Sveučilište u Rijeci • Fakultet dentalne medicine
University of Rijeka • Faculty of Dental Medicine

Course: Biochemistry
Course Coordinator: Dijana Detel, MD, PhD, Associate professor
Department: Department of Medical Chemistry, Biochemistry and Clinical Chemistry
Study program: Integrated Undergraduate and Graduate University Study of Dental Medicine
Study year: first
Academic year: 2022/23

SYLLABUS

Course description (a brief description of the course, general instructions, where and in what form the lessons are organized, necessary equipment, instructions for attendance and preparation for classes, student obligations, etc.):

Biochemistry is a compulsory course at the first year of the Integrated Undergraduate and Graduate University Study of Dental Medicine in English. It consists of 30 hours of lectures, 30 hours of seminars, and 20 hours of laboratory practicals, overall, 80 hours (7 ECTS). Lectures and seminars are held in lecture halls of the Faculty of Medicine according to the course schedule. Laboratory practical's are held at the Department of Medical Chemistry, Biochemistry and Clinical Chemistry.
The broad goal of the teaching of students in biochemistry is to make them understand the scientific basis of the life processes at the molecular level and to orient them towards the application of the knowledge acquired in solving dental oriented clinical problems. The knowledge acquired in biochemistry should help the students to integrate molecular events with structure and function of the human body.
Thorough the seminar part, students will gradually acquire and connect topics related to course aims. Students will acquire knowledge and experience in basic laboratory techniques and analytical clinical methods related to physiological and pathological states of the organism thorough laboratory practicals.

Content of the course

- Amino acids, peptides, and proteins.
- Enzymes and Coenzymes
- Citric acid cycle
- Bioenergetics
- Metabolism of carbohydrates
- Metabolism of lipids
- Metabolism of proteins and amino acids
- Structure and function of DNA and RNA
- Hormone action and signal transduction
- Integration of Metabolism

Assigned reading:

VW. Rodwell et all.: Harpers Illustrated Biochemistry, 30th edition, The McGraw –Hill Education, New York 2015.

Detel, D. et. all.: Handbook for seminars and Laboratory practical's in Biochemistry, Department of Chemistry and Biochemistry Faculty of Medicine, University of Rijeka, 2019.

Optional/additional reading:

Berg JM, Tymoczko JL, Stryer L. Biochemistry, 5th edition. WH Freeman, New York, 2002.

COURSE TEACHING PLAN:

The list of lectures (with topics and descriptions):

L1-2 Importance of biochemistry in understanding health and disease and the application of biochemistry in medicine. Amino acids.

Understanding the aim of the course. Recognizing the role of Biochemistry in health care. To define the general structure of amino acids.

L3-4 Structure and biological importance of the proteins. Myoglobin and hemoglobin

Describe the structural levels in the architecture of proteins (primary, secondary, tertiary, and quaternary). To describe the structure and function of myoglobin and hemoglobin. Describe the structural similarities and difference between myoglobin and hemoglobin. Explain the mechanism of oxygen biding (allosteric effects, cooperativity) and transport and the role of hemoglobin in CO_2 and proton transport. Explain the Bohr effect.

L5-6 Enzymes. Classification of enzymes. The kinetics of enzyme catalysis. Regulation of enzyme activity.

To explain the structure and the function of enzymes. To explain the structure and the function of catalytic centers. To describe the kinetics and the mechanism of enzyme-catalyzed reactions. To define and describe mechanisms of regulation of enzyme activity (allosteric regulation, covalent modifications, izoenzymes, zymogens).

L7 Overview of metabolism.

Define the metabolism, explain the anabolic, catabolic reactions. Define and integrate the stages of the metabolism in energy production. Explain the role of acetyl-CoA, ATP and metabolic pathways in the formation and interconversion of metabolic fuels.

L8 Digestion and absorption of carbohydrates. Cell glucose transport.

To list carbohydrates that appear in the food and carbohydrates that are final products of digestion (hydrolysis catalyzed by an enzyme) being transported into enterocytes. To describe enzymes that catalyze hydrolytic cleavage of oligosaccharides and polysaccharides. To list the metabolic pathways of the glucose.

L9-10 Glycolysis. Gluconeogenesis. Regulation mechanisms.

