UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	BIOANALIZNA KEMIJA
Course Title:	BIOANALYTICAL CHEMISTRY

Študijski program in stopnja Study Programme and Level	Študijska smer Study Field	Letnik Academic Year	Semester Semester
MAG Biokemija, 2. stopnja	**/**	**2.**	**3.**
USP Biochemistry, 2nd Cycle	**/**	**2nd**	**3rd**

Vrsta predmeta / Course Type: izbirni strokovni / Elective Professional

Univerzitetna koda predmeta / University Course Code: BI2T04

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje Work	Druge oblike študija	Samost. delo Individual Work	ECTS
30	**30**	**15 LV**	**/**	**/**	**75**	**5**

Nosilec predmeta / Lecturer: prof. dr. Helena Prosen / Dr. Helena Prosen, Full Professor

Jeziki / Languages:

Predavanja / Lectures:	**slovenski / Slovenian**
Vaje / Tutorial:	**slovenski / Slovenian**

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	Prerequisites:
Študent oz. kandidat mora imeti predmet opredeljen kot študijsko obveznost.	The course has to be assigned to the student.

Vsebina:	Content (Syllabus outline):
Inštrumentacija in analizni pristopi za analizo bioloških sistemov: - teoretske osnove in praktične izvedbe inštrumentacije za analizo bioloških sistemov (elektroforezne tehnike: conska elektroforeza, izoelektrično fokusiranje, kapilarna elektroforeza, eno- in dvodimenzionalna gelska elektroforeza; kromatografske tehnike: izključitvena/gelska, afinitetna, ionsko-izmenjalna kromatografija; spektroskopske tehnike: spektrometrične, fluorescenčne, luminiscenčne metode; masna spektrometrija: ionizacije - elektrorazprševanje, MALDI, DIOS; masni analizatorji - kvadrupol, ionska past, čas preleta, orbitrap; načini fragmentacije in	Instrumentation and analytical approaches for the analysis of biological systems: - theoretical basis and practical instrumental solutions for the analysis of biological systems (electrophoresis: zone electrophoresis, isoelectric focusing, capillary electrophoresis, one- and two-dimensional gel electrophoresis; chromatography: size-exclusion/gel, affinity, ion-exchange chromatography; spectroscopy: spectrometric, fluorescence, luminiscence methods; mass spectrometry: ionizations - electrospray, MALDI, DIOS; mass analyzers - quadrupole, ion trap, time of flight, orbitrap; types of fragmentation and product ion scan in tandem MS; electrochemistry: amperometry,

snemanja produktnih ionov v tandemski MS; elektrokemijske tehnike: amperometrija, potenciometrija, konduktometrija; drugo: merjenje radioaktivnega sevanja) - spoznavanje teorije in praktičnih izvedb postopkov za izolacijo in ločevanje spojin iz bioloških sistemov (ekstrakcija, preparativna elektroforetska in kromatografska separacija. - imunski testi / immunoassay (na principu protiteles, ligandov, radioizotopov, fluoroforjev, kemiluminiscence, encimov) Aplikacije, prednosti in omejitve analiznih metod za določanje različnih spojin v bioloških sistemih: - določanje zdravil in drugih eksogenih biološko aktivnih spojin - aplikacije imunskih testov - biosenzorji (amperometrični, potenciometrični, optično-fluorescenčni, piezoelektrični, encimski termistorji...) - uporaba masne spektrometrije za analizo bioloških makromolekul (kvalitativna in kvantitativna proteomika, določanje strukture proteinov in peptidov ter PTM, genomika in sekvenciranje oligonukleotidov, glikomika, lipidomika, kompleksomika, metabolomika in metabonomika, biomarkerji in diagnostika bolezni, določitev mikroorganizmov) Validacija bioanaliznih metod.	potentiometry, conductometry; other: radioactivity measurement) - theory and practical approaches to isolation and separation of compounds from biological systems (extraction, preparative electrophoretic and chromatographic separation) - immunoassays (on the basis of antibodies, ligands, radioisotopes, fluorophores, chemiluminiscence, enzymes) Applications, advantages and limitations of analytical methods for the determination of different compounds in biological systems: - determination of drugs and other exogenous biologically active compounds - applications of immunoassay - biosensors (amperometric, potentiometric, optical- fluorescent, piezoelectric, enzyme thermistors...) - application of mass spectrometry to analysis of biological macromolecules (qualitative and quantitative proteomics, determination of protein and peptide structure, PTM, genomics and oligonucleotide sequencing, glycomics, lipidomics, complexomics, metabolomics and metabonomics, biomarkers and disease diagnostics, determination of microorganisms) Validation of bioanalytical methods.

Temeljna literatura in viri / Readings:

Bioanalytical Chemistry, S.R. Mikkelsen, E. Corton, Wiley (2004) 361 str. (50 %)
Mass Spectrometry for Biotechnology, G. Siuzdak, Academic Press (1996) 161 str. (30 %)
Mass Spectrometry, Principles and Applications (nekatera poglavja), E. de Hoffmann, V. Stroobant, Wiley, 2. izd. (2001) 407 str. (20 %)

Dopolnilna literatura:

Mass Spectrometry, A Foundation Course, K. Downard, RSC (2004) 210 str.
Practical Organic Mass Spectrometry, J.R. Chapman, Wiley, 2. izd. (1993) 330 str.
Primarna literatura (znanstveni članki) / primary literature (scientific articles)

