

COURSE UNIT DESCRIPTION - BIOCHEMISTRY

Course unit title	Code
BIOCHEMISTRY	

Lecturer(s)	Department(s)
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Cycle	Level of the course unit	Type of the course unit
Full-time studies (1 st stage)	1 out of 1	Compulsory

Mode of delivery	Period of delivered	Language(s) of instruction
Face-to-face	2 nd year of study, 3 th semester, autumn	Lithuanian

Prerequisites and corequisites	
Prerequisites: Bioorganic chemistry	Corequisites (if any): Studies of organic chemistry

Number of credits allocated to the course unit	Student's total workload	Contact hours	Self-study and research hours
9	240	112	113

Purpose of the course unit: programme competences to be developed		
The course unit aims to develop: <i>Subject-specific competences:</i> • knowledge of the structure and function of biological polymers – proteins, nucleic acids, carbohydrates, lipids and other biologically active compounds; • knowledge of the metabolism of proteins, nucleic acids, carbohydrates and lipids; • knowledge of the cellular regulation of metabolism and skills to integrate it; • knowledge of the basic methods of isolation, purification and identification of proteins-enzymes, amino acids, nucleic acids and corresponding practical skills; • skills to select appropriate methods for the investigation of the properties of biological molecules and biological processes; • skills to perform experiments and interpret the data obtained; • skills to perform reliable measurements, document and analyse the results of the measurements; • skills to analyze, compare, and critically evaluate the biochemistry information; <i>General competences:</i> • skills for self-development; • learning skills in order to study both molecular biology and general science resources; • ability to communicate in written and verbal forms using correct Lithuanian in professional field. • ability to use information sources in English in professional field;		
Learning outcomes of the course unit	Teaching and learning methods	Assessment methods
• Describes the general concepts of structure and functions of biological polymers – proteins, nucleic acids, lipids, carbohydrates; explains the connection between structure and functions • Analyzes, compares, critically evaluates theoretical	Lectures, laboratory works, self-study.	Exam; Preparation and defence of Lab Reports

- knowledge in biochemistry; - Performs biochemical experiments and interprets the data obtained.		
- Applies the principles biochemistry, kinetics thermodynamics to describe the chemical reactions catalyzed by enzymes; - Performs the experiments in enzymology, analyzes the kinetic data.		
Describes the structure and functions of biological membranes and explains solute transport across the membranes.		
- Describes catabolism of carbohydrates, lipids and amino acids; - selects appropriate methods to investigate amino acids, proteins, lipids, nucleic acids.		
- Explains the general concepts and principles of bioenergetics and metabolism; - Describes the mechanisms of oxidative phosphorylation and photosynthesis; - Explains the energy transformation for cell metabolism.		
- Describes the biosynthesis of carbohydrates, lipids, amino acids; - Selects appropriate methods to investigate anabolism processes.		
Explains the general principles and concepts of the regulation and integration of mammalian metabolism, compartmentalisation of biochemical processes, the regulation of metabolism.		

Content: breakdown of the topics	Contact hours							Self-study work: time and assignments	
	Lectures	Tutorials	Seminars	Exercises	Laboratory work	Internship/work placement	Contact hours	Self-study hours	Assignments
1. Structure and catalysis	28						28	40	Self-directed learning; learning of topic-related material in the course preparation for laboratory work and for examination.
Introduction. Proteins composition and structure. Higher levels of protein organisation. Protein folding, molecular chaperones.	3						3	3	
Protein degradation, proteasomes, quality control.	2						2	3	
Enzymes, general concepts, kinetics, coenzymes.	2						2	3	
Enzyme specificity, the active site. Mechanism of catalysis. Regulation of enzyme catalysis. Isoenzymes.	3						3	3	
DNA and RNA and protein synthesis.	4						4	3	
Carbohydrates. Structure and biological functions	2						2	3	
Glycoproteins, proteoglycans, peptidoglycans –	2						2	3	

structure and biological functions.									
Lipids, classification, structure and functions.	2						2	4	
The composition of biological membranes. Lipids. Lipid polymorphism, lipid bilayer, phase transition temperature.	2						2	3	
Types of membrane proteins, structure of membrane protein. Membrane structure.	2						2	4	
Solute transport across membrane. Channels, mechanism of action. .	2						2	4	
Active transport. P-type, V-type ATPases. ABC transporters	2						2	4	
2. Bioenergetics and metabolism	36						36	40	
Bioenergetics and metabolism. High energy compounds, phosphoryl group transfer and ATP.	3						3	3	
Glycolysis, fermentation, regulation of carbohydrate metabolic pathways.	5						5	4	
Fatty acid catabolism. Oxidation of saturated and unsaturated fatty acids. Ketone bodies.	4						4	4	
Amino acid oxidation and the production of urea. Pathways of amino acid degradation.	4						4	4	
The citric acid cycle. Glyoxylatic cycle.	2						2	4	
Oxidative phosphorylation	4						4	3	
Photosynthesis. Calvin cycle.	4						4	3	
Biosynthesis lipids and carbohydrates.	2						2	3	
Biosynthesis of amino acids	2						2	3	
Biosynthesis and degradation of nucleotides	2						2	3	
Regulation and integration of mammalian metabolism. Tissue specific metabolism	4						4	6	
Total	64						64	80	
Laboratory works									
Laboratory work 1: The instruction for students about a safe work in the laboratory of biochemistry (concentrated bases and acids, electric equipment and apparatus, fire-fighting rules). Solution concentration calculus (w%, C_M , C_N).					3		3	1	Group discussion during laboratory work. Preparation and defence of Lab Reports
Laboratory work 2. Pipetting and dilution techniques. Estimating volumes by pipetting, determination of accuracy of measurements, calculation errors					3		3	3	
Laboratory work 3: Buffers and preparation of solutions. Calculation and preparation of buffer solutions; an introduction to acids and bases, pK_a , principles of buffers. Measurement of pH of buffer solutions with pH-meter (ion meter). The capacity of buffer determination					4		4	3	
Laboratory work 4: Proteins . Quantitative determination of protein concentration: standard Bradford curve, determination of unknown sample. Qualitative reactions of amino acids.					3		3	3	
Laboratory work 5: Chromatographic methods in biochemistry. Thin-layer chromatography of amino acids and nucleotides, molecular exclusion (gel chromatography) of dextran and inorganic salts.					3		3	3	
Laboratory work 6 : Lipids and carbohydrates. Hydrolysis of triacylglycerols (fats), isolation of glycogen from liver. Qualitative tests for glycogen,					3		3	3	