To explain anaerobic and aerobic glycolysis pathways and state their final products. To show glycolysis schematically, list glycolysis enzymes, calculate the balance of ATP formation on the substrate level by "aerobic" glycolysis of glucose, to describe NAD+ and NADH + H+ roles in the glycolysis, glyceraldehyde-3P oxidation, and pyruvate reduction. To describe the cellular location of anaerobic glycolysis. To describe and discuss the regulation of glycolysis. To describe gluconeogenesis, to define molecules that enter the gluconeogenesis pathway., To state reversible glycolysis reactions. To state allosteric enzymes involved in gluconeogenesis regulation.

L11 Oxidative decarboxylation of pyruvate.

To show sum equation of oxidative phosphorylation of pyruvate into acetyl-CoA; list all the enzymes, coenzymes, and cofactors involved in the formation of acetyl-CoA from pyruvate and insert them in the metabolic scheme. Describe the regulation of oxidative decarboxylation of pyruvate.

L12 Citric Acid Cycle. Regulation of the Citric Acid Cycle.

To state the basic role of citric acid cycle (Tricarboxylic Acid Cycle); to show the cycle schematically, to state cycle reactions' cellular locations; to state reactions by which terminal oxidations occur

together with corresponding enzymes and coenzymes; to state citric acid. To list regulatory enzymes and reactions catalysed by those enzymes.

L13-14 Bioenergetics. Oxidative Phosphorylation.

To describe oxidative phosphorylation and electron transport chain, the location of electron transport chain and its topology. To explain the coupling of oxidation of reduced coenzymes with the synthesis of ATP. To explain the ATP synthase mechanism and the regulation of the oxidative phosphorylation.

L15 Digestion and absorption of lipids.

To list the part of the digestive tract where lipolytic breakdown of triacylglycerols (lipids and oils) takes place and the factors that stimulate this breakdown; to describe the intraluminal process of triacylglycerol breakdown concerning pancreatic lipase specificity and the action of bile salts; to describe the triacylglycerol metabolism inside enterocytes.

L16-17 Oxidation of fatty acids. Ketone body formation and utilization.

To explain processes of fatty acid activation and transport into the matrix of the mitochondria. To describe the catabolism of fatty acids and their cellular location.

To calculate energy balance of fatty acid breakdown. List the essential fatty acids and their characteristics.

To identify ketone bodies. Explain the reactions of formation of ketone bodies and their utilization in extrahepatic tissues. Identify pathological conditions when ketosis and ketoacidosis occur.

L18 Biosynthesis of fatty acids.

To describe the reaction catalyzed by acetyl-CoA carboxylase and understand the mechanisms by which its activity is regulated to control the rate of fatty acid synthesis. To explain reactions of fatty acid biosynthesis and the role of the multienzyme complex in that process.

L19-20 Biosynthesis and metabolism of cholesterol. Biosynthesis and metabolism of bile acids.

To explain the importance of cholesterol as an essential structural component of cell membranes, as a precursor of steroid hormones, bile acids, and vitamin D. To identify stages of cholesterol biosynthesis from acetyl-CoA. Understand the role of 3-hydroxy-3-methylglutaryl CoA reductase in controlling the rate of cholesterol synthesis and explain the mechanisms by which its activity is regulated. To display cholic, glycocholic, and taurocholic acid biogenesis (bile acids); to state physical and chemical characteristics and biosynthesis of steroid hormones.

L21 Digestion and absorption of proteins.

To understand the proteolysis in the digestive tract and the absorption of amino acids in the intestine; to know extracellular proteases and their classification (exopeptidase, endopeptidase, aminopeptidase, carboxypeptidases, dipeptidylpeptidases), to know the location of action of proteolytic enzymes, the activation and mechanisms of pepsin, trypsin, and chymotrypsin action.

L22-23 Metabolism of amino acids.

To name and know the basic pathways of amino acid degradation (decarboxylation, transamination, oxidative deamination); to explain the reaction of amino acid decarboxylation, name enzymes and co-enzymes; to list biologically important amines. To explain the processes of oxidative deamination of amino acids, formation of keto acids and ammonia, specify oxidoreductases that catalyze reactions and coenzymes; to explain the formation of ammonia in the combined processes of transamination and oxidative deamination resulting in glutamate; to explain the mechanism of transaminase action.

