APPROVED
at the Chair meeting of 25.08.23, minute no.1,
Head of the Biochemistry and Clinical Biochemistry Chair,
MD, PhD., prof., Olga TAGADIUC _____

THE THEMATIC PLAN
of courses and laboratory work in Pharmaceutical Biochemistry for students
of the Faculty of Pharmacy, year III, academic year 2023-2024

		the autumn semester(5) - year III	
N	**Date**	**Course, theme name**	**Laboratory work, name of the topic**
1	04-08.09	1. Classification and structure of lipids. Lipids of pharmaceutical interest. Essential fatty acids. Digestion and absorption of lipids in the digestive tract. Chylomicrons and Plasma Lipoproteins. 2. Biosynthesis of saturated and unsaturated fatty acids. Biosynthesis of triacylglycerols and phosphoglycerides: Lipotropic substances, their role. Biosynthesis of sphingo- and glycolipids: general concepts. Cholesterol biosynthesis – stages, reactions of stage I (up to mevalonic acid), ways of use and elimination of cholesterol. Eicosanoids (prostaglandins, leukotrienes, thromboxanes) – synthesis and biomedical role. The therapeutic effect of eicosanoids. Fat-soluble vitamins - A, D, E, K - structure and biomedical role. Their use in therapy. Hypo- and avitaminoses.	The biological role of lipids. Protoplasmic and reserve lipids. Classification and structure of lipids. Biological membranes. Digestion and absorption of lipids in the gastrointestinal tract. Plasma lipoproteins. The action of pancreatic phospholipases. Identification of bile acids.
2	11-15.09		Biosynthesis of saturated and unsaturated fatty acids. Biosynthesis of triacylglycerols and phosphoglycerides: reactions and regulation. Lipotropic substances, their role. Biosynthesis of sphingo- and glycolipids: general concepts. Cholesterol biosynthesis – stages, stage I reactions (up to mevalonic acid). Ways of using and eliminating cholesterol.

			Eicosanoids (prostaglandins, leukotrienes, thromboxanes) – synthesis and biomedical role. The therapeutic effect of eicosanoids. Fat-soluble vitamins - A, D, E, K - structure and biomedical role. Their use in therapy. Hypo- and avitaminoses. Determination of total lipids in blood serum.
3	18-22.09	1. Catabolism of triacylglycerols: Glycerol oxidation. Oxidation of fatty acids: i. saturated with an even number of carbon atoms; ii. unsaturated with an even number of carbon atoms; iii. saturated with an odd number of carbon atoms; 2. Catabolism of phospho-, sphingo- and glycolipids. Metabolism of ketone bodies. Biosynthesis and catabolism - reactions, enzymes, coenzymes, regulation. The biomedical role. Regulation of lipid metabolism at cellular and neurohormonal level. The role of catecholamines, glucagon, thyroid hormones, insulin. Pathology of lipid metabolism: a) disorders of lipid digestion and absorption; b) fatty degeneration of the liver, obesity; c) lipid metabolism disorders in diabetes, starvation and alcoholism.	Catabolism of triacylglycerols: Glycerol oxidation. Oxidation of fatty acids: i. saturated with an even number of carbon atoms; ii. unsaturated with an even number of carbon atoms; iii. saturated with an odd number of carbon atoms; Catabolism of phospho-, sphingo- and glycolipids. Metabolism of ketone bodies. Biosynthesis and catabolism - reactions, enzymes, coenzymes, regulation. The biomedical role. Regulation of lipid metabolism at cellular and neurohormonal level. The role of catecholamines, glucagon, thyroid hormones, insulin. Pathology of lipid metabolism: a) disorders of lipid digestion and absorption; b) fatty degeneration of the liver, obesity; c) lipid metabolism disorders in diabetes, starvation and alcoholism. Determination of the content of □-lipoproteins in the blood serum.
4	25-29.09		***Total test to: "Lipid metabolism"***
5	02-06.10	1. The need for protein in food. The nutritional value of dietary proteins. The dynamic state of proteins. Nitrogen balance. Protein deficiency. Parenteral protein nutrition. Protein digestion and absorption. Proteolytic enzymes Zymogens and their activation. Protein digestion in the stomach. Protein digestion in the intestine. Absorption of amino acids in the intestine. Active secondary and facilitated transport of amino acids. Amino acid putrefaction in the large intestine. The products of putrefaction. The mechanisms of	The need for protein in food. The nutritional value of dietary proteins. The dynamic state of proteins. Nitrogen balance. Protein deficiency. Proteolytic enzymes Protein digestion in the stomach. Protein digestion in the intestine. Absorption of amino acids in the intestine. Active secondary and facilitated transport of amino acids. Amino acid putrefaction in the large intestine. The products of putrefaction. The mechanisms of detoxification of toxic products in the liver (microsomal oxidation, conjugation). Conjugation agents, enzymes.