aldoses and ketoses, determination of fatty acids.									
Laboratory work 7 : Extraction and quantitative detection of caffeine from plant sources (coffee, tea) and energy drinks.					3		3	3	
Laboratory work 8 : Purification of ribonucleoprotein from yeast cells. Protein and DNA biochemical analysis.					14		14	6	
Laboratory work 9: Trans-amination an amino acids. Determination of reaction products using thin-layer chromatography method.					6		6	4	
Laboratory work 10: Kinetic analysis of an enzyme Alcohol dehydrogenase (ADH) Determination of the ADH level for kinetic assays, detection of the initial velocity of enzyme; $V_{\max}$ and K_M determination.					6		6	4	
Total	64				48		112	113	

Assessment strategy	Weight, %	Assessment period	Assessment criteria
Midterm exam	22,25	4 th week of the course	Test questions <50 answered questions – 2-4 (insufficient) 50-55 answered questions – 5 (sufficient) 56-65 answered questions -6 (satisfactory) 66-75 answered questions - 7(highly satisfactory) 76-85 answered questions -8 (good) 86-90 answered questions -9 (very good) 91-100 answered questions - 10 (excellent)
Midterm exam	22,25	9th week of the course	Test questions <50 answered questions – 2-4 (insufficient) 50-55 answered questions – 5 (sufficient) 56-65 answered questions -6 (satisfactory) 66-75 answered questions - 7(highly satisfactory) 76-85 answered questions -8 (good) 86-90 answered questions -9 (very good) 91-100 answered questions - 10 (excellent)
Midterm exam	22,25	13th week of the course	Test questions <50 answered questions – 2-4 (insufficient) 50-55 answered questions – 5 (sufficient) 56-65 answered questions -6 (satisfactory) 66-75 answered questions - 7(highly satisfactory) 76-85 answered questions -8 (good) 86-90 answered questions -9 (very good) 91-100 answered questions - 10 (excellent)
Exam	23	Exam session	Test questions <50 answered questions – 2-4 (insufficient) 50-55 answered questions – 5 (sufficient) 56-65 answered questions -6 (satisfactory) 66-75 answered questions - 7(highly satisfactory) 76-85 answered questions -8 (good) 86-90 answered questions -9 (very good) 91-100 answered questions - 10 (excellent)
Completion of laboratory works, preparation and defence of laboratory works reports.	10	The exam is allowed only when all laboratory works are completed,	Completion of each laboratory work and preparation and defence of laboratory work report is evaluated. 0,5 0,6 0,7 0,8

		practical work reports prepared and defended until 16 th week of the course.	0,9 1,0 The final grade is a mean of evaluations of all laboratory works (0,5 – 1,0).		
Total	100		The final evaluation is the sum of mean test evaluation (90%) + mean evaluation of laboratory works (10%). Both evaluated parts must be completed at least with the minimal grade (sufficient, 5) to obtain the final evaluation.		
Author		Year of publication	Title	Issue of a periodical or volume of a publication	Publishing place and house or web link
Compulsary reading					
J. Kadziauskas		2008 2012	Biochemijos pagrindai (Principles of Biochemistry, Lithuanian)	1 st , 2 nd ed.	Vilnius University Press
D. L. Nelson, M. M. Cox.		2008 2013	Lehninger Principles of Biochemistry.	5 th , 6 th ed.	H. Freeman and company New York, NY
L. Bagdonienė, V. Bendikienė, ir kt.		2006	Biochemijos laboratoriniai darbai. (Laboratory works in biochemistry, in Lithuanian)		Vilnius University Press
Optional reading					
T. M. Devlin (ed.)		2010	Textbook of biochemistry. With clinical correlations.	6 th ed.	Wiley-Liss., Hoboken, NJ, USA
J. M. Berg, L.J. Tymoczko, L. Stryer		2012	Biochemistry	7 th ed.	W.H. Freeman and company
A.Praškevičius, L. Ivanovienė, N. ir kt.		2006	Biochemija (Biochemistry, Lithuanian)	2 nd ed	KMU leidykla