

NAME OF THE COURSE		Medical Chemistry and Biochemistry				
Code	MFE201	Year of study	2nd			
Course teacher	Full.prof. Vedrana Čikeš Čulić, PhD	Credits (ECTS)	17			
Associate teachers	Full.prof. Anita Markotić, PhD; full.prof. Irena Drmić Hofman, PhD; full.prof. Maja Pavela-Vrančić, PhD; assist.prof. Nikolina Režić Mužinić, assist.prof. Marina Degoricija, PhD; PhD; assoc.prof. Mila Radan, PhD; Angela Mastelić, PhD; Sandra Marijan, PhD.	Type of instruction (number of hours)	L	S	P	T
			66	50	74	190
Status of the course	Mandatory	Percentage of application of e-learning	0%			
COURSE DESCRIPTION						
Course enrolment requirements and entry competences required for the course	Passed exams from the first year of the Program.					
Learning outcomes expected at the level of the course (4 to 10 learning outcomes)	1. Describe and explain the basic chemical bonds between the compounds and analyze and calculate the basic physicochemical principles that apply to gases and solutions 2. Describe and explain the structure and reactions of the most important biochemical compounds, including small, large and supramolecular structures that are found in the cell 3. Define and explain the principles of biochemical and energetic changes as well as regulation mechanisms of metabolism of carbohydrates, lipids, proteins, informational macromolecules and signaling molecules 4. Integrate the metabolic changes at the cell, tissue, and whole organism level 5. Develop practical skills for working in the laboratory (the basics of safe practice in the lab, the calculation of basic laboratory parameters and monitoring and interpretation of results of laboratory measurements 6. Critically judge the meaning of biochemistry in modern medical science					
Course content broken down in detail by weekly class schedule (syllabus)	Total number of hours :					
	LECTURES (L) 66					
	SEMINARS (S) 50					
	PRACTICALS (P) 74					
	TOTAL 190					
	In parentheses is the number of hours referred to each topic.					
	I. MEDICAL CHEMISTRY (MC)					
	1. GENERAL CHEMISTRY (C1)					
	Lectures (L)					
	L1 (2) Introduction into chemical basis of life. Atoms and elements.					
	L2 (2) Chemical bonds.					
	L3 (1) Free particles: the nature of gases.					
	L4 (1) Water and aqueous solutions. Colligative properties of solutions.					
	L5 (2) Acids and bases. Buffer solutions.					
	L6 (2) Colloidal-dispersed systems.					

L7 (2) Energy in transition: thermochemistry.
L8 (1) Reactions at equilibrium.
L9 (1) The rate of chemical change.
L10 (1) The natural direction of change: the second law.
L11 (1) Chemical energy and electrical energy: electrochemistry.

Seminar practicals (SP) and practicals (P)

SP1+P1 (2+3) Basic stoichiometry. Preparation of solutions.
SP2+ P2 (2+3) Optical methods in medical chemistry.
SP3+ P3 (1+3) Gas laws. Ions in solution. Osmotic pressure.
SP4+ P4 (1+3) Volumetry: neutralization methods.
SP5+ P5 (1+3) Volumetry: oxidation and reduction method.
SP6+ P6 (1+4) Acids and alkalis, pH and buffers.
SP7+ P7 (2+3) Energetics and kinetics of chemical reaction.
P8 (2) Integration of general chemistry

2. ORGANIC CHEMISTRY (C2)

Lectures (L)

L12 (2) Introduction to organic chemistry. Saturated and unsaturated hydrocarbons; physical and chemical properties. Isomers.
L13 (2) Halogenalkanes; nucleophilic substitution, elimination. Optical isomerism; relative and absolute configuration.
L14 (1) Alcohols. Ethers. Aldehydes. Ketones.
L15 (2) Carboxylic acids and their derivatives.
L16 (2) Cyclic and aromatic hydrocarbons. Sulfuric and heterocyclic compounds.
L17 (1) Amino acids. Carbohydrates.

