



COURSE DESCRIPTION AND STUDY REGULATIONS

Course: CONCEPTS OF BIOCHEMISTRY

Study Programme: Uniform Master level programme of Medicine

Year of the course: 1.

Semester of the course: Summer

Course type:
COMPULSATORY

ECTS credits:
12

Nominated teacher(s):
Damjana Rozman
Tea Lanišnik Rižner
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Valid for academic year:
2018/2019

Associated/participating departments or institutes involved in the course:
Institute of biochemistry, Medical faculty, University of Ljubljana

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1. Course objectives

The student learns about biomolecules in the human body and basic principles and mechanisms of biochemical events, which represent the basis for understanding life processes in the healthy and diseased state of the organism.

2. Course description (in accordance with rules of assessment and examination*)

Organized forms of teaching the Concepts of Biochemistry are carried out as lectures, laboratory lessons, seminars and other forms of study. The attendance is mandatory at laboratory lessons and seminars.

Lectures are held two times per week in great lecture hall of MF UL (Korytkova 2):

Monday 8.00-10.00 am

Friday 8.00-11.00 am

Other forms of study (problem lessons with clinical cases) are conducted by groups, for each group of students once per week for four school hours at Institute of Biochemistry (Vrazov trg 2).

Seminars are held in groups once per week for three school hours at Institute of Biochemistry (Vrazov trg 2). In the first part of the semester there are guided teacher seminars, while in the second part of the semester students' seminars are held. In students' seminars, each student prepares about 15 minutes long presentation, which is carried out using only board and the writing tool. The student also prepares a half page long written document, briefly summarizing the structure and key thoughts of the presentation. The summary is sent to the teacher for review one week before the defense. The seminar is followed by a discussion where the teacher as well as colleagues in the group asks questions.

Laboratory lessons take place in groups once per week for three school hours at Institute of Biochemistry (Vrazov trg 2). A student may perform exercises if she/he demonstrates understanding of the theoretical basis and the practical course of the exercise. At the end of the exercise, the student writes a report to the Laboratory Practicum. The exercise is completed when the teacher confirms it by signature.

The student must complete all laboratory lessons and seminars in the program including the defense of a student seminar so that she/he can take the exam. A student may be missing out on justified reasons for at most two exercises and two seminars. The absence in case of illness, judicial recall, etc. is apologetic, which the student proves by means of an appropriate certificate. All missed exercises must be replaced by defense in agreement with the teacher, at the last (repetition) exercise. A student, who due to her/his unwillingness was not allowed to perform an exercise, can substitute a maximum of one exercise. A student who was missing for one of the exercises or seminars due to unreasonable reasons or who was missing from two or more seminars for justifiable reasons must submit to the head of the Institute of Biochemistry MF the application to carry out the missing exercises and seminars. If her/his application is approved, she/he will agree on a further procedure with the teacher who leads the group.

3. Description of assessment of knowledge and skills during the course

The ongoing assessment of knowledge in the course of the Concepts of Biochemistry is carried out in the form of student seminars and oral checking for the laboratory lessons. The seminar is assessed with a descriptive assessment (passed / not passed). A student who has not been assessed by the grade for the seminar can do the seminar ones again, but only during the regular schooling. Successfully completed seminar defense is one of the conditions for joining the final exam.

4. Eligibility requirements for the examination (course exam)

The student can take the final exam after passing the requirements regarding seminars and laboratory lessons. The student has recognized laboratory lessons and seminars if he has completed all laboratory lessons and seminars according to the program, has a signed Laboratory practicum and a positive evaluation of the seminar presentation.

If the student hasn't completed with all conditions for taking the final exam within organized forms of teaching, he must repeat all missing laboratory lessons in the form of oral defense in agreement with the teacher, at the latest at the repeating laboratory lesson. A negative evaluation of the seminar can also be amended one time, but only during regular lessons.

5. Final examination (Course exam): description of examination procedure

Comprehension of the course Concepts of Biochemistry is tested by written and oral exam. The written exam lasts 120 minutes and is composed of 80 multiple choice questions, with only one correct answer for each question. Correctly answered question is awarded by 1 point, unanswered question with 0 points, whereas an incorrect answer (wrong answer or multiple answers) is penalized by -0,2 points. To pass the written exam, a student must collect more than 40 out of 80 total points.

