

SYLLABUS			
The academic year 2017/2023 [INT]			
Module/course name:	BIOCHEMISTRY AND MOLECULAR BIOLOGY	Module code	LK.3.B.003
Faculty:	I Faculty of Medicine with Dentistry Division II Faculty of Medicine with English Language Division		
Major:	Medical		
Specialty:			
Level of study:	I (Bachelor studies) <input type="checkbox"/> II (Master studies) <input type="checkbox"/> integrated Master studies X III (Doctoral studies) <input type="checkbox"/>		
Mode of study :	full-time X		
Year of study:	I <input type="checkbox"/> II X III <input type="checkbox"/> IV <input type="checkbox"/> <input type="checkbox"/> V <input type="checkbox"/> VI <input type="checkbox"/>	Semester :	1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 X 4 X 5 <input type="checkbox"/> 6 <input type="checkbox"/> 7 <input type="checkbox"/> 8 <input type="checkbox"/> 9 <input type="checkbox"/> 10 <input type="checkbox"/> <input type="checkbox"/> 11 <input type="checkbox"/> 12 <input type="checkbox"/>
Module/course type:	obligatory X elective <input type="checkbox"/>		
Language of instruction:	Polish <input type="checkbox"/> foreign X		
Form of education	Hours		
Lecture	30		
Seminar			
Laboratory class	120		
E-learning			
Practical class			
Internship			
Student's work input (participation in class, preparation, evaluation, etc.)		Student's hourly workload	
1. In class		150	
2. Student's own work		210	
Summary of the student's workload		360	
ECTS points for module/course		12	
Educational objectives: Structures and physiological functions of amino acids, peptides, proteins, carbohydrates, lipids, nucleic acids existing in the human organism. Mechanisms and kinetics of enzymes activity. Types of enzymes. Diagnostic significance of enzymes. Processes of biological oxidation and their regulation. Metabolic pathways by which human organisms use or degrade amino acids, peptides, proteins, carbohydrates, lipids, nucleic acids and their regulation and disorders. Mechanisms of extracellular and intracellular communications between tissues and organs of the human organism. Nutrition. The digestion and absorption of food components and disorders. Types of vitamin and minerals. An influence of different vitamins and ions on the general metabolism of the human organism and disorders occurring in cases of their deficiencies or excesses. Biochemistry of plasma, red blood cells, the kidneys and the liver. Lab classes provide possibilities to acquaint with many different chemical methods used in biochemistry and molecular biology during which students familiarize and use the various kind of suitable equipment .			

The matrix of learning outcomes for module/subject with reference to verification methods of the intended educational outcomes and forms of instruction:

Learning outcome code	A student who has obtained a credit for the module/ course has the knowledge/skill to:	Methods of verifying the achievement of the intended learning outcomes:	Form of instruction * provide the symbol
*L- a lecture; S- a seminar; Lab - a lab class.			
W 01 (B. W 2)	describe an acid-base equilibrium and buffer action mechanisms as well as their significance in systemic homeostasis;	Oral exams. Written exams. SSQ, MCQ, MRQ, matching test, true/false test.	L/Lab
W 02 (B.W 11)	describe the structure of lipids and polysaccharides and their function in cellular and extracellular structures;	Oral exams. Written exams. SSQ, MCQ, MRQ, matching test, true/false test.	L/Lab
W 03 (B.W 12)	describe primary, secondary, tertiary and quaternary protein structures, know posttranslational and functional protein modifications and their significance;	Oral exams. Written exams. SSQ, MCQ, MRQ, matching test, true/false test.	L/Lab
W 04 (B.W 13)	know the function of nucleotides in a cell, primary and secondary structures of DNA and RNA and chromatin structure;	Oral exams. Written exams. SSQ, MCQ, MRQ, matching test, true/false test.	L/Lab
W 05 (B. W 15)	describe basic katabolic and anabolic pathways, methods of their control and the effect of genetic and environmental factors;	Oral exams. Written exams. SSQ, MCQ, MRQ, matching test, true/false test.	L/Lab
W 06 (B.W 16)	know metabolic profiles of basic organs and systems;	Oral exams. Written exams. SSQ, MCQ, MRQ, matching test, true/false test.	L/Lab
W 07 (B. W 17)	know the concepts of: the system oxidation potential of the body and oxidative stress;	Oral exams. Written exams. SSQ, MCQ, MRQ, matching test, true/false test.	L/Lab

