BIOCHEMISTRY	
GENERAL INFORMATION	
Course coordinator	Prof. Ljubica Glavaš-Obrovac, MScBiotech, PhD
Assistant/Associate	Assoc. Prof. Stana Tokić, MBiol Mol,PhD Assist. Prof. Marijana Leventić, Mbiol,PhD Assist. Prof. Teuta Opačak-Bernardi, MBiol Mol,PhD Assist. Prof. Barbara Viljetić, MEduBiol et Chem, PhD
Study Programme	Undergraduate University Study of Medical Laboratory Diagnostics
Status of the course	mandatory
Year of study, semester	1st year, 2nd semester
ECTS	**5**
Workload (hours)	Lecture: 30; Seminars: 15; Laboratory exercises: 15
Expected number of students	30-35
COURSE DESCRIPTION	
Course objectives	
The goal of the course is to transfer to students knowledge of biochemical processes and their regulation that enable living organisms to work normally, maintain the optimal concentration of ingredients in cells and body fluids, and the processes involved in growth and reproduction.	
Enrolment requirements and entry competencies	
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Learning outcomes at the Programme level	
1.1, 1.2, 2.1, 2.2, 2.5, 2.7	
Learning outcomes at the course level	
After attending lectures, participating in seminars and exercises, self-study and passing the examination, students will be able to: 1. explain the principles of biochemical and energetic changes as well as the mechanisms of regulation of the metabolism of carbohydrates, lipids, proteins, informational macromolecules and signaling molecules. 2. integrate metabolic changes at the level of cells, tissues and the whole organism. 3. relate the structure and role of biological membranes and the extracellular matrix. 4. integrate the flow and connection of metabolic reactions in different tissues, emphasize similarities and differences, list signaling molecules involved in (inter)cellular signaling and at all levels. 5. determine the peculiarities of metabolic processes in skeletal muscle, fatty tissue, liver and brain. 6. explain the biochemical background of disorders caused by errors in the structure of molecules, biochemical reactions or biochemical processes. 7. interpret the diagnostic importance of serum enzymes and proteins. Independently perform qualitative methods of chemical analysis to prove pathologically or normally present ingredients in biological fluids or simple solutions. 8. independently perform quantitative methods of chemical analysis to determine indicators of lipid status, glycemic index, enzyme activity and non-protein nitrogen compounds in biological fluids or simple solutions. 9. independently evaluate laboratory equipment and techniques.	

10. calculate and present the results of quantitative analysis and apply theoretical knowledge in the interpretation of the obtained results.

Course content

Lectures: Introduction to biochemistry. *Enzymes*: Properties of enzymes. Gibbs free energy of activation. The active site of the enzyme. Substrate binding specificity. Affinity and catalytic site. Division of enzymes according to the specificity for the type of reaction. Distribution and metabolic role. The role of serum proteins and enzymes in disease diagnosis. *Cofactors and coenzymes*. In general about intermediate metabolism. In general about the regulation of metabolic pathways. Oxidation processes in the cell associated with obtaining energy.
Kinetics and regulation of enzymatic reactions: Mechanism of enzymatic catalysis. Kinetics of enzymatic reactions. Michaelis-Menten model. Ways of expressing enzymatic activity. Allosteric enzymes. Regulation of enzyme catalytic activity. *Respiratory chain and oxidative phosphorylation*. The role of the mitochondrial respiratory chain in the conversion of energy from food. Redox potential and free energy change. Four complexes of the respiratory chain: 3 proton pumps and succinate-Q reductase. Respiratory electron chain. Incomplete reduction and formation of toxic derivatives of molecular oxygen. ATP biosynthesis - proton gradient. Malate aspartate shuttle. *Carbohydrates*: Digestion of carbohydrates; Decomposition and biosynthesis of carbohydrates; Regulation of carbohydrate metabolism.
Lipids: Digestion of lipids. Cellular degradation and biosynthesis of simple and complex lipids. Metabolism of cholesterol and bile acids. Lipoprotein metabolism. Metabolism of eicosanoids. Regulation of lipid metabolism.
Amino acids: Protein digestion. Intracellular degradation of proteins. Decomposition of amino acids. Biosynthesis of non-essential amino acids. Regulation of the rate of amino acid metabolism. Amino acids as a source of substances in biosynthesis. Conversion of amino acids into specialized products; Porphyrins and bile dyes. Amino acids as precursors of many biomolecules. Synthesis of NO. Glutathione. Peptide hormones. Porphyrin biosynthesis. Heme degradation. The urea cycle. *Nucleotides*: Biosynthesis and breakdown of nucleotides. Regulation of nucleotide metabolism. Cellular signaling. Nutrition, digestion and absorption. Micronutrients and macronutrients. *Regulation of metabolic pathways and interrelationships in intermediate metabolism*: Biosynthetic and degradative metabolic pathways. Tissue specificity of energy metabolism. Regulation of metabolic pathways. Metabolic relationships between tissues in a well-nourished organism, after a meal and in a state of starvation.