Cilji in kompetence:	**Objectives and Competences:**
Cilj predmeta je spoznavanje modernih analiznih tehnik, ki se uporabljajo v analitiki bioloških sistemov. Študentje naj bi spoznali	Objective of the course is to gain knowledge of modern analytical techniques used in the analytics of biological systems. Students should

prednosti in pomanjkljivosti posameznih pristopov, primerjali rezultate, pridobljene z njimi, in jih kritično vrednotili. Pridobili naj bi zmožnost samostojne izbire in uporabe primernega analiznega pristopa za reševanje specifičnih problemov. Študentje si pri predmetu pridobijo naslednje specifične kompetence: - zmožnost izbire najprimernejšega analiznega pristopa za reševanje specifičnih raziskovalnih problemov - zmožnost poiskati v razpoložljivi primarni in sekundarni literaturi problemu primerno analizno metodo/postopek - usposobljenost za implementacijo obstoječih analiznih metod na svoje specifične raziskovalne probleme - kritično vrednotenje rezultatov, dobljenih z apliciranimi metodami/postopki - usposobljenost za pisanje poročil, kritično vrednotenje in interpretacijo eksperimentalnih rezultatov - usposobljenost za vodenje bioanaliznega laboratorija	get to know the advantages and disadvantages of different approaches, compare the obtained results and critically evaluate them. They should gain the ability to autonomously select and apply an appropriate analytical method to solve a specific problem. Students acquire the following specific competences during the course: - ability to select the most appropriate analytical approach to solve a specific research problem - ability to find an appropriate analytical method/procedure for the respective problem in the available primary and secondary literature - skill to implement the existing analytical methods to their specific research problem - critical evaluation of the results obtained by the applied methods/procedures - skills for report writing, critical evaluation and interpretation of experimental results - skills and ability to run a bioanalytical laboratory

Predvideni študijski rezultati:	**Intended Learning Outcomes:**
<u>Znanje in razumevanje</u> Študent pozna osnove delovanja inštrumentov in teoretične osnove postopkov, ki se uporabljajo v bioanalizni kemiji. Razume prednosti in omejitve posameznih tehnik. Ve, kaj lahko vpliva na analizni postopek, pozna vire motenj in napak.	<u>Knowledge and Comprehension</u> Student knows the fundamentals of instrumental operation and theoretical basis of the procedures used in analytical chemistry. Understands the advantages and limitations of different techniques. Knows the factors which can influence the analytical procedure, knows the sources of interference and error.
<u>Uporaba</u> Študent zna izbrati ustrezni analizni pristop za reševanje specifičnega problema in prirediti obstoječe postopke nanj. Zna rokovati z enostavnejšimi analiznimi inštrumenti. Zna uporabljati imunske teste.	<u>Application</u> Student is able to select an appropriate analytical approach to solve a specific problem and apply the existing procedures to it. Is able to operate simple analytical instruments. Is able to use immunoassay.
<u>Refleksija</u> Študent bo interpretiral, kritično vrednotil vsebino ter pred kolegi predstavil lastno	<u>Analysis</u> Student will interpret, critically evaluate the contents and present their understanding of the

razumevanje člankov iz znanstvenih publikacij. Pri tem bo uporabil pridobljena teoretična znanja ter jih vrednotil s predstavljenimi praktičnimi problemi oziroma izkušnjami.	scientific articles to their peers. They will use the acquired theoretical knowledge and evaluate it with the presented practical problems or experience.
Prenosljive spretnosti Uporaba domačih in tujih primarnih in sekundarnih literaturnih virov. Znanje, kako zbrati in interpretirati podatke. Ustno in pisno poročanje in interpretacija rezultatov. Identifikacija in reševanje problemov in virov napak. Kritična analiza in sinteza rezultatov, pisanje člankov.	Skill-transference Ability Use of domestic and foreign primary and secondary literature sources. Knowledge of data collection and interpretation. Oral and written reporting and interpretation of the results. Identification and solving of problems and error sources. Critical analysis and synthesis of results, manuscript preparation.

Metode poučevanja in učenja:	**Learning and Teaching Methods:**
Predavanja, seminarji, laboratorijske vaje.	Lectures, seminar coursework, laboratory work.

Načini ocenjevanja:	Delež (v %) / Weight (in %)	**Assessment:**
Opravljene laboratorijske vaje in seminarska naloga so pogoj za pristop k pisnemu izpitu. Seminarska naloga Pisni izpit Ocene: 6-10 (pozitivno), 1-5 (negativno)		Concluded laboratory work and seminar coursework are prerequisites for the written exam. Seminar coursework Written exam Grades: 6-10 (positive), 1-5 (negative)

Reference nosilca / Lecturer's references:

1. T. Vnučec Popov, L. Cvitkovič-Maričič, **H. Prosen**, D. Brodnjak-Vončina. Development and validation of dried blood spots technique for quantitative determination of topiramate using liquid chromatography-tandem mass spectrometry. Biomed. Chromatogr. 2013, 27, 1054-1061.
2. A. Ćirić, **H. Prosen**, M. Jelikić Stankov, P. Đurđević. Evaluation of matrix effect in determination of some bioflavonoids in food samples by LC-MS/MS method. Talanta 2012, 99, 780-790.
3. **H. Prosen**, M. Kokalj, D. Janeš, S. Kreft. Comparison of isolation methods for the determination of buckwheat volatile compounds. Food Chem. 2010, 121, 298-306.

UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	BIOANORGANSKA KEMIJA
Course Title:	BIOINORGANIC CHEMISTRY

Študijski program in stopnja Study Programme and Level	Študijska smer Study Field	Letnik Academic Year	Semester Semester
MAG Biokemija, 2. stopnja	**/**	**1.**	**2.**
USP Biochemistry, 2nd Cycle	**/**	**1st**	**2nd**

Vrsta predmeta / Course Type: obvezni / Mandatory

Univerzitetna koda predmeta / University Course Code: BI215

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje Work	Druge oblike študija	Samost. delo Individual Work	ECTS
30	**15**	**30 LV**	**/**	**/**	**75**	**5**

Nosilec predmeta / Lecturer: prof. dr. Iztok Turel / Dr. Iztok Turel, Full Professor

Jeziki / Languages:

Predavanja / Lectures:	**slovenski / Slovenian**
Vaje / Tutorial:	**slovenski / Slovenian**

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	**Prerequisites:**
Študent oz. kandidat mora imeti predmet opredeljen kot študijsko obveznost.	The course has to be assigned to the student.

