2026/2027

Univerza v Mariboru

Medicinska fakulteta

UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	**Biokemija**
Course title:	**Biochemistry**

Študijski program in stopnja Study programme and cycle	Študijska smer Study option	Letnik Year of study	Semester Semester
Dentalna medicina/Dental Medicine 2. stopnja/2nd cycle		**1**	**2.**

Vrsta predmeta / Course type	Obvezni/Compulsory
Univerzitetna koda predmeta / University course code:	

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje Clinical training	Druge oblike študija Other forms of study	Samost. delo Individual work	ECTS
45	**45**	**30**			**60**	**6**

Nosilec predmeta / Lecturer:	**Red. prof. dr. Uroš Potočnik, doc. Helena Sabina Čelešnik, Ph.D. (ZDA)**

Jeziki / Languages:	**Predavanja / Lectures:**	slovenščina/slovene
	Vaje / Tutorial:	slovenščina/slovene

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	**Prerequisits:**
POGOJI ZA PRISTOP K POSAMEZNEMU PREVERJANJU ZNANJA Opravljen kolokvij iz vaj – pogoj za pristop k izpitu Opravljene vaje in dnevnik – pogoj za pristop h kolokviju iz vaj Opravljena seminarska naloga – pogoj za pristop k izpitu	REQUIREMENTS FOR ACCESS TO INDIVIDUAL KNOWLEDGE CHECKING: Laboratory and seminary work project is condition for applying to written exam Students can pass the exam with colloquia which is highly recommended. Colloquia are divided in two sets. For the recognition of written examination must all be positive.

Vsebina:	**Content (Syllabus outline):**
1. Uvod v biokemijo 2. Uvod v strukturo beljakovin: • Aminokisline: struktura, povezava med strukturo in funkcijo, izoelektrična in izoionska točka, analitika aminokislin, biološka vloga. • Peptidi: biološko aktivni peptidi; strukturne osnove delovanja peptidnih hormonov • Primarna, sekundarna, terciarna in kvartarna struktura beljakovin 3. Beljakovine: splošna zgradba in lastnosti, razdelitev po funkciji (encimi, transportne, skladiščne, kontraktilne, strukturne, obrambne in regulatorne beljakovine) 4. Fibrilarne in globularne beljakovine	1. Introduction to the biochemistry 2. Introduction to the protein structure: • aminoacids: structure, links between structure and function, isoelectric and isoionic point, analysis of aminoacids, biological role. • Peptides: biologically active peptides, structurally based function of peptide hormones • Primary, secondary tertiary and quaternary structure of proteins. 3. Proteins: general structure and characteristics, classification by the function (enzymes, transport, contractile, accumulative, defence and regulatory proteins). 4. Fibrilar and globular proteins.

- Struktura in funkcija fibrilarnih beljakovin: keratin, kolagen, elastin
- Monomerna in oligomerna struktura beljakovin: mioglobin in hemoglobin
5. Encimi: splošne značilnosti in osnove encimske kinetike
- Mehanizmi encimskih reakcij, regulacija encimske aktivnosti (alosterična modulacija, kovalentna modifikacija, regulacija prek proteolitičnih encimov), klasifikacija in nomenklatura encimov
- Koencimi
6. Biokemijske komponente celic in tkiv
7. Enostavni in sestavljeni polisaharidi, glikoproteini, celična stena
8. Metabolizem
9. Prebavni encimi, uvod v metabolne poti – regulacija metaboličnih poti, glavni eksperimentalni pristopi za študij metabolizma
10. Encimska razgradnja glikozidnih vezi
11. Oksidativni procesi v celici in pridobivanje energije
12. Metabolizem ogljikovih hidratov, uravnavanje sinteze in razgradnje ogljikovih hidratov
13. Metabolizem maščobnih kislin in trigliceridov
14. Metabolizem nukleotidov in nukleinskih kislin, uravnavanje metabolizma nukleotidov, bolezni povezane z metabolizmom nukleotidov
15. Metabolizem membranskih lipidov, celična razgradnja in biosinteza enostavnih in sestavljenih lipidov; biosinteza in razgradnja žolčnih kislin; metabolizem lipoproteinov; metabolizem prostaglandinov; uravnavanje metabolizma lipidov, bolezni povezane z metaboličnimi defekti v metabolizmu lipidov
16. Metabolizem aminokislin, prebava proteinov, biološka vloga vitaminov
17. Pomen biokemije za razlago in zdravljenje bolezni
18. Biosinteza proteinov, usmerjanje, znotrajcelični transport, zvijanje, kontrola kvalitete, degradacija
19. Membranske beljakovine, prenos snovi skozi biološke membrane, pasivni in aktivni transport, primeri pasivnega in aktivnega transporta pri človeku
20. Vloga hormonov v uravnavanju metaboličnih procesov
21. Metabolizem mineralov, vnos, zadrževanje in izločanje mineralnih snovi pri človeku (kalcij, magnezij, železo, cink, jod, itn.)
22. Metabolizem goriv v različnih metabolnih stanjih (po obroku, med obroki, dolgotrajno stradanje)
23. Metabolične značilnosti posameznih tkiv in organov. Skeletna mišica, srčna mišica, jetra, maščevje, ledvica, živčevje, krvni elementi, koža, oko, pljuča, vezivno tkivo
24. Medsebojna odvisnost in vloga organov v metaboličnih procesih pri človeku.
25. Biokemija krvnih skupin in koagulacija krvi;
26. Signalna transdukcija