L24 The Urea cycle reactions and function.

To indicate from which compounds high-energy carbamoyl phosphate is formed, schematically show intermediates of urea cycle and urea formation; to identify the subcellular locations of the enzymes that catalyzes the cycle; to explain the utilization of ATP.

L25-26 Structure and function of the nucleic acids. Protein synthesis.

To describe the structure and function of nucleic acids; to explain semiconservative replication of DNA, transcription, and protein biosynthesis (translation). Understand the flow of genetic information from DNA to RNA to proteins.

L27 Post-translation modifications.

To explain the aim and effects of posttranslational modifications of protein on structure, biochemical activity, and intracellular traffic and sorting of proteins (trans-membrane proteins, peripheral membrane proteins, glycosylphosphatidylinositol anchored proteins); to state the examples; to explain membrane lipids and proteins mobility. To describe the role of ubiquitin in protein degradation.

L28-29 Signal molecules.

To explain the principles of cellular signaling. To list the signal molecules according to solubility. To explain the role of receptors in signal transduction. To describe the classification of hormones. To explain the mechanisms of hormone action and the hierarchy of hormones. To explain the role of receptors and G proteins as well as the generation of second messengers in hormone signal transduction.

L30 Control and integration of metabolism.

Integrate the metabolic destiny of a food ingredient from its digestion and absorption to complete degradation or conversion into an intermediate product. To describe the peculiarities of metabolic processes, present in adipose tissue, liver, and brain. Integrate the various aspects of metabolism and their regulatory pathways.

The list of seminars with descriptions:

S1 Amino acids and peptides.

Define chemical properties and general reactions of amino acids. Define and calculate the isoelectric point of amino acids. List the physiologically active peptides.

S2 The connective tissue. Extracellular Matrix and its major components

To classify the proteins based on structure, solubility, and function. Describe the structural and functional properties of collagen and elastin. To explain the denaturation of the proteins.

S3 Cofactors. Water soluble vitamins. Biochemically important reactions.

To classify and to describe the structure of cofactors. To explain the modalities of coenzyme action. To explain the role of water-soluble vitamins in enzymatic activity. To indicate, explain the physiological role and mechanism of biochemically important reactions.

S4 Metabolism of glycogen.

Describe the structure of glycogen and its importance as a carbohydrate reserve. Explain the synthesis and breakdown of the glycogen. Describe the mechanisms by which synthesis and breakdown are regulated.

S5 Pentose phosphate pathway. Pathways of other hexose sugars.

To describe the conversion of galactose and fructose into glucose (monosaccharide interconversion); to state enzymes (and coenzymes) involved in the enzyme catalyzed epimerization of galactose into glucose; to explain the chemical background of galactose metabolism disorders; to show and to explain fructose metabolism. To describe the Pentose phosphate pathway reactions, enzymes, and major functions. Explain the role of pentose pathway as a source of NADPH.

S6 Metabolism of lipids.

To name and understand the structure and chemistry of physiologically important lipids. To define the meaning of the term lipids, and to explain their distribution according to their role and structure; to know the most important representatives of elementary and complex lipids, biological important steroids, biological important terpenes. To identify essential fatty acids and to explain their

characteristics. To explain the biosynthesis of polyunsaturated fatty acids. To explain biochemical mechanism and biochemical aspects of clinical disorders of lipoprotein metabolism.

S7 Biosynthesis of membrane lipids. Synthesis of phospholipids and sphingolipids.

To outline the general structure of triacylglycerols, phospholipids, and glycerosphingolipids and indicate their functions. To explain glycerol origin for the glycerolipid biosynthesis. To explain the role of phospholipases in the degradation and remodeling of phospholipids. To display the phosphatidylcholine, phosphatidylethanolamine, phosphatidylserine, and phosphatidylinositol metabolism; to display sphingomyelin and glycosphingolipid metabolism; to describe and to explain the eicosanoid structure, biological role, and metabolism.

S8 Metabolic fate of amino acid carbon skeleton. Metabolic transformation of individual amino acids.