Vsebina:	**Content (Syllabus outline):**
Osnove bioanorganske kemije (definicije, izomerija, koordinacijsko število, teorija polja ligandov, reaktivnost/stabilnost). Bioligandi in njihove koordinacijske lastnosti pri vezavi kovinskih ionov. Lastnosti kovinskih ionov in njihov pomen pri reakcijah v organizmih. Prevzem-transport kovinskih ionov. Delovanje pomembnejših kovinskih ionov v organizmih-primeri. Osnove bioanorganske medicinske kemije. Tematika vaj se smiselno povezuje z vsebinami. Študenti spoznajo različne sintezne poti med kovinskimi ioni in raznimi bioligandi ter ugotavljajo vplive na strukturo/sestavo nastalih koordinacijskih spojin.	Fundamentals of Inorganic Biochemistry (introduction, isomerism, coordination number, ligand field stabilisation energy, reactivity/stability…). Bioligands and their coordination properties in the binding of metal ions. Properties of metal ions and their importance in the biological systems. Storage/transport of metal ions. Illustration of functioning of some metal ions in the living systems (examples). Basics of bioinorganic medicinal chemistry. The content of lab course is complementary to lectures. The students meet different synthetic approaches between metal ions and various bioligands and study the influences that affect structure and composition of isolated

	coordination compounds.

Temeljna literatura in viri / Readings:

Temeljni učbenik: / Basic literature:

- R.R. Crichton, Biological Inorganic Chemistry: an introduction, Elsevier, Amsterdam, 2008, 369 strani/pages (50 %).

Dodatna literatura: / Additional literature:

- J.A. Cowan, Inorganic Biochemistry, An Introduction, Wiley, 1997, pp 1-63, 133-163, 357-417 od 430 strani/pages.
- J. J. R Frausto da Silva, R. J. P. Williams, The Biological Chemistry of the Elements (The Inorganic Chemistry of Life), 2nd Ed., Clarendon Press, Oxford, 2001, pp 315-500 of 561 strani/pages.

Cilji in kompetence:	**Objectives and Competences:**
Cilj predmeta: Poglobitev in nadgradnja znanja kemije kompleksov v nekaterih bioloških sistemih ter seznanitev študentov s kovinskimi ioni, ki jih najdemo v živih organizmih in njihov pomen za delovanje le-teh. **Predmetno specifične kompetence:** Pri predmetu študent utrjuje strategijo reševanja problemov in pridobi zmožnost predstavitve znanstvenih problemov pred strokovno javnostjo.	**Aim of course** To get more knowledge about the chemistry of complexes in biological systems. Additionally, the students are informed about metal ions which are found in living organisms and their role for the functioning of the latter. **Specific competences** The student is trained in strategy of solving complex problems. He/she is able to present scientific results/problems in front of the expert public.

Predvideni študijski rezultati:	**Intended Learning Outcomes:**
<u>Znanje in razumevanje</u> Študent spozna osnovne trende razvoja bioanorganske kemije. Sposoben je demonstrirati znanje in razumevanje bistvenih podatkov, konceptov in teorij, ki so povezane s pojmi vsebovanimi v opisu vsebine.	<u>Knowledge and Comprehension</u> The student is acquainted by basic trends in the development of bioinorganic chemistry. He/she is able to demonstrate the knowledge and understanding of essential data, concepts and theories which are described in the description of Contents.
<u>Uporaba</u> Študent naj bi znal uporabiti svoje znanje za reševanje interdisciplinarnih praktičnih primerov. Laboratorijsko delo je nadgradnja osnovnih praktikumov in študenta uvaja v večjo samostojnost v laboratoriju kot tudi v timsko delo.	<u>Application</u> Student should be able to use the knowledge to solve interdisciplinary practical problems. The lab course is the continuation of basic courses and introduces the student towards self-dependence and also into team work.
<u>Refleksija</u> Tematika vaj je tesno povezana s seminarskimi temami, zato se študent nauči kritičnega razmišljanja o skladnosti med teoretičnimi načeli in prakso.	<u>Analysis</u> The topics of seminars are closely related with lab course. The student is learned about critical thinking between theoretical and practical principles.

Prenosljive spretnosti	Skill-transference Ability
Poznavanje vsebin omogoča tudi boljše razumevanje zakonitosti pri drugih predmetih študija (npr. biokemija)kar omogoča širši vpogled na celoto.	The learned contents enable better understanding of the processes in other courses of study (e.g. Biochemistry) which enables broader view of the whole picture.

Metode poučevanja in učenja:	**Learning and Teaching Methods:**
Predmet se izvaja v obliki predavanj, seminarjev in praktičnih vaj, ki jih študentje v skupinah izvedejo v laboratorijih. Študentje pripravijo seminarje o izbranih temah, ki jih nato predstavijo pred svojimi kolegi. Praktični del predmeta je zasnovan izrazito projektno. Študentom se zastavi konkretni problem, ki ga nato na osnovi zbranih podatkov iz literature in z aktivnim sodelovanjem s pedagoškim osebjem, tudi rešijo. Svoje delo opišejo v poročilu in ga tudi predstavijo.	The course consists of lectures, seminars and practical exercises which are performed in the lab. The students prepare seminars on selected topics which are then presented to the colleagues. Practical part of the course is truly project based. Students have to solve a problem. They first analyse the literature and then they solve it with the help of assistants. Their work is described in the report which is also presented at the end.

Načini ocenjevanja:	Delež (v %) / Weight (in %)	**Assessment:**
Kolokvij iz vaj (pisni in ustni)	30 %	Laboratory exercise (written and oral)
Seminar	20 %	Seminar
Ustni izpit	50 %	Oral exam

Reference nosilca / Lecturer's references:

1. **I. Turel**, P. Živec, A. Pevec, S. Tempelaar, G. Psomas, Compounds of antibacterial agent ciprofloxacin and magnesium- Crystal structures and molecular modeling calculations, Eur. J. Inorg. Chem., 3718-3727 (2008).
2. **I. Turel**, J. Kljun, F. Perdih, E. Morozova, V. Bakulev, N. Kasyanenko, J. A. W. Byl, N. Osheroff, First ruthenium organometallic complex of antibacterial agent ofloxacin. Crystal structure and interactions with DNA, Inorg. Chem., 49, 10750-10752 (2010).
3. J. Kljun, A. K. Bytzek, W. Kandioller, C. Bartel, M. A. Jakupec, C. G. Hartinger, B. K. Keppler, **I. Turel**, Physicochemical Studies and Anticancer Potency of Ruthenium(η6-p-cymene) Complexes Containing Antibacterial Quinolones, Organometallics, 30, 2506-2512 (2011).

UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	BIOFIZIKALNA KEMIJA 1
Course Title:	BIOPHYSICAL CHEMISTRY 1

Študijski program in stopnja Study Programme and Level	Študijska smer Study Field	Letnik Academic Year	Semester Semester
MAG Biokemija, 2. stopnja	**/**	**1.**	**1.**
USP Biochemistry, 2nd Cycle	**/**	**1st**	**1st**

Vrsta predmeta / Course Type: obvezni / Mandatory

Univerzitetna koda predmeta / University Course Code: BI213

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje Work	Druge oblike študija	Samost. delo Individual Work	ECTS
45	**10**	**20 LV**	**/**	**/**	**75**	**5**

Nosilec predmeta / Lecturer: prof. dr. Jurij Lah / Dr. Jurij Lah, Full Professor

Jeziki / Languages:

Predavanja / Lectures:	**slovenski / Slovenian**
Vaje / Tutorial:	**slovenski / Slovenian**

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	Prerequisites:
Študent oz. kandidat mora imeti predmet opredeljen kot študijsko obveznost.	The course has to be assigned to the student.

Vsebina:	Content (Syllabus outline):
Molekulska interpretacija termodinamskih količin: Boltzmannova porazdelitev in statistična definicija entropije v povezavi s termodinamiko konformacijskih sprememb bioloških makromolekul. **Termodinamika raztopin bioloških makromolekul**: Osnove termodinamike raztopin, virialna enačba za kemijski potencial topila. Membransko ravnotežje, Donnansko ravnotežje, Prenos snovi preko bioloških membran. **Interakcije v raztopinah bioloških makromolekul**: Interakcije topljenec-topilo, topilo-topilo in topljenec-topljenec opredeljene s pomočjo elementarnih interakcij (Coulombske, van der Waalsove, vodikove	***Molecular interpretation of thermodynamic quantities*** Boltzmann distribution, statistical definition of entropy and the corresponding interpretation of folding/unfolding of biological macromolecules. ***Thermodynamics of solutions of biological macromolecules*** Fundamentals of solution thermodynamics, virial equation for the chemical potential of the solvent membrane equilibria, Donnan equilibrium. Transport across biological membranes. ***Interactions in solutions of biological macromolecules*** Solute-solvent, solvent-solvent and solute-

vezi). Lastnosti vode in hidrofobne interakcije. **Konformacijska ravnotežja**: Intra- in intermolekularne interakcije, ki določajo stabilnost proteinov in nukleinskih kislin. Opis termodinamike denaturacije proteinov in nukleinskih kislin z modelom dveh stanj. Odvisnost stabilnosti od temperature, koncentracije denaturanta, pH, ionske moči… Določanje termodinamskih parametrov denaturacije. **Vezanje bioloških makromolekul**: Vezava na eno vezno mesto, na več med seboj neodvisnih in ekvivalentnih veznih mest ter vezava na neekvivalentna vezna mesta. Določanje ravnotežnih konstant vezanja. Vezanje protonov, Henderson-Hasselbalchova enačba.	solute interactions interpreted in terms of non-covalent interactions (electrostatic, van der Waals, H-bonds). Properties of water and hydrophobic interactions. ***Conformational equilibria*** Interactions determining protein and nucleic acid thermodynamic stability. Thermodynamic description of protein and nucleic acid unfolding by the two-state model. Thermodynamic stability as a function of temperature, denaturant concentration, pH and salt concentration. ***Binding of biological macromolecules*** Binding to a single binding site and to several mutually independent and equivalent binding sites. Binding to nonequivalent binding sites. Determination of equilibrium binding constants. Allosteric effects. Binding of protons, Henderson-Hasselbach equation.

Temeljna literatura in viri / Readings:

- Principles of Physical Biochemistry, K.E. van Holde Prentice Hall (1998), 657 str., (30 %)
- Biophysical Chemistry, A. Cooper, RSC, Cambridge (2004), 184 str., (50%)

Dopolnilna literatura:

- Thermodynamics and Kinetics for the Biological Sciences, G.G. Hammes, J. Wiley & Sons (2000), 158 str.

Cilji in kompetence:	**Objectives and Competences:**
Cilj predmeta: Spoznavanje, razumevanje in obravnava fizikalno-kemijskih lastnosti bioloških makromolekul ter zakonitosti, ki te lastnosti določajo in povezujejo. **Predmetno specifične kompetence**: Sposobnost osnovne fizikalno-kemijske karakterizacije raztopin bioloških makromolekul, njihovega vezanja in strukturnih sprememb.	Knowledge and understanding of the basic physico-chemical properties of biological macromolecules in solution and understanding of physical laws that determine these properties and link them together. Ability to accomplish basic physico-chemical interpretation of properties of biological macromolecules in the solution, their binding and structural alterations.

Predvideni študijski rezultati:	**Intended Learning Outcomes:**
<u>Znanje in razumevanje</u> Predmet daje študentu teoretično (predavanja, seminar) in praktično (laboratorijske vaje) znanje iz osnov biofizikalne kemije. Pridobljeno znanje je nujno potrebno pri razumevanju osnov termodinamike biokemijskih procesov na molekularnem nivoju.	<u>Knowledge and Comprehension</u> The subject gives students the theoretical (lectures, seminars) and practical (lab exercises) knowledge of basic biophysical chemistry. The acquired knowledge is necessary to understand basics thermodynamics of biochemical processes at the molecular level

Uporaba Pridobljeno teoretično in praktično znanje je potrebno ne samo za uspešen študij drugih predmetov na magistrski stopnji ampak tudi za uspešno teoretično in praktično raziskovalno delo na področju biokemije.	Application Acquired theoretical and practical knowledge is necessary not only for successful study of other subjects at the MSc level but also for a successful theoretical and practical research in the field of biochemistry and chemistry.
Refleksija Študent bo pridobil občutek, kako s pomočjo osnov termodinamike lahko opišemo relativno zapletene biokemijske procese. S pridobljenim znanjem bo lahko kritično ovrednotil rezultate laboratorijskih vaj in ga uporabil v praksi.	Analysis Students will find out how to use thermodynamics in description of relatively complex biochemical processes. With the knowledge gained they will be able to critically evaluate the results of laboratory work and use it in biochemical and chemical practice.
Prenosljive spretnosti Študent se nauči nekaterih teoretičnih in eksperimentalnih pristopov, ki so osnova pri načrtovanju, spremljanju in vodenju eksperimentov v biokemiji.	Skill-transference Ability Students will learn some of the theoretical and experimental approaches, which set the basis for planning and monitoring experiments in biochemistry and chemistry.