W 08 (B.W 18)	know enzymes involved in digestion, the mechanism for the production of hydrochloric acid in the stomach, the role of bile, the course of absorption of digestive products and disorders associated with it;	Oral exams. Written exams. SSQ, MCQ, MRQ, matching test, true/false test.	L/Lab
W 09 (B. W 20)	know the consequences of a deficiency of vitamins or minerals and their excess in the body;	Oral exams. Written exams. SSQ, MCQ, MRQ, matching test, true/false test.	L/Lab
W10 (B.W 21)	know the ways of communication between cells, between a cell and the extracellular matrix and signaling pathways in a cell and examples of disorders in these processes leading to the development of tumors and other diseases;	Oral exams. Written exams. SSQ, MCQ, MRQ, matching test, true/false test.	L/Lab
U 01 (B. U6)	predicts the direction of biochemical processes depending on the energy state of the cells;	Oral exams. Written exams. SSQ, MCQ, MRQ, matching test, true/false test.	L/Lab
U 02 (B.U 9)	use basic laboratory techniques, such as qualitative analysis, titration, colorimetry, pH-metry, chromatography, the electrophoresis of proteins and nucleic acids;	The completion of a given assignment; project, presentation	Lab
U 03 (B. U 14)	plan and perform a simple scientific investigation and interprets its results and draw conclusions;	Performed on laboratory classes.	Lab
K 01	can perform properly and prepare a well-documented report from the results of laboratory classes;	Oral and written reports.	Lab
K 02	an active participation in lab classes, willingly undertaking and performing additional tasks entrusted by a teacher conducting classes;	An extended observation by a tutor.	Lab
K 03	showing the ability to work in a team, responsibility for the safety of one's own work and colleagues.	An extended observation by a tutor.	Lab

EXAMPLES OF METHODS VERIFYING THE ACHIEVEMENT OF THE INTENDED LEARNING OUTCOMES:

In terms of knowledge: Oral exam (*non-standardized, standardized, traditional, problem-based*).

Written exam – the student produces/identifies answers (*essay, report; structured short-answer questions /SSQ/; multiple choice questions /MCQ/; multiple response questions /MRQ/; matching test; true/false test; open cloze test*).

In terms of skills: practical exam; Objective Structured Clinical Examination /OSCE/; Mini-CEX (mini – clinical examination); completion of a given assignment; project, presentation.

In terms of social competences:

A reflective essay; an extended observation by a supervisor/tutor; 360-degree assessment (feedback from teachers, peers, patients, other co-workers); self-assessment (portfolio included).

Course content: (use keywords referring to the content of each class following the intended learning outcomes):

Lectures:

1.Amino acids and peptides.

Structures, physicochemical properties, classification, and biological values of amino acids.

The primary structure of polypeptide chain and the characterization of peptide bonds. Examples of biologically active peptides.

2.Proteins.

Structures of proteins and interactions which stabilize all of them. Physicochemical properties, classification and biological values of proteins. Functions of protein in the human organism. Structures and functions of hemoglobin, myoglobin, collagen and elastin.

3.Enzymes.

Structures, general properties, coenzymes, cofactors, classification of enzymes. Mechanisms of enzyme action, substrate specificity, factors affecting reaction velocity, kinetics of an enzyme-catalyzed reaction, inhibition of enzyme activity, regulation of enzyme activity. Isoenzymes. Enzymes in clinical diagnosis.

4.Biological oxidations.

Energy-producing and energy-utilizing systems. Thermodynamic laws. Energy-rich compounds.

The tricarboxylic acid cycle. Transport systems by the inner mitochondrial membrane, The electron transfer chain and oxidative phosphorylation. The uncoupling agents and inhibitors. Oxido-reduction reactions.

5.Carbohydrates – part I

Structures, physicochemical properties and classification of carbohydrates. Monosaccharide derivatives. Functions of oligo- and polysaccharides. Glycoproteins and proteoglycans. Digestion and absorption of carbohydrates. Hormonal regulation of glucose levels in the blood.