Possibility to pass a written examination with partial exams.

Written examination can be done with three partial exams in terms set at the Council of the 1st year. The questions of the partial exams include the thematic of lectures, other forms of study, seminars and theoretical and practical part of the exercises. Partial exam lasts for 45 minutes and contains 30 questions of an optional type. Each partial exam is assessed with up to 30 points. Each question has only one correct answer, which is evaluated by 1 point. The unanswered question is scored with 0 points, the wrong answer or the choice of several answers (correct and incorrect) is scored with -0.2 points per question. Each partial exam represents one third of the points that can be achieved through partial exams. Students must collect more than 45 points for a positive assessment from the partial exams. Participation on partial exams is not required to be applied.

A student can enter the oral exam with completed written examination. Students who will collect more than 45 points with the average of three partial exams will fulfill the condition for entering the oral examination without prior written examination. It is also considered that the student can enter the oral examination when he holds recognized seminars and laboratory courses. The final assessment will be made at the oral examination.

In the case that the student does not take the oral exam, a written examination is required again. Students with a joint positive assessment of partial exams are justified in the written part of the exam only when the first oral examination is conducted. In the case that a student sign for the exam (and does not sign out in a timely manner), but does not join the exam or resigns it, the exam is assessed negatively.

In the case the student passes the exam, but would like to improve the grade, the student is examined only by oral examination with the same teacher, as stated in the faculty Rules on the Examination and Assessment of Knowledge and Skills for the Unified Master's Study Program Medicine and Dental Medicine of the Faculty of Medicine UL.

6. Additional provisions

Examination rules

For all forms of subject examination (partial written exam, written and oral exam), the student must have a personal identifying document. In a written examination of the knowledge, the student can carry only a pencil, eraser, a calculator and a personal document. Disconnected or properly muted cell phones / other devices that enable photographing and other personal

belongings must be disposed of by the students in locker cabinets or in places intended for this purpose.

During the examination of knowledge, copying and communication between students is prohibited. Students can open (or turn) written fields only when authorized by the supervisor. Written examination and oral examination should not be performed by another person on behalf of the student who is registered. In the event of this violation, both violators are responsible for the offense. After completing the written examination, the student must immediately submit the exam materials to the supervisor.

A violation of the examination order

A violation of the examination regulations may be established by the supervisor. After a violation has been established, the student cannot proceed with the examination of their knowledge and skills. An exam where a violation of the examination regulations has been established is awarded a failing grade.

Committee exam

The committee examination is conducted in accordance with the Rules on the verification and assessment of knowledge and skills. The examination is written and oral. In the case of fourth and fifth trial, students take the oral course exam in front of the examination committee, which consists of at least three members (examiner and two members). In the sixth examination, in addition to the examiner (who runs the committee), there are two members in the committee, one of them from another department or institute.

7. Primary and supplementary study material

Lectures

Lehninger AL, Nelson DL, Cox MM. Principles of Biochemistry New York: Worth, last edition.

Berg JM, Tymoczko JL, and Stryer L. Biochemistry: New York, W.H. Freeman, last edition (selected topics of proteins).

Other forms of study

Marks DB in sod., Basic Medical Biochemistry, A Clinical Approach, last edition

Students receive the necessary material when participating in other forms of study.

Seminars

Lehninger AL, Nelson DL, Cox MM. Principles of Biochemistry New York: Worth, last edition (selected topics).

Marks DB in sod., Basic Medical Biochemistry, A Clinical Approach, last edition (selected topics).

Bavec A, Goličnik M, Lanišnik Rižner T, Makovec T, Ravnik-Glavač M, Rozman D. Selected topics in biochemistry I, UL MF Ljubljana

Laboratory lessons

Bavec A, Goličnik M, Lanišnik Rižner T, Makovec T, Rozman D. Exercises in Biochemistry, Laboratory practicum, UL MF Ljubljana

Bavec A, Goličnik M, Lanišnik Rižner T, Makovec T, Ravnik-Glavač M, Rozman D. Selected topics in biochemistry I, UL MF Ljubljana