Metode poučevanja in učenja:	**Learning and Teaching Methods:**
Predavanja, seminarji, laboratorijake vaje.	Lectures, seminars, laboratory exercises.

Načini ocenjevanja:	Delež (v %) / Weight (in %)	**Assessment:**
Pisni in ustni izpit. Opravljene vaje so pogoj za pristop k pisnemu izpitu. Opravljen pisni izpit je pogoj za pristop k ustnemu izpitu. Ocene: pozitivno (6-10); negativno (1-5).		Written and oral exam. Tutorials are a prerequisite for taking the exam. Written exam is a prerequisite for taking the oral exam. Grades: (6-10) pass, (1-5) fail.

Reference nosilca / Lecturer's references:

- DROBNAK, Igor, VESNAVER, Gorazd, **LAH, Jurij**. Model-based thermodynamic analysis of reversible unfolding processes. J. Phys. Chem. B, 2010, 114, 8713-8722.
- DROBNAK, Igor, DE JONGE, Natalie, HAESAERTS, Sarah, VESNAVER, Gorazd, LORIS, Remy, **LAH, Jurij**. Energetic basis of uncoupling folding from binding for an intrinsically disordered protein. J. Am. Chem. Soc., 2013, 135, 1288–1294.
- **LAH, Jurij**, DROBNAK, Igor, DOLINAR, Marko, VESNAVER, Gorazd. What drives the binding of minor groove-directed ligands to DNA hairpins? Nucleic Acids Res. 2008, 36, 897-904.

UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	BIOFIZIKALNA KEMIJA 2
Course Title:	BIOPHYSICAL CHEMISTRY 2

Študijski program in stopnja Study Programme and Level	Študijska smer Study Field	Letnik Academic Year	Semester Semester
MAG Biokemija, 2. stopnja	**/**	**2.**	**4.**
USP Biochemistry, 2nd Cycle	**/**	**2nd**	**4th**

Vrsta predmeta / Course Type: izbirni strokovni / Elective Professional

Univerzitetna koda predmeta / University Course Code: BI2I10

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje Work	Druge oblike študija	Samost. delo Individual Work	ECTS
30	**20**	**25 LV**	**/**	**/**	**75**	**5**

Nosilec predmeta / Lecturer: prof. dr. Jurij Lah / Dr. Jurij Lah, Full Professor

Jeziki / Languages:

Predavanja / Lectures:	**slovenski / Slovenian**
Vaje / Tutorial:	**slovenski / Slovenian**

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:

Študent oz. kandidat mora imeti predmet opredeljen kot študijsko obveznost.

Prerequisites:

The course has to be assigned to the student.

Vsebina:

Termodinamika zvitja/razvitja proteinov in nukleinskih kislin:

Problem zvitja proteinov in nukleinskih kislin. Konformacijske značilnosti razvitih (denaturiranih), vmesnih, in zvitih (nativnih) stanj. Termodinamski opis zvitja/razvitja proteinov in nukleinskih kislin z različnimi modeli. Eksperimentalno določanje termodinamske stabilnosti proteinov in nukleinskih kislin s pomočjo spektroskopskih in kalorimetričnih tehnik. Izračun termodinamske stabilnosti s pomočjo 3D strukture. Primerjava eksperiment-račun.

Termodinamika prepoznavanja bioloških makromolekul:

Content (Syllabus outline):

Thermodynamics of folding/unfolding of proteins and nucleic acids:
Protein and nucleic acid folding problem. Conformational characteristics of unfolded (denatured) , intermediate , and folded (native) states. Thermodynamic description of folding/unfolding of proteins and nucleic acids using various models. Experimental determination of the thermodynamic stability of proteins and nucleic acids using spectroscopic and calorimetric techniques. Structure-based calculation of thermodynamic stability and its comparison with experimental results

Thermodynamics of molecular recognition :
Basic binding models. Thermodynamics of

Osnovni modeli vezanja. Termodinamika prepoznavanja bioloških makromolekul v povezavi z njihovo 3D strukturo. Zvitje bioloških makromolekul inducirano z njihovim vezanjem. Termodinamika vezanja in načrtovanje novih zdravil. **Eksperimentalne metode v biofizikalni kemiji:** UV-absorbcijska spektroskopija, Spektropolarimetrija (CD), Fluorimetrija, Izotermna titracijska kalorimetrija (ITC), Diferenčna dinamična kalorimetrija (DSC). Fizikalne osnove signala, merjenje in analiza signala, uporabnost pri študiju vezanja in strukturnih sprememb bioloških makromolekul.	recognition of biological macromolecules in relation with their 3D structure . Folding of biological macromolecules induced by their binding . Thermodynamics of binding and design of novel drugs . **Experimental methods in biophysical chemistry:** UV-absorption spectroscopy, CD-spectroscopy, fluorimetry , isothermal titration calorimetry (ITC), differential scanning calorimetry (DSC). Physical basics of the measured signal, measurement and analysis, usefulness in the study of binding and structural changes of biological macromolecules.

Temeljna literatura in viri / Readings:

- Principles of Physical Biochemistry, K.E. van Holde Prentice Hall (1998), 657 str., (30 %)
- Mechanisms of protein folding, R.H. Pain (Editor), Oxford University Press (2000), 433. str, (10 %)
- Thermodynamics and Kinetics for the Biological Sciences, G.G. Hammes, J. Wiley & Sons (2000), 158 str. (20 %)
- Biophysical Chemistry, A. Cooper, RSC, Cambridge (2004), 184 str., (20 %)

Cilji in kompetence:	**Objectives and Competences:**
Cilj predmeta: Razumevanje gonilnih sil zvitja/razvitja bioloških makromolekul in njihovega prepoznavanja na molekularnem nivoju. **Predmetno specifične kompetence**: Vpogled v temeljne eksperimentalne tehnike, ki se uporabljajo pri termodinamski karakterizaciji omenjenih biokemijskih procesov. Sposobnost osnovne modelske analize merjenih signalov in njihova molekulska interpretacija.	The aim of the course: Understanding the driving forces of folding/unfolding of biological macromolecules and their recognition at the molecular level. Specific competencies: Insights into the basic experimental techniques used in the thermodynamic characterization of these biochemical processes. The ability to perform model-based analysis of the measured signals and their molecular interpretation.