6.Carbohydrates – part II

Glycolysis in anaerobic and aerobic conditions, gluconeogenesis, the pentose phosphate pathway, glycogen metabolism, metabolism of fructose and galactose, lactose metabolism and regulation. Tissue specificity of carbohydrate metabolism. Disorders in carbohydrate metabolism.

7.Lipids – part I.

Structures, physicochemical properties and classification of lipids. Digestion and absorption of lipids. Metabolism of fatty acid, metabolism of ketone bodies, metabolism of triacylglycerols and regulation. Functions and metabolism of phospholipids. Functions and metabolism of glycosphingolipids.

8.Lipids – part II.

Functions and metabolism of eicosanoids and regulation. Functions and metabolism of cholesterol and regulation. Functions and metabolism bile salts and regulation. Structures, functions and metabolism of plasma lipoproteins and regulation. Tissue specificity of lipid metabolism. Disorders in lipid metabolism.

9.Nutrition. Minerals. Vitamins.

Essential nutrients. Calories. Dietary guidelines. Nutritional requirements of macrominerals, microminerals, their functions and deficiencies. Classification of vitamins. Nutritional requirements, sources, functions of water-soluble vitamins and deficiencies. Nutritional requirements, sources, functions of lipid-soluble vitamins and deficiencies.

10.Hormones. Integration of metabolism.

Classification of hormones according to a site of synthesis, chemical structure and properties, the location of receptors and the nature of signaling within the cell. Endocrine hormones. Growth factors and cytokines. Neurotransmitters. Metabolic fuels. Categories, location and integration of metabolic pathways.

11.Nucleic acids.

Structure and nomenclature of the components of nucleic acids. Structure and biological function of DNA and RNAs. Digestion of nucleic acids. Steps in prokaryotic and eukaryotic DNA synthesis. Steps in prokaryotic and eukaryotic RNA synthesis. Posttranscriptional modifications of rRNA, mRNA and tRNA. Disorders in nucleic acid metabolism.

12.Protein synthesis.

Characteristics of the genetic code. The function of aminoacyl tRNA synthetases and tRNAs. Ribosome structure. Characteristics of prokaryotic and eukaryotic RNAs. Steps of translation. Posttranslational modifications of polypeptides. Mutations. Inhibitors of protein biosynthesis.

13.Catabolism of proteins.

Classification of proteolytic enzymes. Protein digestion. Mechanisms of amino acids absorption from the gastrointestinal tract. Protein turnover and regulation. Protein degradation in lysosomes. Protein degradation in proteasomes.

14.Metabolism of amino acids.

Interorgan amino acid exchange. The major reactions of amino acid degradation. Catabolic pathways of individual amino acids. Fates of final products. Ammonia metabolism. Pathways of amino acid conversion to specialized products. Pathways of biosyntheses of amino acids in the human organism.

15.Biochemistry of the blood and the kidneys.

Metabolism of erythrocytes. Metabolism and functions of hemoglobin. Plasma proteins. Non-protein constituents of plasma. Functions of the kidneys. An acid-base balance.

Laboratory classes:

1 – 3. Isolation of proteins from cancer cells. Quantitative determination of protein content by the Bradford's method. Protein analysis by the Western blotting technique. Electrophoresis of proteins by SDS-PAGE, semi-dry electrotransfer of separated proteins, immunodetection. Gel filtration chromatography. The repetition – amino acids, peptides and proteins

4 – 6. Determination of catalase activity in biological materials. Preparation and evaluation of succinate dehydrogenase activity. Evaluation of enzymatic activities of phenolase and peroxidase. Quantitative determination of glutathione. The repetition – enzymes and biological oxidations.

7 – 9. Determination of amylase activity. Determination of lactate dehydrogenase activity. Determination of aldolase activity. Quantitative determination of a glucose concentration in the blood serum.

The repetition – properties, functions and metabolism of carbohydrates.

10 – 12. Characteristics of lipolytic enzymes. Demonstration of bile effects on pancreatic lipase activity. Quantitative determination of a triacylglycerol concentration in the blood serum. Quantitative determination of a total cholesterol in the blood serum. Determination of a cholesterol concentration in plasma proteins such as HDL and LDL. The repetition – properties, functions and metabolism of lipids.

13 – 15. Determination of trypsin proteolytic activity. Quantitative determination of total acidity and a deficiency of hydrochloric acid in gastric juice. Preparation and quantitative determination of liver alanine aminotransferase activity. Quantitative determination of urea in the blood serum.