8. Concepts of biochemistry - exam topics, clinical pictures and skills

Exam topics	Subtopics	Courses and Readings
1. Molecular characteristics of living systems	1. Chemical and genomic evolution. 2. Characteristics of living systems. 3. Elemental composition of living organisms, major bioelements and bioelements in traces.	<ul style="list-style-type: none"> Lecture B: Lehninger AL, Nelson DL, Cox MM. Principles of Biochemistry, last issue
2. Structure of atoms and molecules, chemical bonds	1. Fundamentals of the atomic structure, intra-atomic interactions. 2. The structure of molecules. 3. Chemical bonds (strong and weak interactions); their importance in the maintenance of the structure and interactions of biological macromolecules.	<ul style="list-style-type: none"> Lecture STB: Chemical bonds P: Chemical bonds
3. Water	1. Structure of water 2. Characteristics of water important for structure of macromolecules and the life; phase diagram. 3. Hydrogen bond, hydrophobic interactions. 4. Dissolution in water (groups of biomolecules and their orientation in hydrophilic and hydrophobic environment). 5. Water as reagent.	<ul style="list-style-type: none"> Lecture B: Lehninger AL, Nelson DL, Cox MM. Principles of Biochemistry, last issue STB: Chemical bonds P: Chemical bonds AFS: Water and gas solutions
4. Solutions	1. Definition of solvent and solute. 2. Aqueous solutions of gases, liquids, solids and definitions of concentrations (molar fraction, molar, molar, percentage concentration). 3. Dissolution of gases in water (Henry's law). 4. Dissolution of gases in body fluids and disturbances due to changed external conditions. 5. Colligative properties of solutions; lowering of the vapour pressure of the solvent (Raoult's law), depression of the freezing point, elevation of the boiling point, osmosis and osmotic pressure, tonicity, Donnan equilibrium. 6. Solutions of the electrolyte, electrolyte dissociation. 7. Ionization of water, K_w , pH; biochemical / biological relevance of pH. 8. Acids and bases; strength (dissociation rate, dissociation constant). 9. Neutralization of acids with bases et vice versa (titration curves, pH indicators). 10. Weak and strong electrolytes. 11. Buffers; the definition of the buffer system, buffer capacity, the functioning of the buffer system.	<ul style="list-style-type: none"> Lecture B: Lehninger AL, Nelson DL, Cox MM. Principles of Biochemistry, last issue STB: Colligative properties STB: Acids, bases and buffers P: Colligative properties P: Acids, bases and buffers AFS: Colligative properties, electrolytes.

	<p>12. Relevance of pH maintenance in cells / organism. Buffer systems in the organism (extracellular, intracellular).</p> <p>13. Ionic strength of solutions; the influence of electrolyte concentration on ionic strength.</p> <p>14. Salt solubility and solubility product; examples of salt formation/ crystals in the organism hydroxy- and fluoroapatite in bones and teeth).</p>	
5. Thermodynamics	<p>1. Work and heat as a form of energy.</p> <p>2. First law of thermodynamics and enthalpy.</p> <p>3. Energy changes in biochemical reactions.</p> <p>4. Burnout and energy value of certain metabolic nutrients (carbohydrates, proteins).</p> <p>5. Hess law. Enthalpy of chemical bonding.</p> <p>6. Reversible / irreversible chemical reactions, entropy, second law of thermodynamics.</p> <p>7. Equilibrium of chemical reactions, standard state, spontaneous and non-spontaneous processes free energy, chemical potential.</p> <p>8. Effects of various factors on the chemical equilibrium.</p> <p>9. Coupled reactions, the importance for maintenance of life.</p> <p>10. ATP (structure, hydrolysis, activation of biomolecules).</p> <p>11. Other compounds with high phosphorylation potential (phosphoenolpyruvate, phosphocreatine).</p>	<ul style="list-style-type: none"> • Lecture • B: Lehninger AL, Nelson DL, Cox MM. Principles of Biochemistry, last issue • STB: Chemical thermodynamics and kinetics • P: Chemical thermodynamics and kinetics • AFS: Thermodynamics
6. Oxidoreductions	<p>1. Oxidoreduction reactions; oxidoreduction couples, oxidation / reduction, oxidant / reducer.</p> <p>2. Flow of electrons and change in free energy.</p> <p>3. Standard state. Nernst equation.</p> <p>4. Oxidoreduction reactions in organism, respiratory chain.</p>	<ul style="list-style-type: none"> • Lecture • B: Lehninger AL, Nelson DL, Cox MM. Principles of Biochemistry, last issue • STB: Oxidoreduction reactions • P: Oxidoreduction reactions. • AFS: Oxidoreductions.
7. Chemical kinetics	<p>1. The course of the chemical reaction against the equilibrium.</p> <p>2. Energy profile of chemical and biochemical reactions.</p> <p>3. Reaction rate and rate constant; determination of the rate constant.</p> <p>4. Reaction order; determining the order of the reaction.</p> <p>5. The influence of various factors on the reaction rate.</p> <p>6. Catalysis, reaction mechanism, kinetics of catalyzed and non-catalyzed reactions.</p>	<ul style="list-style-type: none"> • Lecture • B: Lehninger AL, Nelson DL, Cox MM. Principles of Biochemistry, last issue • STB: Chemical thermodynamics and kinetics • P: Chemical thermodynamics and kinetics • AFS: Chemical thermodynamics and kinetics