		detoxification of toxic products in the liver (microsomal oxidation, conjugation). Conjugation agents, enzymes. Transamination of amino acids: mechanism, enzymes, coenzymes, significance of the process. The diagnostic value of determining the activity of transaminases (ALT and AST) in the blood. Deamination of amino acids. The types. Direct deamination of amino acids. Oxidative deamination of glutamic acid (reaction, enzyme, coenzymes, importance of the process). Indirect deamination of amino acids. The stages. Enzymes, coenzymes. Biological role. 1. Mechanisms of ammonia toxicity. Modes of ammonia detoxification: glutamine synthesis b) urea synthesis (ureogenetic cycle), clinical importance of urea determination c) elimination of NH3 in the form of ammonium salts (NH4+). Decarboxylation of amino acids. The influence of biogenic amines on the body, their detoxification.	Transamination of amino acids: mechanism, enzymes, coenzymes, significance of the process. The diagnostic value of determining the activity of transaminases (ALT and AST) in the blood. Deamination of amino acids. The types. Direct deamination of amino acids. Oxidative deamination of glutamic acid (reaction, enzyme, coenzymes, importance of the process). Indirect deamination of amino acids. The stages. Enzymes, coenzymes. Biological role. Determination of gastric juice acidity. Identification of pathological components of gastric juice.
6	09-13.10		Mechanisms of ammonia toxicity. Ways to detoxify ammonia: a) glutamine synthesis b) urea synthesis (ureogenetic cycle), the clinical importance of urea determination c) elimination of NH3 in the form of ammonium salts (NH4+). Decarboxylation of amino acids. The influence of biogenic amines on the body, their detoxification. Determination of urea in urine.
7	16-20.10	1. Metabolism of phenylalanine and tyrosine. Metabolism of glycine and serine. Metabolism of methionine and cysteine. Metabolism of dicarboxylic amino acids, Reciprocal link between protein, carbohydrate and lipid metabolism. 2. Nucleoprotein metabolism.	Peculiarities of the metabolism of some amino acids. Metabolism of phenylalanine and tyrosine. Congenital disorders of the metabolism of these amino acids (phenylketonuria, alkaptonuria, albinism) Metabolism of glycine and serine. The role of tetrahydrofolic acid in their metabolism. Mechanism of action of sulfanilamides.

		a) Digestion and absorption of nucleic acids. b) Biosynthesis of purine nucleotides - "de novo" and from synthesized nitrogenous bases. c) Degradation of purine nucleotides. Uric acid. Gout. d) Biosynthesis of pyrimidine nucleotides. The role of thioredoxin in the formation of deoxyribonucleotides. e) Degradation of pyrimidine nucleotides (general notions). Metabolism of chromoproteins. a) Digestion of chromoproteins. b) Heme biosynthesis. Location, stages, regulation. The porphyrias. c) Heme catabolism. Location, stages. Jaundice.	Metabolism of methionine and cysteine. The role of methionine in the synthesis of phospholipids, creatine, adrenaline. Synthesis and role of phosphocreatine. Metabolism of dicarboxylic amino acids, their use as medicinal preparations. The mutual connection between protein, carbohydrate and lipid metabolism. Urinary creatinine dosage. Identification of homogentisinic acid in urine.
8	23-27.10		Nucleoprotein metabolism. a) Digestion and absorption of nucleic acids. b) Biosynthesis of purine nucleotides - "de novo" and from synthesized nitrogenous bases. c) Degradation of purine nucleotides. Uric acid. Gout. d) Biosynthesis of pyrimidine nucleotides. The role of thioredoxin in the formation of deoxyribonucleotides. e) Degradation of pyrimidine nucleotides (general notions). Metabolism of chromoproteins. a) Digestion of chromoproteins. b) Heme biosynthesis. Location, stages, regulation. The porphyrias. c) Heme catabolism. Location, stages. Jaundice. Dosage of uric acid in urine.
9	30.10-03.11	1. Notions about hormones General properties. Classification of hormones. Mechanisms of hormone action: Hypothalamus hormones - liberins and statins. Vasopressin and oxytocin. Pituitary hormones - chemical nature, mechanism of action, biological effect, regulation of secretion and its deregulation, practical use as medicinal preparations.	***Test total:*** ***"Metabolism of simple and complex proteins"***

