COURSE UNIT DESCRIPTION - BIOORGANIC CHEMISTRY

Course unit title	Code
BIOORGANIC CHEMISTRY	

Lecturer(s)	Department(s)
Coordinator: Assoc. prof. Zofija SASNAUSKIENĖ **Other(s):**	Faculty of Natural Sciences, Department of Biochemistry and Molecular biology, Čiurlionio 21, LT 03101, Vilnius

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

Mode of delivery	Period of delivered	Language(s) of instruction
Face to face	1st year of study, 2st semester, spring	Lithuanian (English)

Prerequisites and corequisities	
Prerequisites: General biology and chemistry	**Corequisities (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
5	**130**	**64**	**66**

Purpose of the course unit (module): programme competences to be developed

The course unit aims to develop:

Subject-specific competences:

- basic knowledge of the structure and features, chemical synthesis, biosynthesis of bioorganic molecules necessary for understanding of biochemical processes in a living cell;

General competences:

- analytical and critical thinking
- skills for self-development, learning skills in order to study general science resources;
- ability to communicate in written and verbal forms using correct Lithuanian in professional field.

Learning outcomes of the course unit	Teaching and learning methods	Assessment methods
• Describes the structure of amino acids, stereochemistry, acid-base properties, protein structure and functions; • Describes concepts of determination of protein primary structure; describes protein secondary, tertiary and quaternary structures.	Lectures, self-directed learning	Midterm exam
• Describes concepts of amino acid and peptide synthesis;	Lectures, self-directed learning	Midterm exam
• Describes structure of nucleosides, nucleotides, phosphodiester bonds, primary structure of deoxy-(DNA) and ribo-(RNA) nucleic acids; DNA secondary and tertiary structure; three dimensional structure of RNA.	Lectures, self-directed learning	Midterm exam
• Describes principles of biological functions and biosynthesis of nucleic acids.	Lectures, self-directed learning	Midterm exam
• Describes synthesis of oligodeoxyribonucleotides, concepts of DNA sequencing and polymerase chain reaction.	Lectures, self-directed learning	Midterm exam
• Describes structure and features of	Lectures, self-directed learning	Midterm exam

monosaccharides, oligosaccharides and polysacharides, their stereochemistry, redox reactions of monosaccharides, formation of glycosides, reducing and non-reducing sugars, synthetic sweeteners.		
• Describes structure and features of fatty acids, fats (triacylglycerols), waxes; • Describes features of phospholipids and sphingolipids, eicosanoids, steroids and cholesterol, terpenes, lipid-soluble vitamins.	Lectures, self-directed learning	Midterm exam
• Describes structure and functions of alkaloids and antibiotics.	Lectures, self-directed learning	Midterm exam

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. Protein structure	**12**						**13**	**11**	Self-directed learning; learning of topic-related material in course virtual learning environment.
Amino acids: structure, configuration, acid-base properties, isoelectric point, peptide and disulfide bonds	4						**4**	**4**	
Protein primary structure. Chromatogragraphy of proteins and amino acids. Methods to identify the N-terminal and C-terminal amino acids, amino acids sequence determination.	4						**4**	**4**	
The three-dimensional structure of proteins: secondary- α-helix, β-pleated sheet, tertiary and quaternary structure. Fibrous and globular proteins.	4						**4**	**4**	
2. Peptide synthesis strategy	**6**						**6**	**6**	Self-directed learning; learning of topic-related material in course virtual learning environment.
Synthesis and resolution of racemic mixtures of amino acids	2						**2**	**3**	
Peptide bond synthesis: N- and C- protection and C-activation of amino acids. Automated solid-phase and semi-synthesis of peptides.	4						**4**	**3**	
3. Nucleic acids Deoxyribonucleic acid –DNA Ribonucleic acid–RNA	**18**						**18**	**17**	Self-directed learning; learning of topic-related material in course virtual learning environment.
Structure and conformation of nucleosides and nucleotides: heterocyclic bases, D-ribose, D-2-deoxyribose, glycosidic and phosphodiester bonds.	6						**6**	**5**	
DNA primary, secondary and tertiary structures.	4						**4**	**4**	
Three kinds of RNA: rRNA, mRNA, tRNA. Primary and three dimensional structure of RNA.	4						**4**	**4**	