Predvideni študijski rezultati:	**Intended Learning Outcomes:**
Znanje in razumevanje Predmet daje študentu poglobljeno teoretično (predavanja, seminar) in praktično (projekt) znanje iz biofizikalne kemije. Pridobljeno znanje je nujno potrebno pri poglobljenem razumevanju procesov zvitja in molekulskega prepoznavanja.	Knowledge and Comprehension The subject gives students an in-depth theoretical (lectures, seminars) and practical (laboratory exercises) knowledge of biophysical chemistry. Acquired knowledge is necessary for a thorough understanding of the processes of folding and molecular recognition.

Uporaba Pridobljeno teoretično in praktično znanje je potrebno za uspešno teoretično in praktično raziskovalno delo na področju biofizikalne kemije in uporabno v farmacevtski industriji in biotehnologiji.	Application Acquired theoretical and practical knowledge is necessary for a successful theoretical and practical research in the field of biophysical chemistry and can be applied in the pharmaceutical industry and biotechnology.
Refleksija Študent bo pridobil občutek, kako s povezavo eksperimentalne termodinamike in strukturnih značilnosti bioloških makromolekul lahko opišemo procese njihovega zvitja in medsebojnega prepoznavanja . S pridobljenim znanjem bo lahko kritično ovrednotil rezultate projektne vaje in ga uporabil v praksi.	Analysis Students will gain a feeling how to describe folding of biological macromolecules and their mutual recognition using experimental thermodynamic and structural characteristics. With the knowledge gained, they will be able to critically evaluate the results of the laboratory exercises and use it in practice.
Prenosljive spretnosti Študent se nauči nekaterih teoretičnih in eksperimentalnih pristopov, ki so osnova pri načrtovanju, spremljanju in vodenju eksperimentov v biokemiji.	Skill-transference Ability Students will learn some of the theoretical and experimental approaches, which set the basis for planning and monitoring experiments in biochemistry.v

Metode poučevanja in učenja:	**Learning and Teaching Methods:**
Predavanja, seminarji, laboratorijake vaje.	Lectures, seminars, laboratory exercises.

Načini ocenjevanja:	Delež (v %) / Weight (in %)	**Assessment:**
Pisni izpit po uspešno opravljenih vajah. Ocene: pozitivno (6-10), negativno (1-5).		Written examination after successful completion of laboratory exercises. Grades: (6-10) pass, (1-5) fail.

Reference nosilca / Lecturer's references:

- DROBNAK, Igor, VESNAVER, Gorazd, **LAH, Jurij**. Model-based thermodynamic analysis of reversible unfolding processes. J. Phys. Chem. B, 2010, 114, 8713-8722.
- MARUŠIČ, Jaka, PODLIPNIK, Črtomir, JEVŠEVAR, Simona, KUZMAN, Drago, VESNAVER, Gorazd, **LAH, Jurij**. Recognition of human tumor necrosis factor α (TNF-α) by therapeutic antibody fragment : energetics and structural features. J. Biol. Chem., 2012, 287, 8613-8620.
- BUTS, Lieven, **LAH, Jurij**, DAO-THI, Minh-Hoa, WYNS, Lode, LORIS, Remy. Toxin-antitoxin modules as bacterial metabolic stress managers. Trends Biochem. Sci. 2005, 30, 672-679.

UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	BIOKEMIJA BOLEZNI ČLOVEKA
Course Title:	BIOCHEMISTRY OF HUMAN DISEASES

Študijski program in stopnja Study Programme and Level	Študijska smer Study Field	Letnik Academic Year	Semester Semester
MAG Biokemija, 2. stopnja	**/**	**1.**	**1.**
USP Biochemistry, 2nd Cycle	**/**	**1st**	**1st**

Vrsta predmeta / Course Type: izbirni strokovni / Elective Professional

Univerzitetna koda predmeta / University Course Code: BI2I03

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje Work	Druge oblike študija	Samost. delo Individual Work	ECTS
45	**15**	**15 SV**	**/**	**/**	**75**	**5**

Nosilec predmeta / Lecturer: izr. prof. dr. Tomaž Marš /
Dr. Tomaž Marš, Associated Professor,

Jeziki / Languages:

Predavanja / Lectures:	**slovenski / Slovenian**
Vaje / Tutorial:	**slovenski / Slovenian**

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:

Študent oz. kandidat mora imeti predmet opredeljen kot študijsko obveznost.

Prerequisites:

The course has to be assigned to the student.

Vsebina:

Predmet obravnava biokemične temelje naslednjih patoloških stanj:

Stres. Vnetje. Okvare zaradi prostih radikalov. Staranje.

Integracija presnove. Stradanje. Sladkorna bolezen. Hipoglikemija. Debelost. Motnje celičnega dihanja in hipovitaminoze B. Motnje delovanja ščitnice. Dedne bolezni presnove. Konformacijske bolezni.

Bolezni jeter. Jetrni testi. Žolčni kamni. Motnje prebave in absorpcije hranil.