To describe metabolic pathways for glycine, serine, aspartic and glutamic acid, arginine, histidine, phenylalanine, tyrosine, tryptophan, cysteine catabolism, metabolic scheme of aromatic amino acid degradation. To explain the mechanism of phenylketonuria, alkaptonuria, albinism, and disease of metabolism of branched-chain amino acids.

S9 Fat soluble vitamins.

To explain the biological role of vitamins in human health. To explain the structure, principal functions, and metabolism of fat-soluble vitamins A, D, E, K. To explain the role of vitamin A in the metabolism of rhodopsin (rhodopsin biosynthesis), gene expression, and tissue differentiation. To describe the metabolism of vitamin D in the skin, liver, and kidney. To explain the role of vitamin D in the control of calcium homeostasis. To explain vitamin E antioxidative properties in cell membranes and plasma proteins. To describe the role of vitamin K in blood clotting

S10 Metabolism of iron, porphyrins, and bile pigments.

To describe the mechanism of iron absorption, distribution, and storage into tissues. To describe the physiological and clinical role of transferrin, ferritin, iron concentration in serum, and hepcidin in the human organism. To explain the causes and clinical picture of iron deficiency. To explain the pathway of porphyrin biosynthesis.

The list of practicals with descriptions:

LP1 Color reactions of proteins and amino acids

To determine of different amino acids. Determine the isoelectric point of a given protein solution.

LP2 Serum total protein, albumin, and globulin estimation.

To measure the concentration of total proteins and albumin in the serum.

LP3 Determination of aminotransferase activity in serum

To explain how substrate concentration and inhibitor affect the rate of enzyme-catalyzed reaction.

LP4 Factors affecting enzymatic activity

To explain how the temperature and pH influence on amylase activity. To determination α-amylase activity.

LP5 Qualitative and quantitative analysis of carbohydrates

To apply a qualitative reaction to detect carbohydrates in biological samples. To measure serum glucose concentration, interpret, and explain the results.

LP6 Lipids

To apply spectrophotometry and electrophoresis in order to determine serum lipid profile. Apply qualitative methods for the detection of pathological components of urine.

LP7 Determination of non-protein nitrogen compounds

To measure urine and serum renal function parameters, interpret the results, and explain possible causes of hyperuricemia and urinary infections. Apply qualitative methods for the detection of pathological components in the urine.

Students' obligations:

Class attendance, including test attendance, is mandatory. Students may be absent from 30% of each form of teaching provided they have a justifiable cause. If a student is absent for more than 30% of the classes, he/she will have to re-enroll the course.
Absence from seminars is compensated by an oral colloquium. Students are expected to actively participate in all aspects of the course, complete laboratory reports on time, and attend the examinations. Moreover, preparation of the course content, which is going to be discussed during seminars and laboratory practical's, is obligatory. During laboratory practical's, a student is obligated to wear a lab coat, to have tools (a wiping pad, a ruler, and a calculator), and the Handbook for seminars and practical's in Biochemistry.

Assessment (exams, description of written / oral / practical exam, the scoring criteria):

Student grading will be conducted according to the current Ordinance on Studies of the University of Rijeka.

Student work will be assessed and graded during the course and on the final exam. During the course, students may obtain a total of 100 grade points (credits). Students can achieve up to 70% of the final grade during the classes, and a maximum of 30% of the final grade at the final exam.

Evaluation of students' progress during classes, midterms, and the final exam in academic year 2021/2023 is shown in Table 1.

Table 1. Distribution of grade points in the course "Biochemistry"

	Evaulation	**Grade points**
Midterm exams	Midterm exam I	27
	Midterm exam II	27
	Total	**54**
Laboratory practical's	Completed practical and accepted written report	7
Seminars	Active participation/short written exams	9
TOTAL		**70**
Final exam	Written exam	15
	Oral exam	15
	Total	**30**
TOTAL		**100**

Written midterm exams

During the semester, two written midterm exams are planned, which will include the content of lectures, seminars, and laboratory practical's. At each midterm exam, the maximum of grade points that a student can obtain is 27.

All written midterm exams consist of 40 multiple choice questions and are evaluated according to the criteria shown in Table 2. In order to obtain grade points, a student should have/gain a minimum 50% of correct answers on each midterm exam. Settled midterm exams are valid for the current academic year in which they are placed.