		Parathyroid hormone. Regulation of phosphorus and calcium metabolism. Parathyroid gland function disorders. 2. Pancreatic hormones (insulin, glucagon). Mechanism of action of insulin and glucagon. Pharmaceutical preparations based on insulin synthesized in the laboratory. Thyroid gland hormones (iodothyronines and thyrocalcitonin) – their biosynthesis and regulation. Hypo- and hyperfunction of the thyroid gland. Adrenal medullary hormones (adrenaline, noradrenaline) and adrenal cortex (gluco- and mineralocorticoids). Sex hormones: a) androgens and their biological role, anabolic steroids as active pharmaceutical preparations. b) estrogens, physiological action and mechanism of action;	
10	06-10.11		Notions about hormones and substances with hormonal action, their use as pharmaceutical preparations. General properties. Classification of hormones. Mechanisms of hormone action: a) membrane-cytosolic (indirect), the role of G-proteins and second messengers in the transmission of hormonal information; b) cytosolic-nuclear (direct). Hypothalamus hormones - liberins and statins. Vasopressin and oxytocin. Pituitary hormones - chemical nature, mechanism of action, biological effect, regulation of secretion and its deregulation, practical use as medicinal preparations. a) the corticotropin family (ACTH, MSH, lipotropins and related peptides); b) the family of glycoprotein hormones (TSH, FSH, LH and placental chorionic gonadotropin); c) the family of somatomammotropic hormones (STH, prolactin and

			placental lactogen); Parathyroid hormone. Regulation of phosphorus and calcium metabolism. Parathyroid gland function disorders. Dosage of inorganic phosphorus in blood serum. The reaction to identify 17-ketosteroids in urine. Calcium dosage in blood serum. Dosage of inorganic phosphorus in blood serum
11	13-17.11	1. Chemical composition of blood plasma: a) Plasma proteins (albumins, globulins, enzymes, immunoglobulins, interferon); b) Nitrogenous non-protein compounds of the blood plasma. Their origin and role in plasma. Associated pathological conditions. c) Non-nitrogenous organic compounds. Their origin and role in plasma. Associated pathological conditions. d) Mineral components of blood plasma. Their role in plasma and body. Blood ionogram. 2. The chemical composition and peculiarities of the metabolism of erythrocytes and platelets: a) Chemical composition and peculiarities of erythrocyte metabolism. i. Glycolysis and the Rapoport shunt ii. The pentose phosphate pathway and glutathione iii. Hemoglobin and oxygen transport. iv. Carbonic anhydrase and CO2 transport. b) Chemical composition and peculiarities of platelet metabolism and blood coagulation. i. Platelet coagulation factors ii. Plasma coagulation factors and blood coagulation scheme. iii. The fibrinolytic system. iv. Anticoagulant factors: natural (native) anticoagulants.	1. Pancreatic hormones (insulin, glucagon). Mechanism of action of insulin and glucagon. Pharmaceutical preparations based on insulin synthesized in the laboratory. 2. Thyroid gland hormones (iodothyronines and thyrocalcitonin) – their biosynthesis and regulation. Hypo- and hyperfunction of the thyroid gland. 3. Adrenal medullary hormones (adrenaline, noradrenaline) and adrenal cortex (gluco- and mineralocorticoids). 4. Sex hormones: a) androgens and their biological role, anabolic steroids as active pharmaceutical preparations. b) estrogens, physiological action and mechanism of action;

