



COURSE UNIT (MODULE) DESCRIPTION

Course unit (module) title	Code
Biochemistry	

Academic staff	Core academic unit(s)
Coordinating: Assoc. prof. Dovilė Karčiauskaitė Other: of Assist. prof. Eglė Mazgelytė	Department of Physiology, Biochemistry, Microbiology and Laboratory Medicine, Institute of Biomedical Sciences, Faculty of Medicine, Vilnius University, M.K. Čiurlionio str. 21, Vilnius

Study cycle	Type of the course unit
Integrated studies (Cycles I and II)	Compulsory

Mode of delivery	Semester or period when it is delivered	Language of instruction
Mixed (auditory and distance): distance lectures, seminars and laboratory work in the classroom and independent studies	2 nd semester	Lithuanian, English

Requisites	
Prerequisites:	Co-requisites (if relevant):

Number of ECTS credits allocated	Student's workload (total)	Contact hours	Individual work
5	135	68	67

Purpose of the course unit		
<p>The aim is to impart understanding regarding the composition of substances constituting the human body, primary metabolic processes, their interconnections, and regulation. Additionally, it aims to cultivate the ability to organize, scrutinize, and employ fundamental theoretical knowledge required for subsequent medical studies.</p> <p>Upon course completion, students will possess the knowledge to analyze biochemical processes within the human body, comprehend their associations, and grasp regulatory principles. Furthermore, they will develop practical laboratory skills.</p>		
Learning outcomes of the course unit	Teaching and learning methods	Assessment methods
1. Understand and explain the structural features of essential compounds involved in bodily functions and key chemical changes. 2. Recognize and evaluate the biological functions of biomolecules. 3. Analyze the primary processes of substance and energy metabolism in the human body, including carbohydrates, lipids, proteins, nucleotides, and their regulation. 4. Gain practical laboratory skills and the ability to assess the diagnostic importance of major biochemical indicators.	Lectures, seminars, laboratory work, discussions, case studies, "flipped classroom" learning method; application of experiential, synchronous, targeted learning principles and digital learning methods, consultations in biochemistry educational laboratories	Formative and cumulative assessment of seminars, colloquiums and the final exam.

Content	Contact hours							Individual work: time and assignments	
	Lectures	Tutorials	Seminars	Workshops	Laboratory work	Internship	Contact hours, total	Individual work	Tasks for individual work
1. Structure, classification, physical and chemical properties of amino acids. Importance, properties, primary and spatial structure, biological functions of proteins. Simple and complex proteins. Globular and fibrillar proteins. Basic features of collagen structure. Blood proteins and their role. Structure of hemoglobin and immunoglobulins.	2		3		3		8	4	Get ready for the laboratory experiment and seminar focusing on proteins by independently reviewing the designated literature.
2. Enzymes: classification, nomenclature. Enzyme mechanism of action. Factors affecting enzyme activity. Inhibition of enzymes. Inhibitors and activators. Coenzymes. Structure and role of NAD ⁺ , NADP ⁺ , FMN, FAD. Role of vitamins. Enzyme activity regulation: enzyme synthesis (genetic), allosteric regulation, covalent modification by reversible phosphorylation and partial proteolysis. Diagnostic importance of determination of enzyme activity in blood serum. Enzymopathies	1		2		2		5	4	Get ready for the laboratory experiment and seminar focusing on enzymes by independently reviewing the designated literature.
3. Metabolism overview. Catabolism. Anabolism. High energy compounds. Substrate phosphorylation. Oxidative phosphorylation, electron transport chain and ATP synthase. Uncoupling. Cytosolic NADH transport shuttles. Oxidative decarboxylation of pyruvate, regulation. Tricarboxylic acid (Krebs) cycle, its enzymes, energy value, regulation, use of compounds for synthesis.	1		3				4	4	Get ready for the seminar focusing on metabolism by independently reviewing the designated literature.
4. Carbohydrates structure and function. Monosaccharides and their derivatives, oligosaccharides, polysaccharides, proteoglycans and glycoproteins.	1		2		2		5	5	Get ready for the laboratory experiment and seminar focusing on carbohydrates by independently reviewing the designated literature.
5. Structure and function of glycogen. Glycogenesis and glycogenolysis in the liver and muscles, and its regulation. Role of hormones (insulin, glucagon, adrenaline, glucocorticoids and STH) in carbohydrate metabolism.	1		2		2		5	5	Get ready for the laboratory experiment and seminar focusing on glycogen by independently reviewing the designated literature.
6. Glycolysis and gluconeogenesis and their regulation. Fructose and galactose metabolism and its disorders. Pentose phosphate pathway.	1		3		2		6	5	Get ready for the laboratory experiment and seminar focusing on glucose by