8. Transport of matter through biological membranes	<ol style="list-style-type: none"> 1. Membrane permeability depending on the biochemical properties of the substance. 2. Thermodynamics of transport and transmembrane potential. 3. Direct and indirect transport. 4. Active transport: ATP hydrolysis and ionic gradient as the source of energy. 	<ul style="list-style-type: none"> • Lecture • B: Lehninger AL, Nelson DL, Cox MM. Principles of Biochemistry, last issue
9. Carbon as the fundamental atom of biomolecules	<ol style="list-style-type: none"> 1. Carbon atom; electronic configuration, resonance, steric properties. 2. Bonds between carbon atoms and between carbon and other atoms. 	<ul style="list-style-type: none"> • Lecture
10. Biomolecules - general	<ol style="list-style-type: none"> 1. Functional groups; structure, properties and characteristic reactions. 2. Interaction between functional groups (inductive, resonance and steric effects). 3. Isomerism; classes and biochemical significance. 4. Weak interactions between functional groups. 	<ul style="list-style-type: none"> • Lecture
11. Aminoacids	<ol style="list-style-type: none"> 1. Types of amino acids; structure, properties, nomenclature. 2. Nonstandard aminoacids. 3. Optical isomerism of aminoacids. 4. Aminoacids and pH; titration curves, isoionic and isoelectric points. 5. Typical reactions and separation. 	<ul style="list-style-type: none"> • Lecture • B: Lehninger AL, Nelson DL, Cox MM. Principles of Biochemistry, last issue • STB: Aminoacids. • P: Aminoacids
12. Peptides	<ol style="list-style-type: none"> 1. Peptide bond; formation, strenght and properties. 2. Definition of peptides and the nomenclature. 3. Types of biologically active peptides and their significance. 4. Peptide hormones, structure and function of insuline. 5. Basics of peptide hormone activity at the molecular level. 	<ul style="list-style-type: none"> • Lecture • B: Lehninger AL, Nelson DL, Cox MM. Principles of Biochemistry, last issue • AFS: Aminoacids and peptides
13. Biogenic amines	<ol style="list-style-type: none"> 1. The formation and types of biogenic amines. 2. Structure and function of adrenaline. 3. The formation and structure of thyroid hormones. 	<ul style="list-style-type: none"> • Lecture • B: Lehninger AL, Nelson DL, Cox MM. Principles of Biochemistry, last issue
14. Carbohydrates	<ol style="list-style-type: none"> 1. Definition and distribution. 2. Monosaccharides aldoses and ketoses, representatives, structure and meaning. 3. Monosaccharide derivatives; amino-, acetyl-, alkyl- and sulfoderivatives 4. Optical isomery and mutarotation. 5. Glycoside bond, types and characteristics. 6. Characteristic reactions. 7. Disaccharides; types, properties and meaning. 8. Lactose and saccharose and intolerance. 9. Oligosaccharides. 10. Biochemical concepts of blood groups (AB0 system). 11. Polysaccharides: monoglycane, heteroglycans. 	<ul style="list-style-type: none"> • Lecture • B: Lehninger AL, Nelson DL, Cox MM. Principles of Biochemistry, last issue • STB: Carbohydrates. • P: Carbohydrates. • AFS: Carbohydrates.