12	20-24.11		Chemical composition of blood plasma: a) Plasma proteins (albumins, globulins, enzymes, immunoglobulins, interferon); b) Nitrogenous non-protein compounds of the blood plasma. Their origin and role in plasma. Associated pathological conditions. c) Non-nitrogenous organic compounds. Their origin and role in plasma. Associated pathological conditions. d) Mineral components of blood plasma. Their role in plasma and body. Blood ionogram. The chemical composition and peculiarities of the metabolism of erythrocytes and platelets: a) Chemical composition and peculiarities of erythrocyte metabolism. i. Glycolysis and the Rapoport shunt ii. The pentose phosphate pathway and glutathione iii. Hemoglobin and oxygen transport. iv. Carbonic anhydrase and CO2 transport. b) Chemical composition and peculiarities of platelet metabolism and blood coagulation. i. Platelet coagulation factors ii. Plasma coagulation factors and blood coagulation scheme. iii. The fibrinolytic system. iv. Anticoagulant factors: natural (native) anticoagulants. Determination of hemoglobin in blood by the cyanmethemoglobin method.
13	27.11-01.12	1. Biotechnology of medicinal preparations (liposomes, genetic engineering, monoclonal antibodies with targeted action, application of enzymes as chemical reagents, etc.). Absorption (digestive, dermal, pulmonary), tissue distribution (volume of distribution, tissue affinity, tissue storage) and elimination (urinary, biliary, salivary, sweat, lactation) of xenobiotics (drugs). Passive transport (simple	Pharmaceutical biochemistry. Biotechnology of medicinal preparations (liposomes, genetic engineering, monoclonal antibodies with targeted action, application of enzymes as chemical reagents, etc.). Absorption (digestive, dermal, pulmonary), tissue distribution (volume of distribution, tissue affinity, tissue storage) and elimination (urinary, biliary, salivary, sweat, lactation) of xenobiotics (drugs).

		diffusion), facilitated transport, active transport. Structural-functional peculiarities of xenobiotic (drug) transporters: ABC-transporters, SLC-transporters. Biotransformation (metabolization) of xenobiotics (medicines). Location of biotransformation: cavity, extracellular and tissue. The conditions that determine the metabolism of drugs. Dependence of drug action on their metabolism: deactivation, activation, modification of the main effect. General biochemical reactions of drug biotransformation - oxidation, reduction, hydrolysis and synthesis (conjugation). 2. Two phases of biotransformation of xenobiotics (medicines): modification and conjugation. The phase of modification of drugs and xenobiotics by microsomal oxidation. Mechanism of microsomal oxidation and the role of cytochrome P450. Monooxidase and reductase chains. Non-microsomal drug modification phase (alcohol dehydrogenase, xanthine oxidase, mono- and diamine oxidases). Synthetic phase - conjugation. Examples of type I conjugations (glucuronic, sulfate, acetyl, thiosulfate, methyl). Examples of type II conjugations (glycine, glutathione).	Passive transport (simple diffusion), facilitated transport, active transport. Structural-functional peculiarities of xenobiotic (drug) transporters: ABC-transporters, SLC-transporters. Biotransformation (metabolization) of xenobiotics (medicines). Location of biotransformation: cavity, extracellular and tissue. The conditions that determine the metabolism of drugs. Dependence of drug action on their metabolism: deactivation, activation, modification of the main effect. General biochemical reactions of drug biotransformation - oxidation, reduction, hydrolysis and synthesis (conjugation). Two phases of biotransformation of xenobiotics (medicines): modification and conjugation. The phase of modification of drugs and xenobiotics by microsomal oxidation. Mechanism of microsomal oxidation and the role of cytochrome P450. Monooxidase and reductase chains. Non-microsomal drug modification phase (alcohol dehydrogenase, xanthine oxidase, mono- and diamine oxidases). Synthetic phase - conjugation. Examples of type I conjugations (glucuronic, sulfate, acetyl, thiosulfate, methyl). Examples of type II conjugations (glycine, glutathione).
14	04-08.12		**Test : "Hormones. The blood. Pharmaceutical biochemistry".**
15	11-15.12		**Individual work. Admission to the session.**

N O T E: The course is fully taught by PhD, university lecturer, Eugen Simionică;
Duration of lectures – 2 hours, practical works – 3 hours.