									independently reviewing the designated literature.
7. Colloquium. Proteins, structures, functions; Amino acid classification, properties. Enzymes. Metabolism and bioenergetics. Carbohydrate metabolism			1				1	8	Get ready for the colloquium by independently reviewing the studied material
8. Lipids structure and function. Fatty acids, their properties, classification. Lipogenesis and lipolysis and its regulation. Eicosanoids structure, function and synthesis.	2		2		2		6	5	Get ready for the laboratory experiment and seminar focusing on lipids by independently reviewing the designated literature.
9. Cholesterol structure, synthesis and its regulation. Use of cholesterol for the synthesis of bile acids, vitamin D, steroid hormones. Lipoprotein structure, functions and metabolism. Blood cholesterol concentration.	2		2		2		6	5	Get ready for the laboratory experiment and seminar focusing on cholesterol and lipoproteins by independently reviewing the designated literature.
10. Fatty acid β -oxidation and regulation. Synthesis of saturated and polyunsaturated fatty acids. Metabolism of complex lipids - phospholipids and glycolipids.	1		3		3		7	5	Get ready for the laboratory experiment and seminar focusing on fatty acids by independently reviewing the designated literature.
11. Amino acids metabolism: transamination, deamination and decarboxylation. Biogenic amines. Ammonia synthesis. Urea and other nitrogenous substances in urine and blood. Synthesis of creatine, creatine phosphate and creatinine. Amino acids carbon skeleton metabolism. Precursors for amino acids synthesis.	2		2		4		8	6	Get ready for the laboratory experiment and seminar focusing on amino acids metabolism by independently reviewing the designated literature.
12. Structure and properties of purine and pyrimidine bases and mononucleotides. DNA and RNA structure. Synthesis and degradation of purine and pyrimidine nucleotides and its regulation. Uric acid synthesis. Gout. Synthesis of deoxyribonucleotides.	2		2		2		6	5	Get ready for the laboratory experiment and seminar focusing on nitrogenous bases by independently reviewing the designated literature.
13. Colloquium. Lipid metabolism. Amino acid and nitrogen metabolism. Nucleotide structure and metabolism. Structure of nucleic acids.			1				1	8	Get ready for the colloquium by independently reviewing the studied material.
Total	16		28		24		68	67	

Assessment strategy	Weight %	Deadline	Assessment criteria
Work during seminars and laboratory works and	50 %	During semester	The student is able to perform the specified tasks:

intermediate knowledge test in writing			<ul style="list-style-type: none"> - perform laboratory experiment, evaluate research data and summarize the obtained information; - theoretically prepared to discuss the topic discussed during the seminar; - actively participate in the discussion, answer questions, formulate problems, provide critical comments. <p>Written questions are presented during the colloquiums. Each question is evaluated in percentages, which are converted into a score</p>
Written exam at the end of the semester	50 %	During exam session	<p>Written questions are presented during the colloquiums. Each question is evaluated in percentages, which are converted into a score:</p> <p>Evaluation</p> <p>10 (excellent) The student knows well the material of lectures, compulsory literature, and practical classes, and has well mastered the subject competences.</p> <p>9 (very good) The student knows well the material of lectures, compulsory literature, and practical classes, and has mastered the subject competencies.</p> <p>8 (good) The student knows the material of lectures, mandatory literature, and practical classes, but the answers to some questions are incomplete or incomplete.</p> <p>7 (average) Answers with minor errors. Non-essential errors are considered to be those that do not raise doubts about the student's acquired subject competences.</p> <p>6 (satisfactory) The student's answers contain errors that can already be considered essential, the answers to the questions are incomplete.</p> <p>5 (weak) The answers to the given questions are very incomplete, superficial, full of errors, and the skills are seriously lacking.</p> <p>4 (not satisfactory) The student did not acquire one or more subject competencies, even in the answers that are partially correct, there are fundamental errors.</p> <p>3 (dissatisfied-home) There are fundamental errors in the answers. Less than a third of the question was answered.</p> <p>2 (not satisfied) The student did not acquire subject competencies, practical skills and abilities.</p> <p>1 (unsatisfactory) The student did not acquire subject competencies, practical skills and abilities or the question was not answered at all.</p>

Author (-s)	Publishing year	Title	Issue of a periodical or volume of a publication	Publishing house or web link
Required reading				
Ph.D. Ferrier, Denise R.	2019 and later	Biochemistry (Lippincott's Illustrated Reviews)		Wolters Kluwer
Recommended reading				
Devlin T.	2019 and later	Textbook of Biochemistry With Clinical Correlations		Wiley-Liss, Inc.
D.L.Nelson, M.M.Cox	2019 and later	Lehninger Principles of Biochemistry		Worth Cummings