	<p>12. Starch, structure, biochemical meaning.</p> <p>13. Structural polysaccharides; cellulose, chitin, glukosaminglycans.</p> <p>14. Hydrolysis of glycoside bonds by polysaccharides.</p> <p>15. Bacterial cell wall; structure, biochemical stability.</p> <p>16. Structural characteristics of glycoproteins.</p>	
15. Lipids	<p>1. Fatty acids; classification, characteristics and function.</p> <p>2. Triacylglycerols; structure and function.</p> <p>3. Glycerophospholipids; classification, structure and function.</p> <p>4. Sphingolipids; classification, structure and function.</p> <p>5. Biological membrane; biochemical aspects, structure and function.</p> <p>6. Building blocks of lipids as signaling molecules; unsaturated fatty acids, phosphoinositides.</p> <p>7. Eikosanoids (prostaglandins, prostacyclins, tromboxanes and leukotrines) structure and function.</p> <p>8. Lipid transport in aqueous media, emulgation, micelles, lyposomes, lipoptoreins.</p> <p>9. Steroids; structure, clasification, stereochemistry and nomenclature.</p> <p>10. Cholesterol: structure and function.</p> <p>11. Bile acids; classification, structure and function.</p> <p>12. Steroid hormones; structure and function of corticosteroids and sex hormones.</p> <p>13. Structural basis of steroid hormone action.</p> <p>14. Lipid soluble vitamins; general characteristics.</p> <p>15. Structure and function of vitamin A. Role in visual cycle.</p> <p>16. Structure and function of vitamins D, E and K.</p> <p>17. Biochemical aspects of hyper and hypo-aminoses.</p>	<ul style="list-style-type: none"> • Lecture • B: Lehninger AL, Nelson DL, Cox MM. Principles of Biochemistry, last issue • STB: Lipids. • P: Lipids. • AFS: Lipids.
16. Water soluble vitamins	<p>1. Characteristics and structure of active parts of water soluble vitamnis.</p> <p>2. Coenzyme forms of vitamins.</p> <p>3. Biochemical insights into hypovitaminoses.</p>	<ul style="list-style-type: none"> • Lecture • B: Lehninger AL, Nelson DL, Cox MM. Principles of Biochemistry, last issue • P: Oxidoreduction reactions (Vitamin C) • AFS: Nucleotides and vitamins.

17. Nucleotides	<ol style="list-style-type: none"> 1. Purine and pyrimidine bases, structure and properties. 2. Nucleosides and nucleotides, structure and nomenclature. 3. Nucleotides and their role in storage and transmission of energy. 4. Cyclic nucleotides as secondary messengers. 5. Nucleotides as building blocks of nucleic acids. 6. Characteristic reactions and biochemical meaning. 	<ul style="list-style-type: none"> • Lecture • B: Lehninger AL, Nelson DL, Cox MM. Principles of Biochemistry, last issue • STB: Nucleic acids. • P: Nucleic acids. • AFS: Nucleotides and vitamins.
18. Nucleic acids	<ol style="list-style-type: none"> 1. Structure and properties of nucleic acids 2. Types of nucleic acids, biochemical composition and the role. 3. Physico-chemical basis of secondary structure 3. Layers of DNA structure. 4. Structure of different RNA molecules. 	<ul style="list-style-type: none"> • Lecture • B: Lehninger AL, Nelson DL, Cox MM. Principles of Biochemistry, last issue • STB: Nucleic acids. • P: Nucleic acids. • AFS: Nucleotides and vitamins.
19. Genome	<ol style="list-style-type: none"> 1. The structure of human genome. Biochemical meaning of different nucleotide sequences. 2. The influence of changes in primary structure DNA on the protein structure. 3. The »Human Genom Project« and project »1000 genomes« and genomics. 4. Understanding the causes and consequences of genetic diseases / defects at the molecular level. 	<ul style="list-style-type: none"> • Lecture • B: Lehninger AL, Nelson DL, Cox MM. Principles of Biochemistry, last issue • AFS: Nucleotides abd vitamins
20. Proteins	<ol style="list-style-type: none"> 1. Classification based on structure and function. 2. Primary and secondary structure of proteins; α-helix, β-structure, β-turn. 3. Tertiary and quarternary structure of proteins. Allosteric effects. 4. Protein folding and denaturation. 5. Biochemical aspects of protein conformational disorders. 	<ul style="list-style-type: none"> • Lecture • B: Lehninger AL, Nelson DL, Cox MM. Principles of Biochemistry, last issue • STB: Proteins. • P: Proteins. • AFS: Proteins.
21. Globular proteins, myoglobin and haemoglobin	<ol style="list-style-type: none"> 1. Myoglobin, haemoglobin; structure and function. 2. Quarternary structure of haemoglobin, positive cooperativity, conformations T and R. 3. Alosteric modulators of haemoglobin; homotropic and heterotropic modulators O₂, CO₂, H⁺, 2,3-BPG. 4. CO and competitive inhibition of haemoglobin. 5. Types of haemoglobins: A, A₂, F. 6. Biochemical basis of haemoglobinopathies 	<ul style="list-style-type: none"> • Lecture • B: Lehninger AL, Nelson DL, Cox MM. Principles of Biochemistry, last issue • AFS: Proteins.
22. DNA-binding proteins	<ol style="list-style-type: none"> 1. Histones; biochemical characteristics; structure of nucleosome. 	<ul style="list-style-type: none"> • Lecture