- Structure and function of fibrilary proteins: keratin, collagen, elastin.
- Monomeric and oligomeric structure of proteins: myoglobin and haemoglobin.
5. Enyzmes: general features and bases of enzymatic kinetics.
- Mechanism of enzymatic reactions, regulation of enzymatic actvitiy (allosteric modulation, covalent modification, regulation of proteolytic enzymes), classification and nomenclature of enzymes.
- Coenzymes.
6. Biochemical components of cells and tissues.
7. Simple and complex polysaccharides, glycoproteins, cell wall.
8. Metabolism.
9. Digestive enzymes; introduction to the metabolic pathways, major experimental approaches to the study of metabolism.
10. Enzymatic digestion of glycoside bonds.
11. Oxidative processes in the cell and energy generation.
12. Metabolism of carbohydrates, regulation of anabolism and catabolism of carbohydrates.
13. Metabolism of fatty acids and triglycerides.
14. Metabolism of nucleotides and nucleic acids, regulation of their metabolism, diseases.
15. Metabolism of membrane lipids, anabolism and catabolism of simple and complex triglycerides, bile acids, lipoproteins, prostaglandins, regulation of lipid metabolism. Diseases that arose from metabolism disorders.
16. Metabolism of amino acids and proteins, Haem metabolism, biological role of vitamins
17. Importance of biochemistry for disease explanation and treatment.
18. Biosynthesis of proteins, conformations, folding, quality control, intracellular transport, protein degradation.
19. Membrane proteins: transport over the membrane, passive and active transport in human body.
20. Role of hormones in the regulation of metabolic processes.
21. Metabolism of minerals, intake, storage and secretion of minerals in the human body (calcium, magnesium, zinc, iodine, …).
22. Fuel metabolism in different states (the feed state, absorptive state, prolonged fasting)
23. Metabolic characteristics of individual tissues and organs (skeletal muscle, heart muscle, liver, adipose tissue, kidneys, nervous system, blood elements, skin, eye, lungs, connective tissue).
24. Interrelation and interactions of the organs in the metabolism of human body.
25. biochemistry of blood groups and coagulation;
26. signal transduction
27. Metabolic diseases, including hereditary syndromes

27. Metabolne bolezni, vključno dedni sindromi 28. Rekombinantna DNA tehnologija, genetsko inženirstvo, biotehnologija; tehnologija CRISPR; uporaba v stomatologiji 29. Uvod v genomiko, proteomika, farmakogenomika, personalizirana medicina;bioinformatika; 30. Genska terapija; terapija z matičnimi celicami 31. Biokemija sline (sestava, lastnosti) 32. Sestava in molekularna biologija trdih zobnih tkiv. 33. Regeneracija in reparacija trdih zobnih tkiv 34. Sestava in lastnosti obzobnih tkiv. Biokemijski procesi v obzobnih tkivih. 35. Proces biomineralizacije. 36. Biokemija pelikla. 37. Pomen ustnih bakterij in njihovih metaboličnih aktivnosti.	28. Recombinant DNA technology, genetic engineering, biotechnology; CRISPR technology; applications in stomatology; 29. Introduction to Genomics, proteomics, farmacogenomics, personalized medicine, bioinformatics 30. Gene therapy; stem cell therapy 31. Biochemistry of the saliva (composition, properties). 32. Composition and molecular biology of hard dental tissues. 33. Regeneration and repair of hard dental tissues. 34. Composition and properties of the surrounding tissues (peridontium). Biochemical processes in the peridontium. 35. Biomineralization. 36. Pellicle biochemistry. 37. The role of oral bacteria and their metabolic activities.