The biological functions and biosynthesis of nucleic acids.	4						**4**	**4**	
4. Oligodeoxyribonucleotides synthesis DNA sequencing Polymerase chain reaction (PCR)	**8**						**8**	**9**	Self-directed learning; learning of topic-related material in course virtual learning environment.
Laboratory synthesis of oligodeoxyribonucleotides: phosphodiester, phosphotriester and phosphoramidite methods.	3						**3**	**4**	
How the base sequence of DNA is determined: Maxam-Gilbert sequencing, Sanger DNA chain-termination (dideoxy) method, pyrosequencing, sequencing by ligation, ion semiconductor sequencing.	3						**3**	**4**	
Polimerase chain reaction-technique to amplify DNA in a short time.	2						**2**	**1**	
5. Carbohydrates	**10**						**10**	**12**	Self-directed learning; learning of topic-related material in course virtual learning environment.
Classification of carbohydrates, the D and L rotation. The configurations of aldoses and ketoses.	2						**2**	**2**	
Reactions of monosacharides in basic solutions, redox reactions, the chain lengthening. Monosacharides form cyclic hemiacetals, formation of α- and β glycosides.	3						**3**	**4**	
Disacharides : maltose, cellobiose, lactose, sucrose. Reducing and nonreducing sugars.	2						**2**	**2**	
Polysacharides :amylose, amylopectin, glycogen, cellulose.	2						**2**	**2**	
Synthetic sweeteners: sacharin, dulcin, aspartame, sodium cyclamate, sucralose.	1						**1**	**2**	
6. Lipids	**8**						**8**	**8**	Self-directed learning; learning of topic-related material in course virtual learning environment.
Fatty acids, omega fatty acids, triacylglycerols-fats and oils, waxes.	2						**2**	**2**	
The lipid constituents of biological membranes: glycerophospholipids, sphingolipids	3						**3**	**2**	
Steroids, cholesterol, synthetic steroids.	2						**2**	**2**	
Eicosanoids, terpenes, lipid soluble vitamins.	1						**1**	**2**	
7. Alkaloids, antibiotics	**2**						**2**	**2**	
Total	**64**						**64**	**66**	

Assessment strategy	**Weight,%**	**Assessment period**	**Assessment criteria**
Midterm exam	40	5th week of the course	Test: 40 questions from topics 1-2. <20 answered questions – 2-4 (insufficient) 20-22 answered questions – 5 (sufficient) 23-25 answered questions -6 (satisfactory) 26-29 answered questions - 7(highly satisfactory) 30-33 answered questions -8 (good) 34-37answered questions -9 (very good)

			38-40 answered questions - 10 (excellent)
Midterm exam	40	11th week of the course	Test: 40 questions from topics 3-4 <20 answered questions – 2-4 (insufficient) 20-22 answered questions – 5 (sufficient) 23-25 answered questions -6 (satisfactory) 26-29 answered questions - 7(highly satisfactory) 30-33 answered questions -8 (good) 34-37answered questions -9 (very good) 38-40 answered questions - 10 (excellent)
Midterm exam	20	16th week of the course	Test: of 30 questions from topics 5-6. <15 answered questions – 2-4 (insufficient) 15-16 answered questions – 5 (sufficient) 17-19 answered questions -6 (satisfactory) 20-21 answered questions - 7(highly satisfactory) 22-24answered questions -8 (good) 25-27answered questions -9 (very good) 28-30 answered questions - 10 (excellent)
Total	**100**		Midterm exam grade point average

Author	**Year of publica-tion**	**Title**	**Issue of a periodical or volume of a publication**	**Publishing place and house or web link**
Compulsary reading				
Virtual learning environment of the course (Course material: lectures PDF, Z. Sasnauskienė):	2012	Bioorganic chemistry		http://vma.vu.lt/
Paula Yurkanis Bruice.	2007	Organic chemistry (Part 8. Bioorganic Compounds)		Person Prentice Hall, USA
Optional reading				
	2004	Encyclopedia of Biological Chemistry	Vol.1-4	ELSEVIER Academic Press