basis of physiological metabolic processes and the biochemical mechanisms regulating the functions of organs, tissues, and the entire body.
- Identify the causes and pathogenesis of certain hereditary and acquired diseases.
- Justify the necessity of biochemical investigations and the rational, systematic use of specific markers.
- Accurately interpret laboratory examination results and correlate them with clinical and functional data to establish diagnoses, recommend lifestyle modifications, and propose therapies tailored to the biochemical mechanisms underlying the pathology.

VI. STUDENT'S SELF-TRAINING

No.	Expected product	Implementation strategies	Assessment criteria	Implementation terms
1.	Working with Informational Sources	Selecting essential information and details for each topic by reading lectures, textbooks, and supplementary resources. Systematically organizing the key content. Formulating generalizations and conclusions on the importance of the topic/subject	Level of information assimilation and workload	Throughout the semester
2.	Solved Case Studies	Independently solving case studies for each topic in accordance with the Practical Work Guide, followed by verification and discussion during seminars	Graded from 0 to 0.5 for each chapter	For each studied topic
3.	Self-Assessment Tests Completed	Independently solving self-assessment tests for each topic as per the Practical Work Guide, followed by verification and discussion during seminars	Graded from 0 to 0.5 for each chapter.	For each studied topic
4.	Work with Online Materials	Studying teaching materials on the Department's website and supplementing the information for the studied topics	Level of information assimilation and workload	Throughout the semester
5.	Scientific Report on Contemporary Topics (PPT)	Selecting key information and details on current topics in biochemistry from scientific sources published within the last five years	Graded from 0 to 10.0 for each report	Throughout the semester

VII. METHODOLOGICAL SUGGESTIONS FOR TEACHING-LEARNING-ASSESSMENT

- **Teaching and learning methods used**

The Clinical Biochemistry course is organized using a hybrid model—classical instruction combined with web-based learning.

Theoretical teaching materials and lecture presentations are made available on the MOODLE platform for individual study prior to the courses.

During practical work and seminars, theoretical topics are discussed based on methodological

guidelines. Tests and case studies are solved, and interactive teaching and learning methods are applied.
Students are encouraged to use various **learning methods**, such as observation, analysis, comparison, classification, creating/analyzing diagrams or figures, modeling, deduction, and experimentation.

- **Applied** (specific to the discipline) **teaching strategies / technologies**

The teaching of Clinical Biochemistry employs classical didactic strategies (inductive, deductive, analogical, algorithmic, and heuristic), achieved through various teaching-learning methods (active-participatory, individual study, assessment and evaluation methods), such as exposition and didactic conversation, working with the textbook, theoretical problematization, laboratory work, case studies, and solving tests etc. For the implementation of strategies and methods, a set of technical teaching tools is used during courses, seminars, and laboratory work.

- **Methods of assessment** (including the method of final mark calculation)

Current: Conducted during laboratory work and seminars through methods like control tests, solving situational problems, tests, and practical problem-solving etc. Two cumulative assessments are planned during the semester.

Final*:* The final evaluation takes place in the form of a computer-assisted exam in the SIMU system.

The final grade is composed of the average module grade (50%) and the final computerized test score (50%).

Grades will be expressed numerically according to the grading scale (as per the table provided). The final grade will be recorded with two decimal points in the gradebook.

Method of mark rounding at different assessment stages

Intermediate marks scale (annual average, marks from the examination stages)	National Assessment System	ECTS Equivalent
1,00-3,00	**2**	**F**
3,01-4,99	**4**	**FX**
5,00	**5**	**E**
5,01-5,50	**5,5**	
5,51-6,0	**6**	
6,01-6,50	**6,5**	**D**
6,51-7,00	**7**	
7,01-7,50	**7,5**	**C**
7,51-8,00	**8**	
8,01-8,50	**8,5**	**B**
8,51-9,00	**9**	
9,01-9,50	**9,5**	**A**
9,51-10,0	**10**	

The average annual mark and the marks of all stages of final examination (computer assisted, test, oral) - are expressed in numbers according to the mark scale (according to the table), and the final mark obtained is expressed in number with two decimals, which is transferred to student's record-book.
Absence on examination without good reason is recorded as "absent" and is equivalent to 0 (zero). The student has the right to have two re-examinations in the failed exam.

VIII. RECOMMENDED LITERATURE:

A. Compulsory :

1. www.e.usmf.md (Theoretical support on the MOODLE platform).
2. Campbell P.N. Smith A.D. Biochemistry illustrated. Internatinal edition, 2000

B. Additional

1. https://themedicalbiochemistrypage.org/
2. McPherson R.A., Pincus M. R., Henry's Clinical Diagnosis and Management by Laboratory Methods 24th Edition, Elsevier; 24th edition, 2021. ISBN :9780323673204
3. Marshall, W. J., & Lapsley, M. Clinical Biochemistry: Metabolic and Clinical Aspects (Third Edition), Churchill Livingstone, 2014, ISBN 978-0-7020-5140-1