Temeljni literatura in viri / Readings:

1. Nelson, David Lee: Lehninger principles of biochemistry. 8th ed. New York, 2021.
2. Rodney Boyer, Concepts in Biochemistry, 3rd Ed. Wiley, 2006, ISBN: 139780471661795.
3. Michael Lieberman, Allan Marks, Alisa Peet.: Marks' basic medical biochemistry : a clinical approach. 6th ed., [international ed.]. - Philadelphia [etc.] : Wolters Kluwer Health, ISBN 1-9751-5014-7 (broš.); 978-1-9751-5014-3 (broš.); cop. 2023

Dopolnilna literature in viri/ Additional Readings:

4. M. Levine: Topics in Dental Biochemistry, Springer-Verlag Berlin, Heidelberg, 2011, ISBN 978-3-540-88115-5
5. N. V. Bhagavan, Chung-Eun Ha.: Essentials of Medical Biochemistry 2nd Edition With Clinical Cases, Paperback ISBN: 9780124166875 ; Imprint: Academic Press ; Published Date: 1st June 2015
6. Dewlin, Thomas M: Textbook of Biochemistry With Clinical Correlations, 8th Ed J. Wiley & sons, Hoboken (New Jersey), 2014
7. Lee W. Janson, M. Tischler, Medical Biochemistry: The Big Picture (LANGE The Big Picture), McGraw-Hill, 2012, ISBN:9780071637923.
8. Florian Horn. Biochemie des Menschen : das Lehrbuch für das Medizinstudium, Izdaja - 8., überarbeitete und erweiterte Aufl. Založništvo in izdelava - Stuttgart ; New York : Georg Thieme, cop. 2021; COBISS.SI-ID – 46746371.

Cilji in kompetence:	**Objectives and competences:**
Cilj tega predmeta je obnoviti osnovna znanja iz splošne kemije in poznavanja kemijske zgradbe molekul in reakcij, ter razumeti kemijske reakcije in procese v človeškem organizmu. Študent se spozna z biomolekulami v človeškem telesu in s temeljnimi zakonitostmi ter mehanizmi biokemičnih dogajanj, ki predstavljajo osnovo za razumevanje življenjskih procesov v zdravem in bolezenskem stanju organizma. Pridobi si osnovno znanje iz biokemičnih procesov, ki omogoča živim organizmom normalno delovanje in vzdrževanje optimalnih koncentracij celičnih sestavin in telesnih tekočin ter rast in razmnoževanje.	The objective of this course is to renew the basic knowledge of general chemistry and knowledge of the chemical structure of molecules and reactions, and to understand the chemical reactions and processes in human body. Students get acquainted with biomolecules in the human body with fundamental characteristics and mechanisms of biochemical reactions as a basis for understanding of life and processes in the healthy and ill state of the organism. Students acquire the basic knowledge in biochemical processes to maintain the normal and optimal function of the human body.

Predvideni študijski rezultati:	**Intended learning outcomes:**

Znanje in razumevanje: Študent bo sposoben prepoznati in razlikovati molekule. Razumel bo kemijske reakcije ter znal razložiti transportne pojave, ki potekajo v človeškem organizmu. Biokemija integrira molekularne osnove temeljnih življenjskih procesov in je nujna za razumevanje vzrokov bolezni ter molekularnih pristopov zdravljenja. Povezava znanj o molekularnih mehanizmih delovanja zdravega organizma in okvar, ki privedejo do bolezni. Prenesljive/ključne spretnosti in drugi atributi: Študent bo razvil bo spretnosti dela v skupini ter spretnost računanja. Spoznavanje delovanja organizma na molekulski ravni. Biokemija je povezana s predmeti Molekularna biologija in Biologija celice. Pomaga pri razumevanju Patofiziologije, Farmakologije in večine kliničnih predmetov.	Knowledge and Understanding: On completion of this course the student will be able to recognize and differentiate molecules, to understand the chemical reactions in human body and know to explain transport phenomenon in human body An integrative approach of fundamental living processes and understanding of disease incidence and molecular approaches of healing. Integrative knowledge of molecular mechanisms of functioning of the healthy organism and disorders that consequently lead to the disease. Transferable/Key Skills and other attributes: Student will be able to work in team and to improve the skills of computation. Biochemistry is correlated to the understanding of pathophysiology, pharmacology and most of the clinical subjects.