Seminars: Basic biomolecules, their structures, synthesis, sources in the organism, interactions with other biomolecules and the importance of biomolecules for the normal development of metabolic pathways, which is a prerequisite for the health of the organism. By solving problem tasks related to a particular subject of the curriculum, the student develops the ability to think critically and approach the problem. Furthermore, spoken and written communication skills are developed when presenting a solution to a given problem.

Laboratory exercises: Protein determination. Laboratory analysis of the activity of enzymes, carbohydrates, lipids and breakdown products of metabolism.

Mode of teaching

Lectures / Seminars /Laboratory exercises

Student obligations

Students are expected to attend all class sessions, as well as to take all the examinations. However, they are allowed for excused absences, totalling 30% of all classes.

Exercises: taking the entrance exams, keeping a work diary, writing reports, taking the final exam. Part of the seminar is conducted in the form of a focused discussion, so students should prepare for the seminar in advance. Passing a partial and final written exam, as well as an oral exam.

Monitoring student work *(alignment of learning outcomes, teaching methods, and grading)*

Teaching activity	ECTS	Learning outcome	Student activity	Assessment methods	Grade points	
					Min.	Max.
Class attendance	0.1	1-10	Class attendance; exercises	Evidence sheet; evaluation	1	3
Seminars	0.9	1-7	Seminar work	Presentation	4	12
Exercises	1.0	8-10	Entrance colloquium, practical work, writing a diary from the exercises	Diary, entrance colloquium	6	15
Knowledge check (partial tests)	1.0	1-10	Learning for the partial tests	2 partial tests	12	30
Final exam	2.0	1-10	Learning for the exams	Grading of the written exam	12	20
				Grading of oral the exam	12	20
Total	**8.0**				**50**	**100**

Evaluation/grading of the final written examination:

Percentage of correct answers (%)	Grade points
60.00-64.99	12
65.00-69.99	13
70.00-74.99	14
75.00-79.99	15
80.00-84.99	16
85.00-89.99	17
90.00-94.99	18
95.00-100	20

Calculation of final grade:
Based on the total sum of the points awarded during the course and the final exam, the final grade is determined according to the following distribution: A – excellent (5): 90-100 grade points; B – very good (4): 70-79,99 grade points; C – good (3): 60-69,99 grade points; D – sufficient (2): 50-59,99 grade points

Required reading (available in the library and through other media)

Title	Number of copies in the library	Availability through other media
R.K. Murray, D.A. Bender, K.M. Botham, P.J. Kennelly, V. W. Rodwell, P.A. Weil. Harperova ilustrirana biokemija, 28 izdanje Medicinska naklada 2011.	16	
Glavaš-Obrovac Lj. i sur. Priručnik za seminare i vježbe iz	15	

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Additional reading		
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Course evaluation procedures		
Anonymous, quantitative, standardized student survey providing feedback on the course as well as on the work of course coordinators and their assistants/associates is being conducted by the QA Office of the Faculty of medicine Osijek.		
Note /Other		
E-learning does not count towards course contact hours, but is being used in teaching and comprises links to various web pages, as well as video and audio materials available on web pages.		