	2. Transcription factors; structural characteristics; DNA binding domains (Zn fingers), dimerization domains (Leu zipper).	<ul style="list-style-type: none"> • B: Lehninger AL, Nelson DL, Cox MM. Principles of Biochemistry, last issue • AFS: Proteins
23. Fibrillary proteins	1. Structure of keratins; structure-function relationship. 2. Structure of collagen; structure-function relationship. 3. Age and disease related changes in collagen; the importance of vitamin C.	<ul style="list-style-type: none"> • Lecture • B: Lehninger AL, Nelson DL, Cox MM. Principles of Biochemistry, last issue • AFS: Proteins
24. Biochemical aspects of molecular motors.	1. Transformation of chemical energy into mechanical energy. 2. Structure of muscle contractile proteins. 3. Biochemical concepts of smooth muscle contraction. 4. Biochemical aspects of molecular motor F_0F_1 ATPase / ATP synthase.	<ul style="list-style-type: none"> • Lecture • B: Lehninger AL, Nelson DL, Cox MM. Principles of Biochemistry, last issue • B: Berg JM, Tymoczko JL, and Stryer L. Biochemistry, last issue • AFS: Proteins
25. Membrane proteins and transport	1. Membrane proteins; structure-function relationship. 2. Kinetics and mechanism of transport: transporters and channels. 3. Biochemical aspects of ion transport, transport of glucose and drugs. 4. Structure and biochemical role of Na^+/K^+ -ATPase and Ca^{2+} pump.	<ul style="list-style-type: none"> • Lecture • B: Lehninger AL, Nelson DL, Cox MM. Principles of Biochemistry, last issue
26. Proteins and molecules involved in signal transmission	1. Biochemical mechanisms of signal transmission. 2. Structural characteristics of receptors. 3. Types of signaling molecules and secondary messengers. 4. The biochemical basis of the light-induced cycle and the connection with vitamin A.	<ul style="list-style-type: none"> • Lecture • B: Lehninger AL, Nelson DL, Cox MM. Principles of Biochemistry, last issue
27. Lipoproteins and apolipoproteins	1. Lipoproteins; structure and function. 2. Apolipoproteins; structure and function. 3. Biochemical basis of atherosclerosis.	<ul style="list-style-type: none"> • Lecture • B: Lehninger AL, Nelson DL, Cox MM. Principles of Biochemistry, last issue • Berg JM, Tymoczko JL, and Stryer L. Biochemistry, last issue
28. Immunoglobulins	1. Structure of immunoglobulins. 2. Immunoglobulins and analytical methods: Western blot, ELISA. 3. Biochemical basis of diseases caused by inappropriate folding of immunoglobulins.	<ul style="list-style-type: none"> • Lecture • B: Lehninger AL, Nelson DL, Cox MM. Principles of Biochemistry, last issue • B: Berg JM, Tymoczko JL, Stryer L. Biochemistry, last issue • STB: Proteins. • AFS: Proteins.
29. Enzymes	1. Enzymes - general structural and biochemical properties, specificity, basics	<ul style="list-style-type: none"> • Lecture