Metode poučevanja in učenja:	**Learning and teaching methods:**
Predavanja Seminarji Vaje (laboratorijske)	Lectures Seminars Tutorial (laboratory)

Načini ocenjevanja:	**Delež (v %) / Weight (in %)**	**Assessment:**
Način (pisni izpit, ustno izpraševanje, naloge, projekt)		Type (examination, oral, coursework, project):
pisni izpit	70 %	written exam
laboratorijsko delo	20 %	laboratory work
seminarska naloga	10 %	seminar paper
OPOMBA ŠTUDIJSKE OBVEZNOSTI ŠTUDENTOV Opravljene vaje – prisotnost na vajah Opravljene seminarske naloge – prisotnost na seminarjih		ACADEMIC OBLIGATIONS OF STUDENTS: Students should complete laboratory work and write reports. Presence at all laboratory work is mandatory. Students should write an essay on selected topic and give oral presentation (seminar paper). Presence at seminar presentations is mandatory.

Reference nosilca / Lecturer's references:

GOLE, Boris, PERNAT DROBEŽ, Cvetka, JEZERNIK, Gregor, POTOČNIK, Uroš. The expression IL1B correlates negatively with the clinical response to adalimumab in Crohn's disease patients : an ex vivo approach using peripheral blood mononuclear cells. Life Sciences. [Online ed.]. 2023, [v tisku][27 str.], ilustr. ISSN 1879-0631. https://doi.org/10.1016/j.lfs.2023.121822, https://www.sciencedirect.com/science/article/pii/S0024320523004563, DOI: 10.1016/j.lfs.2023.121822. [COBISS.SI-ID 154108931], [JCR, SNIP]
financer: ARRS, Programi, P3-0427, SI, Sistemski pristopi k raziskavam človeškega genoma za personalizirano medicino kroničnih imunskih bolezni; ARRS, Projekti, J3-9258, SI, Molekularno genetski biooznačevalci in mehanizmi neodzivnosti na biološko zdravljenje z anti-TNF bolnikov s kroničnimi imunskimi boleznimi
kategorija: 1A1 (Z, A', A1/2);

AVBELJ, Monika, HAFNER BRATKOVIČ, Iva, LAINŠČEK, Duško, MANČEK KEBER, Mateja, PETERNELJ, Tina Tinkara, PANTER, Gabriela, TREON, Steven P., GOLE, Boris, POTOČNIK, Uroš, JERALA, Roman. Cleavage-mediated regulation of Myd88 signaling by inflammasome-activated caspase-1. Frontiers in immunology. Jan. 2022, vol. 12, str. 1-14, ilustr.

ISSN 1664-3224. https://www.frontiersin.org/articles/10.3389/fimmu.2021.790258/full, https://doi.org/10.3389/fimmu.2021.790258, DOI: 10.3389/fimmu.2021.790258. [COBISS.SI-ID 93261315], [JCR, SNIP, WoS do 7. 8. 2022: št. citatov (TC): 2, čistih citatov (CI): 2, čistih citatov na avtorja (CIAu): 0,20, Scopus do 22. 7. 2022: št. citatov (TC): 2, čistih citatov (CI): 2, čistih citatov na avtorja (CIAu): 0,20]
kategorija: 1A1 (Z, A'', A', A1/2);

PRAŠNIKAR, Erika, KUNEJ, Tanja, GORENJAK, Mario, POTOČNIK, Uroš, KOVAČIČ, Borut, KNEZ, Jure. Transcriptomics of receptive endometrium in women with sonographic features of adenomyosis. Reproductive biology and endocrinology. 2022, vol. 20, art. 2, str. 1-16, ilustr. ISSN 1477-7827. https://rbej.biomedcentral.com/articles/10.1186/s12958-021-00871-5, https://doi.org/10.1186/s12958-021-00871-5, https://repozitorij.uni-lj.si/IzpisGradiva.php?id=134676, DOI: 10.1186/s12958-021-00871-5. [COBISS.SI-ID 91852035], [JCR, SNIP, WoS do 31. 1. 2023: št. citatov (TC): 2, čistih citatov (CI): 2, čistih citatov na avtorja (CIAu): 0,33, Scopus do 9. 2. 2023: št. citatov (TC): 3, čistih citatov (CI): 3, čistih citatov na avtorja (CIAu): 0,50]
financer: ARRS, Programi, P3-0327, SI, Reprodukcija človeka - laboratorijski in eksperimentalni vidiki
kategorija: 1A1 (Z, A', A1/2);