Table 2. Evaluation of written midterm exams I-II

% of correct answered questions	Grade points/credits
50.00-52.99	15
53.00-54.99	16
55.00 -59.99	17
60.00-65.99	18
66.00-69.99	19
70.00-74.99	20
75.00-79.99	21
80.00-84.99	23
85.00-89.99	23
90.00-92.99	24
93.00-94.99	25
95.00-97.99	26
98.00-100.00	27

Correction of the midterm exams

A student can access the correction of the midterm exams if he/she i) did not obtain a minimum criterion (50% on each midterm) or ii) is not satisfied with the obtained credits and iii) in case of absence at the midterm exam due to a justified reason.
If a student retakes the midterm exam because he/she is not satisfied with the obtained grade points, only the credits gained from the retaken midterms will be considered.
Evaluation of the midterm corrections will be performed according to the criteria shown in Table 2.
Students will have the opportunity to correct one or more midterm exams only once. Correction of the midterm exam I-II will be held after completing the regular class in terms set by the course schedule.

Laboratory practical's

A student can gain 7 credits throughout laboratory practicals. Evaluation of laboratory practicals implies precisely completed experimental part of laboratory practical (maximum of 3.5 grade points) and completed and accepted written report (maximum of 3.5 grade points).

During laboratory practicals, the oral or written examination of the student can be performed by the teacher.

Seminars

Throughout the course, 10 seminars are planned during which students can achieve 9 grade points. A student can obtain a maximum of 6 grade points through short written exams and additional 3 grade points through active participation.

Final exam

The final exam is mandatory and comprises written and oral assessments. During the final exam, students can gain a maximum of 30 credits, 15 credits in the written part, and 15 credits during the oral assessment. Students are required to meet the minimum criteria for both parts of the final exam.

The written and oral part of the final exam covers the entire course content.
The written part of the final exam consists of 30 multiple-choice questions. In order to meet minimum criteria and earn grade points, students must have 50% of correctly solved questions.

Achievements during the written part of the final exam will be converted into grade points according to the criteria shown in Table 3. In case when a student did not achieve the minimum criteria on the written part of the final exam, attending the final exam on the following exam term is mandatory.

Assessment of the oral part of the final exam:
7.5 credits: minimum criteria satisfied
8 - 9 credits: average criteria satisfied with noticeable errors 10 – 12 credits: answer with a few errors 13 – 15 credits: outstanding answer.

In order to pass the final exam, a student must achieve at least 50% of positive answers on both written and oral parts of the final exam.
If the student is not satisfied with the final grade, he/she may refuse the grade. In case a student does not accept the grade, he/she must re-enter the final exam.

Table 3. Evaluation of the written part of a final exam

% of correct answered questions	Grade points/credits
50.00 – 59.99	7
60.00 – 64.99	8
65.00 – 69.99	9
70.00 – 74.99	10
75.00 – 79.99	11
80.00 – 84.99	12
85.00 – 89.99	13
90.00 – 94.99	14
95.00 – 100.00	15

Conditions for admission to the final exam

A student who accomplishes 35 or more grade points during all course classes can access the final exam. If a student achieves less than 35 grade points during all course classes, correction of the midterm exams will be organized.
A student who achieves less than 35 grade points during all course classes even after the correction of the midterm exams or is absent for more than 30% of all forms of classes, is graded as unsuccessful (F) and must reenter the course.

Final grade

The final grade represents a sum of all grade points obtained during all course classes and on the final exam. Students are evaluated according to the ECTS (A-F) and numerical (1-5) system.

The ECTS and the numerical grading system are defined by the following
criteria: A (5) 90 - 100 credits
B (4) 75 - 89.9 credits
C (3) 60 - 74.9 credits
D (2) 50 - 59.9 credits
F (1) 0 - 49.9 credits

Other important information regarding the course:

Retaking the course:

Teaching is held at the prescribed time, and it is not possible to enter after the teacher enters. Food and beverages are not permitted in the classroom or the laboratory. This includes plate lunches, drinks, candies, etc., whether opened or not. Likewise, cell phones are not allowed in the classroom during midterm or final exams. Students must arrive on time for exam attendance. Anyone late for more than 15 minutes may be refused to undertake the exam.