Seminars organic chemistry (SO)

SO1 (3) Resonant structures. Isomers. Alkanes, alkenes, alkynes. Alkaloids, phenols, esters, aldehydes. Ketones
SO2 (3) Amines. Sulfur heterocyclic compounds. Amino Acids. Carbohydrates. Carboxyl compounds

Seminar practicals (SP) and practicals (P)

SP9+ P9 (1+3) Qualitative analysis of some organic compounds
SP10+P10 (1+3) Potentiometric titration of amino acids
P (2) Integration of organic chemistry

II. MEDICAL BIOCHEMISTRY (MB)

Lectures (L) and seminars biochemistry (SB)

BIOCHEMISTRY (B1)

1. PROTEIN STRUCTURE AND FUNCTION

L18 (1) Amino acids
L19 (1) Structure of proteins
L20 (2) Globular proteins SB20 (1) Sickle cell anemia
L21 (1) Fibrous proteins
L22 (2) Enzymes SB22 (2) Enzymes in clinical diagnosis

2. INTERMEDIARY METABOLISM

L23 (2) Bioenergetics and oxidative phosphorylation SB23 (1) Regulation of respiratory chain and oxidative phosphorylation
SB24(1) Introduction to carbohydrates
L25 (2) Glycolysis SB25 (1) Regulation of glycolysis

L26 (1) Tricarboxylic acid cycle SB26 (1) Regulation of TCA cycle
 L27 (1) Gluconeogenesis SB27 (1) Regulation of gluconeogenesis
 L28 (1) Glycogen metabolism SB28 (1) Regulation of glycogen synthesis and degradation
 L29 (2) Metabolism of monosaccharides and disaccharides SB29 (2) Pentose phosphate pathway and NADPH
 L30 (1) Glycosaminoglycans, proteoglycans, and glycoproteins

3. LIPID METABOLISM

SB31(1) Metabolism of dietary lipids
 L32 (1) Fatty acid and triacylglycerol metabolism: structure and synthesis of fatty acids SB32 (1) Regulation of fatty acids synthesis
 L33 (2) Fatty acid and triacylglycerol metabolism: mobilization of stored fats, oxidation of fatty acids, ketone bodies
 L34 (1) Complex lipid metabolism
 L35 (2) Cholesterol metabolism SB35 (1) Hypercholesterolemia
 SB36 (2) Mechanism of hormone action depending on their structure

BIOCHEMISTRY (B2)

4. NITROGEN METABOLISM

L37 (2) Amino acids: disposal of nitrogen
 L38 (2) Amino acid degradation and synthesis SB38 (1) Metabolic defects in amino acid metabolism
 L39 (2) Conversion of amino acids to specialized products: porphyrin metabolism
 L40 (1) Other nitrogen-containing compounds: catecholamines; thyroid hormones
 SB40 (1) Signal transduction disorders
 L41 (1) Nucleotide metabolism SB41 (1) Regulation of nucleotide metabolism

5. INTEGRATION OF METABOLISM

SB42 (2) Metabolic effects of insulin and glucagon
 L43 (2) The feed / fast cycle
 SB44 (1) Diabetes mellitus
 SB45 (1) Obesity
 L46 (2) Nutrition and vitamins SB46 (2) Vitamins
 SB47 (1) Minerals

6. STORAGE AND EXPRESSION OF GENETIC INFORMATION

L48 (1) DNA structure and replication SB48 (2) DNA repair
 L49 (1) RNA structure, synthesis and processing
 L50 (1) Protein synthesis SB50 (1) Protein synthesis regulation and inhibition
 L51 (1) Regulation of gene expression SB51 (1) Gene expression regulation
 L52 (1) Biotechnology and human disease

SPECIAL TOPICS

SB53 (2) Blood clotting

Practicals (P)

P11 (3) Serum proteins electrophoresis
 P12 (3) Urease: determination of inhibitor
 P13 (3) Alkaline phosphatase: effect of pH on enzyme activity