Anemije. Motnje hemostaze. Ateroskleroza. Hiperlipidemije. Spremembe beljakovin v

Content (Syllabus outline):

Biochemical background of the following pathological conditions:
Stress, inflammation, impairments caused by reactive oxygen species (ROS), aging.
Metabolic disorders: starvation, diabetes mellitus, hypoglycemia, obesity, disorders of bioenergetics – B hypovitaminoses , uncoupling and inhibition of electron transport chain, thyroid disorders, hereditary metabolic disorders, conformational diseases.
Liver diseases: tests of liver function, biliary stones. Gastrointestinal disorders: malabsorption disorders.
Blood disorders: anemia, coagulation disorders, atherosclerosis, hyperlipidemias, blood protein

plazmi. Motnje pH krvi. Motnje živčnomišičnega prenosa. Shizofrenija. Zasvojenost z drogami. Zastrupitev z organofosfati. Motnje dihanja. Motnje presnove kalcija in fosforja. Funkcionalno slikanje z magnetno resonanco.	disorders, acid-base imbalances. Neuromuscular junction disorders, organophosphate poisoning, schizophrenia, drug addiction Pulmonary diseases, impairements of calcium and phosphate metabolism, functional NMR imaging

Temeljna literatura in viri / Readings:

Temelji patofiziologije s fiziologijo za študente zdravstvenih ved, 1. Izdaja (1. ponatis), Bajrović F (ur.), Medicinska fakulteta, Inštitut za patološko fiziologijo; Ljubljana, 2015; skupno okrog 150 strani iz tega učbenika.
Izbrana poglavja iz učbenikov:
- Seminarji iz patološke fiziologije , 3. izdaja, Ribarič S (ur.), Medicinska fakulteta, Inštitut. za patološko fiziologijo; Ljubljana, 2014.
- Temelji patološke fiziologije, 3. izdaja, Ribarič S (ur.), Medicinska fakulteta, Inštitut za patološko fiziologijo; Ljubljana 2014.

Okrog 50 strani iz teh dveh učbenikov

Cilji in kompetence:	**Objectives and Competences:**
1. Študenti pridobijo terminologijo in znanje za razumevanje biokemičnih temeljev in mehanizmov pogostih bolezni in bolezenskih procesov pri človeku. 2. Študent bo usposobljen za kasnejšo poklicno vključitev v strokovno in raziskovalno delo na področju biomedicine (medicina, medicinska biotehnologija, dentalna medicina, laboratorijska medicina, farmacija). Lahko se bo strokovno sporazumeval z drugimi poklicnimi profili, ki delajo v zdravstvu. Pripravljen bo za samostojen študij literature s področja medicine, s čimer mu bo omogočen strokovni in znanstveni razvoj.	1. Students become familiar with the medical terminology and with the present understanding of the biochemical background and underlying mechanisms of selected, frequently met human diseases. Students are provided with the knowledge enabling them to become professionally and scientifically involved in various fields of biomedicine (medicine, medical biotechnology, dental medicine, laboratory medicine, pharmacy..). Students become competent for professional communication with other experts in the field of biomedicine and are able to follow medical literature which is essential for their further professional and scientific progress in this field.

Predvideni študijski rezultati:	**Intended Learning Outcomes:**
<u>Znanje in razumevanje</u> Poznavanje imen in opredelitev pomembnih patoloških stanj pri človeku. Razumevanje mehanizmov nastanka in razvoja bolezni in načel zdravljenja v povezavi z biokemičnimi procesi v organizmu.	<u>Knowledge and Comprehension</u> Getting familiar with the terms and definitions of various pathological conditions. Understanding the mechanisms of origin and development of various diseases. Understanding the therapy of these diseases on the basis of the targeted biochemical processes

	in the human organism.
Uporaba Temeljna informacija o bolezenskih procesih potrebna za delo v biomedicini	Application Basic knowledge of the pathological processes necessary for working in the field of biomedicine.
Refleksija Zavedanje, da mnogi patološki procesi temeljijo na motnjah biokemičnih procesov v telesu.	Analysis To be aware that many pathological processes are based on the disorders or impairments of the biochemical processes in the human organism.
Prenosljive spretnosti Večja sposobnost za timsko delo z različnimi zdravstvenimi delavci. Sposobnost branja medicinske literature.	Skill-transference Ability Increased capability for joining the professional teams of experts working in medicine. Aptitude in following medical literature.

Metode poučevanja in učenja:	**Learning and Teaching Methods:**
Predavanja, seminarji, na problemih (papirnati pacienti) temelječ pouk pri seminarskih vajah	Lectures, seminars, problem based learning using “paper” patients at seminary discussions

Načini ocenjevanja:	Delež (v %) / Weight (in %)	**Assessment:**
Pisni izpit Ocene: 6-10 (pozitivno), 1-5 (negativno).		Written exam Grades: 6-10 (positive), 1-5 (negative)

Reference nosilca / Lecturer's references:

1. JAGRIČ, Tomaž, IVANECZ, Arpad, HORVAT, Matjaž, PLANKL, Mojca, KAVALAR, Rajko, POTRČ, Stojan, MIŠ, Katarina, MARŠ, Tomaž. Evaluation of a focused sentinel lymph node protocol in node-negative gastric cancer patients. Hepato-gastroenterol., Jul.-Aug. 2013, vol. 60, no. 125, str. 1231-1236. [COBISS.SI-ID 4548671]
2. REŽONJA, Katja, LORENZON, Paola, MARŠ, Tomaž. Opposing effects of dexamethasone, agrin and sugammadex on functional innervation and constitutive secretion of IL-6 in in vitro innervated primary human muscle cells. Neurosci. lett., 2013, vol. 549, str. 186-190. [COBISS.SI-ID 30721753]
3. KOVAČIĆ, Dragan, GLAVNIK, Nina, MARINŠEK, Matej, ZAGOŽEN, Petra, ROVAN, Ksenija, GOSLAR, Tomaž, MARŠ, Tomaž, PODBREGAR, Matej. Total plasma sulfide in congestive heart failure. J Card Fail, 2012, vol. 18, no. 7, str. 541-548. [COBISS.SI-ID 30114265]

UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	BIOKEMIJA RAKA
Course Title:	BIOCHEMISTRY OF CANCER

Študijski program in stopnja Study Programme and Level	Študijska smer Study Field	Letnik Academic Year	Semester Semester
MAG Biokemija, 2. stopnja	**/**	**1.**	**1.**
USP Biochemistry, 2nd Cycle	**/**	**1st**	**1st**

Vrsta predmeta / Course Type: izbirni strokovni / Elective Professional

Univerzitetna koda predmeta / University Course Code: BI2I04

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje Work	Druge oblike študija	Samost. delo Individual Work	ECTS
30	**15**	**30 LV**	**/**	**/**	**75**	**5**

Nosilec predmeta / Lecturer: doc. dr. Barbara Breznik / Dr. Barbara Breznik, Assistant Professor

Jeziki / Languages:

Predavanja / Lectures:	**slovenski / Slovenian**
Vaje / Tutorial:	**slovenski / Slovenian**

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	Prerequisites:
Študent oz. kandidat mora imeti predmet opredeljen kot študijsko obveznost.	The course has to be assigned to the student.