GORENJAK, Mario, JEZERNIK, Gregor, KRUŠIČ, Martina, SKOK, Pavel, POTOČNIK, Uroš. Identification of novel loci involved in adalimumab response in Crohn's disease patients using integration of genome profiling and isoform-level immune-cell deconvoluted transcriptome profiling of colon tissue. Pharmaceutics. [Online ed.]. Sep. 2022, vol. 14, issue 9, str. 1-16, ilustr. ISSN 1999-4923. https://doi.org/10.3390/pharmaceutics14091893, https://www.mdpi.com/1999-4923/14/9/1893, DOI: 10.3390/pharmaceutics14091893. [COBISS.SI-ID 120609795], [JCR, SNIP, WoS, Scopus]
financer: ARRS, Programi, P3-0427, SI, Sistemski pristopi k raziskavam človeškega genoma za personalizirano medicino kroničnih imunskih bolezni; ARRS, Projekti, J3-9258, SI, Molekularno genetski biooznačevalci in mehanizmi neodzivnosti na biološko zdravljenje z anti-TNF bolnikov s kroničnimi imunskimi boleznimi
kategorija: 1A1 (Z, A', A1/2);

HELENA SABINA ČELEŠNIK

1. Čelešnik, H. S., Gorenjak, M., Krušič, M., Crnobrnja, B., Soboćan, M., Takač, I., Arko, D., & Potočnik, U. (2024). Isoform-level transcriptome analysis of peripheral blood mononuclear cells from breast cancer patients identifies a disease-associated RASGEF1A isoform. *Cancers*, *16*(18, [ ] 3171), 1–17. https://www.mdpi.com/2072-6694/16/18/3171

2. ČELEŠNIK, Helena Sabina, POTOČNIK, Uroš. Blood-based mRNA tests as emerging diagnostic tools for personalised medicine in breast cancer. Cancers. 2023, vol. 15, issue 4, [article no.] 1087, str. [1]-23. ISSN 2072-6694. https://www.mdpi.com/2072-6694/15/4/1087, https://doi.org/10.3390/cancers15041087, DOI: 10.3390/cancers15041087. [COBISS.SI-ID 141250307], [JCR, SNIP, WoS, Scopus]
financer: ARRS, Programi, P3-0427, SI, Sistemski pristopi k raziskavam človeškega genoma za personalizirano medicino kroničnih imunskih bolezni; ARRS, Projekti, J3-9272, SI, Identifikacija molekularnih biooznačevalcev za napoved kliničnega poteka in zasevanja pri pacientkah s trojno negativnim rakom dojke
kategorija: 1A1 (Z, A', A1/2);

3. GORIČAN, Larisa, BÜDEFELD, Tomaž, ČELEŠNIK, Helena Sabina, ŠVAGAN, Matija, LANIŠNIK, Boštjan, POTOČNIK, Uroš. Gene expression profiles of methyltransferases and demethylases associated with metastasis, tumor invasion, CpG73 methylation, and HPV status in head and neck squamous cell carcinoma. Current issues in molecular biology. 2023, vol. 45, issue 6, str. 4632-4646, ilustr. ISSN 1467-3045. https://doi.org/10.3390/cimb45060294, https://www.mdpi.com/1467-3045/45/6/294, DOI: 10.3390/cimb45060294. [COBISS.SI-ID 153940995], [JCR, SNIP]
financer: ARRS, Programi, P3-0427, SI, Sistemski pristopi k raziskavam človeškega genoma za personalizirano medicino kroničnih imunskih bolezni; ARRS, Programi, P3-0067, SI, Farmakologija in farmakogenomika; Sofinancer: Univerzitetni klinični center Maribor (interna raziskovalna projekta IRP-2021/02-14 in IRP-2015/01-21)
kategorija: 1A3 (Z)

4. SKOK, Kristijan, GRADIŠNIK, Lidija, ČELEŠNIK, Helena Sabina, MILOJEVIĆ, Marko, POTOČNIK, Uroš, JEZERNIK, Gregor, GORENJAK, Mario, SOBOČAN, Monika, TAKAČ, Iztok, KAVALAR, Rajko, MAVER, Uroš. MFUM-BrTNBC-1, a newly established patient-derived triple-negative breast cancer cell line : molecular characterisation, genetic stability, and

comprehensive comparison with commercial breast cancer cell lines. Cells. 2022, vol. 11, issue 1, str. [1]-23, ilustr. ISSN 2073-4409. https://doi.org/10.3390/cells11010117, https://www.mdpi.com/2073-4409/11/1/117, DOI: 10.3390/cells11010117. [COBISS.SI-ID 91552259]