	P14 (3) Alkaline phosphatase: determination of K_m and V_{max} in the presence of inhibitors P15 (3) Amylase: determination in saliva sample P16 (2) Determination of HbA1c by ion-exchange chromatography P17 (2) Lipids: separation of skin lipids by thin-layer chromatography P18 (2) Determination of LDL- and HDL-cholesterol P19 (3) Determination of conjugated and total bilirubin in serum P20 (2) Determination of creatinine and the pathological compounds in urine P21 (3) Determination of iron and iron binding capacity in serum P22 (4) Immunochemical analysis. ELISA. P23 (3) Determination of vitamin C P24 (2) Hemostasis- clotting time and bleeding time tests P25 (4) Comprehensive final exam (laboratory practicals)					
Format of instruction	<input checked="" type="checkbox"/> lectures <input checked="" type="checkbox"/> seminars and workshops <input checked="" type="checkbox"/> exercises <input type="checkbox"/> <i>on line</i> in entirety <input type="checkbox"/> partial e-learning <input type="checkbox"/> field work			<input type="checkbox"/> independent assignments <input type="checkbox"/> multimedia <input checked="" type="checkbox"/> laboratory <input type="checkbox"/> work with mentor <input checked="" type="checkbox"/> consultations		
Student responsibilities	In accordance to Rules of studying and Deontological code for USSM students.					
Screening student work (<i>name the proportion of ECTS credits for each activity so that the total number of ECTS credits is equal to the ECTS value of the course</i>)	Class attendance	2	Research		Practical training	2
	Experimental work		Report		(Other)	
	Essay		Seminar essay		(Other)	
	Tests	6	Oral exam	3	(Other)	
	Written exam	4	Project		(Other)	
Student attendance at classes	<p>Attendance at classes is obligatory. Absence from seminars and exercises (for a valid reason, with a medical certificate, up to a maximum of 20% of the total number of hours) must be compensated by colloquium. Students who do not compensate missed seminars and exercises, will not be able to take the partial exam.</p> <p>Seminar and exercise materials should be thoroughly studied by students before they begin. During the exercises and seminars, teachers will check students' preparedness by oral or written test. Students who are not prepared for the exercises will not be able to access the practical classes.</p> <p>Students must buy a Laboratory Manual (available from the School of Medicine's print office "Redak").</p> <p>Students are required to bring the laboratory coat (in case of regular excercise in the laboratory).</p> <p>Students are assigned to seminar and practical groups and MUST follow the schedule.</p>					

Grading and evaluating student work in class and at the final exam

Grading is based on an absolute scale, with a (minimum) course total of 90 points. Scores in four partial written exams (C1, C2, B1, B2) and a comprehensive final exam (practicals) are the principal means of accumulating points.

Students who attended lectures and practicals could write partial written exams, while final exam from practicals is prerequisite for attending B2 partial exam.

Points can be earned in outside of class activities as well at instructor discretion. Instructor has the right to deduct points for missed exams, late work, disruptive classroom behaviour, or lack of effort or participation. Grades are assigned according to percentage of possible points earned.

Grading procedures
Total accumulated points will be comprised of the following:

		pass
Physical chemistry (C1)	40	24
Organic chemistry (C2)	15	9
Biochemistry 1 (B1)	55	33
Biochemistry 2 (B2)	50	28
Final exam-practicals	10	6
Total number of points possible	170	96

Final grade in this course will be determined by calculation of mean grade of the following:

- 1) C1+C2+ final exam-practicals (max 65 points)
- 2) B1+B2 (max 105 points)
- 3) ORAL EXAM grade

Point interval of grade 1)	38-44 sufficient (2) 45-51 good (3) 52-58 very good (4) 59-65 excellent (5)
Point interval of grade 2)	58-69 sufficient (2) 70-81 good (3) 82-93 very good (4) 94-105 excellent (5)

EXAM TERMS:

1. 30.6.2023.
2. 24.7.2023.
3. 8.9.2023.
4. 22.9.2023.

	Title	Number of copies in the library	Availability via other media
Required literature (available in the library and via other media)	1. Denise R. Ferrier: Lippincott Illustrated Reviews: Biochemistry, 6th edition. Lippincott Williams & Wilkins, 2013.	5	
	2. Laboratory Manual of Medical Chemistry	Print office	
	3. Laboratory Manual of Biochemistry	Print office	
Optional literature (at the time of submission of study programme proposal)	<ol style="list-style-type: none"> 1. Atkins PW, de Paula J. Physical Chemistry, 10th edition. Macmillan Education, Oxford, 2014. 2. McMurry JE. Fundamentals of Organic Chemistry, 7th edition. Cornell University, 2011. 3. Lieberman M, Marks AD. Mark's Basic Medical Biochemistry-a Clinical Approach, 4th edition. Lippincott Williams & Wilkins, 2013. 		
Quality assurance methods that ensure the acquisition of exit competences	<ul style="list-style-type: none"> ▪ Teaching quality analysis by students and teachers ▪ Exam passing rate analysis ▪ Committee for control of teaching reports ▪ External evaluation 		