	<p>of action. Enzyme activity, specific activity.</p> <p>2. Isoenzymes.</p> <p>3. Enzymatic reactions with cofactors, coenzymes and prosthetic groups; connection with water-soluble vitamins.</p> <p>4. Classification of enzymes and examples of reactions of representative representatives of individual enzymes.</p>	<ul style="list-style-type: none"> • B: Lehninger AL, Nelson DL, Cox MM. Principles of Biochemistry, last issue • STB: Enzymes • P: Enzymes • AFS: Enzymes
30. Mechanisms of enzyme catalysis	<p>1. Transition state theory.</p> <p>2. Induced fit.</p> <p>3. General and specific acid-base catalysis.</p> <p>4. Other mechanisms; covalent catalysis, catalysis with metal ions, entropy effect, steric stabilization.</p>	<ul style="list-style-type: none"> • Lecture • B: Lehninger AL, Nelson DL, Cox MM. Principles of Biochemistry, last issue
31. Enzyme kinetics	<p>1. Initial rates and Michaelis-Menten kinetics and equation.</p> <p>2. Graphic displays of enzyme activity: Michaelis-Menten graph, Lineweaver-Burk graph.</p> <p>3. Multistep reactions; K_m and k_{cat}.</p> <p>4. Bisubstrate reactions; triple complex, double displacement - ping-pong mechanism.</p>	<ul style="list-style-type: none"> • Lecture • B: Lehninger AL, Nelson DL, Cox MM. Principles of Biochemistry, last issue • AFS: Enzymes
32. Enzyme inhibition	<p>1. Reversible and irreversible enzyme inhibition.</p> <p>2. Competitive enzyme inhibition.</p> <p>3. Noncompetitive and uncompetitive enzyme inhibition.</p> <p>4. Suicide inhibitors.</p>	<ul style="list-style-type: none"> • Lecture • B: Lehninger AL, Nelson DL, Cox MM. Principles of Biochemistry, last issue
33. Regulation of biochemical reactions	<p>1. Metabolic pathways and feedback inhibition.</p> <p>2. Allosteric enzymes; homo- in heterotropic modulators, sigmoid kinetics.</p> <p>3. Other types of regulation; covalent modification, proteolytic cleavage.</p> <p>4. Example: nucleotide synthesis by aspartate transcarbamoylase.</p>	<ul style="list-style-type: none"> • Lecture • B: Lehninger AL, Nelson DL, Cox MM. Principles of Biochemistry, last issue
34. Proteins and medicine	<p>1. Proteins in medical diagnostics.</p> <p>2. Proteins as targets for drug development.</p> <p>3. Proteins as drugs.</p>	<ul style="list-style-type: none"> • Lecture
35. Methods for characterization of biomolecules	<p>1. Biochemical methods for separation and characterization of: carbohydrates, lipids, nucleic acids and proteins.</p> <p>2. Targeted and omics approaches for studying biomolecules.</p>	<ul style="list-style-type: none"> • Lecture • B: Lehninger AL, Nelson DL, Cox MM. Principles of Biochemistry, last issue • STB: Biochemical and molecular-biological laboratory techniques • P: Biochemical and molecular-biological laboratory techniques

Legend: **B** – textbook; **STB** – Selected Topics in Biochemistry 1, material for seminars, last issue; **P** – practical course, Laboratory practicum

9. Other informations

Applying for the exam and taking the exam takes place in accordance with the Rules on the Examination and Assessment of Knowledge and Skills for the Unified Master's Study Program Medicine and Dental Medicine of the Faculty of Medicine UL. A student who does not cancel to participate on exam and does not have an excuse to do so shall be deemed not to have passed the exam and thus loses the right to take one of the exams. Filing the application is not required for participation on partial exams.

Order in the workout rooms

For security reasons, you need to keep the order in the workout rooms. Students need to store clothes and bags in the wardrobe. It is not allowed to drink and store beverages and food in the workout rooms. Students must wear the laboratory robe before carrying out a practical exercise. In certain laboratory courses, students have to wear gloves as well, which will be given in the workout rooms.