16 – 18. Isolation of DNA and detection of its components. Quantitative determination of uric acid in the blood serum. Isolation of RNA and detection of its components. Electrophoresis of nucleic acids. The repetition – protein catabolism and amino acid metabolism.

19 – 21. Detection of water-soluble and fat- soluble vitamins. Quantitative determination of vitamins in biological materials. Detection of 17-ketosteroids. Quantitative determination of testosterone. Quantitative determination of a calcium concentration in the blood serum. Quantitative determination of alkaline phosphatase activity in the blood serum.

The repetition – nutrition, minerals, vitamins, hormones and integration of metabolism.

22 – 24. Identification of inorganic and organic components of the blood. Demonstration of peroxidative properties of the blood. Quantitative determination of a total bilirubin. Electrophoresis of plasma proteins. Salting out and quantitative determination of selected plasma proteins. Detection of organic and inorganic constituents in the physiological urine. Detection of pathological constituents in urine.

The repetition – biochemistry of the blood and the kidneys.

Obligatory literature for lectures and laboratory classes:

1. "LIPPINCOTT'S ILLUSTRATED REVIEWS: BIOCHEMISTRY" Series editor: Richard A. Harvey
2. "HARPER'S ILLUSTRATED BIOCHEMISTRY" Robert K. Murray, Daryl K. Granner, Victor W. Rodwell.

Complementary literature for lectures and laboratory classes:

1. "TEXT BOOK OF BIOCHEMISTRY WITH CLINICAL CORRELATIONS"

Editor: Thomas M. Devlin

Requirements for didactic aids (a multimedia projector, a movie camera, etc.)

Lecture halls, multimedia projectors, laptops, whiteboards, laboratory rooms, fume hoods, safety gloves and glasses, refrigerators, freezers, an equipment for electrophoresis and immunoblotting. shakers, spectrophotometers, centrifuges, magnetic stirrers, thermostats, dry and wet baths, electric ovens, dryers for glass equipment, automatic pipettes, pH meters, burettes and other laboratory glassware such as test tubes, beakers, Erlenmeyer flasks, graduated cylinders and etc.

Conditions for obtaining a credit for the subject:

To receive a credit for the subject is required

- to get a credit for all of the laboratory classes (by their performance and reports of performed experiments),
- to appear at lab classes on time and attend at classes according to the list established by the Dean's Office and information given in the schedule of the subject,
- an active participation in lectures and lab classes according to the schedule announced before the beginning of each semester (only one absence is possible per one semester),
- in the case of an excused absences the content of missed classes should be made up by a student according to the decision given by a teacher or the course coordinator,
- to get a credit for all of the eight partial exams from two semesters and participate in them according to the schedule announced before the beginning of each semester,
- a positive grade from the final exam conducted in the form of a test.

The first correction of the final exam is conducted in the form of a test.

The second correction of the final exam is conducted in the oral form.

There is one set of questions for all of the students taking the exam in the form of a test at the same time.

In the case of the oral exam, the student chooses one set of questions from a dozen of proposals.

The questions of all the test are based on lectures, notes from lectures obtained from teachers, obligatory textbooks, information from laboratory classes.

An absence of a student at the all kinds of final exam is recorded and information is sent to the Dean's Office. An official written excuse has to be delivered within 3 days from the date of the exam.

According to the general rules and regulation of UM of Lublin, the Dean gives unsatisfactory mark (fail) in the case of unexcused absence.

The grading scale of all the tests:

less than 60.0%	2.0	<i>Unsatisfactory</i>
60 – 67.9%	3.0	<i>Satisfactory</i>
68 – 75.9%	3.5	<i>Quite good</i>
76 – 83.9%	4.0	<i>Good</i>
84 – 91.9%	4.5	<i>Better than good</i>
92 – 100%	5.0	<i>Very good</i>

The name and address of the department/clinic where the course is taught (module/course); contact details (phone number/email address):

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Signature of the head of the department/clinic



Date of submission: June 20, 2017

Dean's signature

Medical University of Lublin
VICE-DEAN of II Faculty of Medicine
with English Language Division
Prof. Jarogniew Łuszczko MD, Ph.D.