Academic Honesty

It is expected that all students and teachers follow the code of academic honesty in accordance with the Code of ethics for the students of the University of Rijeka. Please read the policy regarding academic honesty at: http://medical-studies-in-english.com/wp-content/uploads/2016/12/CODE-OF-ETHICS.pdf **Contact information**

For questions and concerns, please feel free to contact us by e-mail or via the Merlin platform. If you want to speak with a teacher during office hours (each working day between 11:00 am and 13:00 am), please let us know by e-mail or in class.
Dijana Detel, MD, Ph.D., Assistant professor e-mail: dijana.detel@uniri.hr

Expected competencies at course enrollment:

Students are expected to have basic knowledge of biology and chemistry.

COURSE SCHEDULE (for the academic year 2022/2023)

Date	Lectures (time and place)	Seminars (time and place)	Practicals (time and place)	Instructor
1st week 6.03.23.	**L 1,2** 10:00-12:00	**S1** 13:00-15:30		D. Detel, Associate professor (L1,2) G. Čanadi Jurešić, Associate professor
7.03.23.		**S2** 13:00-15:30		S. Buljević, Assistant professor (S2)
8.03.23.	**L 3,4** 8:00-10:00	**S3** 11:00-13:30		J. Marinić, Assistant professor I. Potočnjak PhD, Assistant (S3)
9.03.23.	**L 5,6,7** 11:00-14:00		**LP1** 08:00-10:30	I. Potočnjak, PhD, Assistant (LP1) D. Detel, Associate professor
10.03.23.	**L 8,9** 13:00-15:00		**LP2** 08:00-10:30	J. Marinić, Assistant professor S. Buljević, Assistant professor (LP2)
2nd week 13.03.23.	**L 10** 13:00-14:00		**LP3** 10:00-12:30	J. Marinić, Assistant professor S. Buljević, Assistant professor (LP3)
14.03.23.	**L 11,12** 8:00-10:00	**S4** 12:00-14:30		R. Domitrović, Full professor D. Detel, Associate professor (S4)

15.03.23.	**L 13,14** 8:00-10:00	**S5** 12:00-14:30		R. Domitrović, Full professor D. Detel, Associate professor (S5)
16.03.23.			**LP4** 8:00-10:30	S. Buljević, Assistant professor
17.03.23.	**L 15,16** 11:00-13:00		**LP5** 8:00- 10:00	J. Marinić, Assistant professor S. Buljević, Assistant professor (LP5)
3rd week 20.03.23.	Midterm Exam I (the time and place of the exam will be announced)			
20.03.23.	**L 17,18** 8:00-10:00			J. Marinić, Assistant professor
21.03.23.	**L 19,20** 14:00-16:00	**S6** 11:00-13:30		D. Detel, Associate professor I. Potočnjak, PhD, Assistant (S6)
22.03.23.	**L 21,22** 11:00-14:00		**LP6** 9:00- 11:00	D. Detel, Associate professor I. Potočnjak, PhD, Assistant (LP6)
23.03.23.		**S7** 12:00-14:30		D. Detel, Associate professor (S7)
24.03.23.	**L 23,24** 13:00-15:00	**S8** 13:00-15:30		L. Batičić, assistant professor J. Marinić, Assistant professor (S8)
4th week 27.03.23.	**L25** 10:00-11:00	**S9** 10:00-12:00		L. Batičić, Assistant professor
28.03.23.	**L26,27** 9:00-11:00	**S10** 9:00- 11:00		L. Batičić, Assistant professor D. Detel, Associate professor
30.03.23.	**L 28,29** 12:00-14:00		**LP7** 8:00-10:00	I. Potočnjak, PhD, Assistant (LP7) R. Domitrović, Full professor
31.03.23.	**L30** 13:00-14:00			D. Detel, Associate professor
3. 04. 23.	**Midterm Exam II** (the time and place of the exam will be announced)			
4.04.23.	**CORRECTION TEST I-II** (the time and place of the exam will be announced)			
6.04.23.	**CORRECTION TEST I-II** (the time and place of the exam will be announced)			

List of lectures and seminars:

	LECTURES (Topics)	Teaching hours	Location/Lecture room
L1	Introduction to the Course, Basic Biochemical Concepts	1	
L2	Amino Acids	1	
L3	The structural levels in the architecture of proteins.	1	
L4	Structure and function of Myoglobin and Hemoglobin.	1	
L5	Enzymes. Classification of enzymes. The kinetics of enzyme catalysis.	1	
L6	Regulation of enzyme activity.	1	
L7	Overview of Metabolism.	1	
L8	Digestion and absorption of carbohydrates.	1	
L9	Glycolysis. Regulation of glycolysis.	1	
L10	Gluconeogenesis.	1	
L11	Oxidative decarboxylation of pyruvate.	1	Online
L12	Overview of the Citric Acid Cycle.	1	Online
L13	The respiratory chain.	1	Online
L14	Energetics and principles of the respiratory chain.	1	Online
L15	Digestion and absorption of lipids.	1	
L16	□-oxidation of fatty acids.	1	
L17	Ketone body formation and utilization.	1	
L18	Biosynthesis of fatty acids.	1	
L19	Biosynthesis and metabolism of cholesterol.	1	
L20	Biosynthesis and metabolism of bile acids.	1	
L21	Digestion and absorption of proteins.	1	
L22	Amino Acid Metabolism. Transamination.	1	
L23	Oxidative deamination. Decarboxylation of amino acids.	1	
L24	The Urea cycle reactions and function.	1	
L25	Structure and function of nucleic acids. Replication.	1	
L26	Transcription. Biosynthesis of proteins.	1	
L27	Post-translation modifications.	1	
L28	Signal molecules.	1	Online
L29	Signal transduction.	1	Online
L30	Control and integration of metabolism.	1	Online
	Total number of lectures	30	

	SEMINARS (Topics)	Teaching hours	Location/Lecture room
S1	Amino Acids. Peptides: structure and biological role.	3	
S2	Protein classification. Denaturation of the proteins. Collagen and elastin fibers. Plasma proteins and their physiological function.	3	
S3	Cofactors. Water soluble vitamins. Biochemically important reactions.	3	
S4	Metabolism of Glycogen. Regulation of glycogen metabolism. Cori cycle.	3	
S5	The pentose phosphate pathway. Interconversion of sugars. Metabolism of hexose sugars. Glycoproteins.	3	
S6	β-oxidation of odd numbered and unsaturated fatty acids Biosynthesis of unsaturated fatty acids. Regulation of lipolysis and lipogenesis.	3	
S7	Biosynthesis of membrane lipids. Synthesis of acylglycerols and phospholipids; cerebrosides and sphingolipids. Transport of lipids.	3	
S8	Catabolism of carbon skeletons of amino acids. Metabolic transformation of individual amino acids.	3	
S9	Fat soluble vitamins.	2	
S10	Metabolism of iron, porphyrins, and bile pigments	2	
S11	Oral colloquium and Consultation(s)	2	
	Total	30	

	Topics of Laboratory Practicals (LP)	Teaching Hours	Lecture Room
LP1	**Qualitative reactions of Amino Acids and Proteins**	3	Department of Chemistry and Biochemistry
LP2	**Determination of aminotransferase activity in serum** The influence of substrate concentration on enzyme activity.	3	Department of Chemistry and Biochemistry
LP3	**Proteins** Quantitative determination of total protein, albumin, and globulin concentration in the serum.	3	Department of Chemistry and Biochemistry
LP4	**Factors affecting enzymatic activity** Effect of temperature and pH on amylase activity Determination of α-amylase activity	3	Department of Chemistry and Biochemistry
LP5	**Qualitative and quantitative analysis of carbohydrates** Quantitative determination of glucose in the blood. Detection of glucose in urine.	2	Department of Chemistry and Biochemistry
LP6	**Qualitative and quantitative analysis of lipids** Quantitative determination of triglycerides in serum.	2	Department of Chemistry and

	Detection of ketone bodies in urine. Determination of total cholesterol in serum. Determination of serum HDL and LDL cholesterol in serum.		Biochemistry
LP7	**Determination of non-protein nitrogen compounds:** urea, creatinine, and uric acid in urine. Detection of nitrites in urine.	2	Department of Chemistry and Biochemistry
	Midterm exam	2	
	Total	**20**	

	FINAL EXAM DATES
1.	6. 4. 2023.
2.	28. 6. 2023.
3.	13. 7. 2023.
4.	6. 9. 2023.
5.	20. 9. 2023.