Vsebina:	Content (Syllabus outline):
Sklopi predavanj: 1. Uvod 2. Razvoj malignih obolenj (kancerogeneza, celični cikel, apoptoza) 3. Genetske osnove bolezni 4. Virusi, onkogeni in tumorski supresorski gen 5. Prenos signalov, eksperimentalne metode v onkologiji 6-a. Napredovanje tumorjev I (interakcije tumorjev z okoljem, invazija) 6-b. Napredovanje tumorjev II (Angiogeneza metastaziranje) 7. Tumorska proteoliza	1. Introduction to cancer biology and biochemistry 2. Malignat disease initiation (carcinogenese, cell cycle and apoptosis) anad experimental methods in cancer research. 3. Molecular basis of carcinogenesis 4. Viruses and tumour supressor genes. 5. Oncogenes and signal transduction 6. Tumour progression: microenvironment and invasion, proteolysis 7. Tumour progression: metastases and angiogenesis 8. Stem cells in tumor progression 9. Anti-tumour immune response 10. Epidemiology, tumour biomarkers 11. Therapeutic approaches in cancer

8. Protitumorski imunski odziv 9. Epidemiologija, tumorski kazalci, diagnoza, prognoza 10. Terapija rakavih obolenj (kemoterapija, radioterapija, genska terapija, biofarmacevtiki v terapiji raka, dostavni sistemi)	

Temeljna literatura in viri / Readings:

- Weinberg, RA: The Biology of Cancer, druga izdaja, W. W. Norton & Company (2014), ISBN-10: 0815345299 - izbrana poglavja
- Tannock IF, Hill RP, Bristow RG, Harrington L: The Basic Science of Oncology, peta izdaja, McGraw-Hill (2013), ISBN-10: 0071745203
- Pregledni članki /Reviews iz Nature Cancer Reviews in Cancer Research

- ČEMAŽAR, Maja, SERŠA, Gregor, MOTALN, Helena, VERBOVŠEK, Urška, TODOROVIĆ, Vesna, LAH TURNŠEK, Tamara. Biologija raka : navodila za vaje. Ljubljana: [s. n.], 2013. 42 str., ilustr. [COBISS.SI-ID 2919503]

Cilji in kompetence:	**Objectives and Competences:**
Študent spozna osnove biologije tumorjev in eksperimentalne onkologije v luči uporabe v biomedicini. Osvoji znanja o molekularnih spremembah, ki so odgovorne za nastanek maligno transformirane celic in specifičnih bioloških lastnostih tumorskih celic. Spozna biološke osnove nastanka in napredovanja tumorjev ter spozna osnovne principe zdravljenja v onkologiji. Študent pridobi tudi osnovna znanja o epidemiologiji in spozna najnovejša dognanja v diagnostiki in novih ciljanih bioloških terapijah raka. Pridobljena teoretična in praktična znanja dajejo študentom osnovo za delo v različnih biomedicinskih laboratorijih, tako diagnostičnih kot raziskovalnih.	- The goal of study subject is that the student gets familiar with biology and molecular mechanisms of the disease- cancer progression. He also gets the basis in experimental oncology within a broader aspect of biomedicine. - The student acquires knowledge on biochemical processes and changes that are responsible for appearance of malignant transformed cells and their specific biological properties. - The student learns about biological basis of cancer initiation and progression of tumours and possible treatments modalities. - The student also learns about epidemiology and prevention of cancer, as well as latest diagnostics tools and targeted biological therapies in broader he light of personalised medicine. - The acquired theoretical and practical knowledge give the student the basis for the potential work in biomedical laboratories, being research or in clinics.

Predvideni študijski rezultati:	**Intended Learning Outcomes:**
<u>Znanje in razumevanje</u> Slušatelji bodo pridobili znanje o specifičnih lastnostih rakavih celic in pristopih zdravljenja	<u>Knowledge and Comprehension</u> The students will get the knowledge on - cancer incidence

raka:.	- specific properties of tumours and clinical aspect of disease progression - prevention and - therapeutic approaches.
Uporaba Študentje bodo uporabljali pridobljena znanje za razumevanje vse večje razširjenosti raka ter kakšni so problemi pri zdravljenju te bolezni. Nadalje, kateri so novi pristopi zdravljenja in kako načrtovati bazične in translacijske raziskave v predklinični onkologiji.	Application The students will use the acquired knowledge for understanding of cancer prevalence. The understanding of problems of the disease incidence and therapy approaches are relevant for a broader knowledge. The knowledge on the principles of planning basic and translational research has a wider application in applied biochemistry and biomedicine,
Refleksija Kritično ovrednotenje pridobljenega teoretičnega in praktičnega znanja o biologiji raka z nadaljnjim delom v raziskovalnih ali rutinskih laboratorijih.	Analysis The appreciation of the impact of even small molecular changes in the development and spread of the diseases- cancer is very relevant for understanding ad analyses of other diseases that are or are not related to cancer. It also leads to better understanding of similar disciplines such as pharmacy and medicine in general.
Prenosljive spretnosti Razumevanje temeljih zakonitosti biologije raka z osnovami diagnostike in zdravljenja raka bo omogočilo študentom spoznavanje in reševanje problemov s tega podrročja ter uspešno timsko delo s strokovnjaki z drugih medicinskih in biomedicinskih področij.	Skill-transference Ability The understanding of basic cancer biology for biochemistry students can be transferred to application in biomarkers research for diagnosis and as targets for therapy in drugs design. The critical evaluation of the acquired theoretical and practical knowledge on cancer biology is relevant for potential future work in research or industry.

Metode poučevanja in učenja:	**Learning and Teaching Methods:**
Predavanja (30) Seminar (15) Vaje (30)	Lectures. 30 hours Seminars (by students), 15 hours Practical courses, 30 hours

Načini ocenjevanja:	Delež (v %) / Weight (in %)	**Assessment:**
Seminar Pisni izpit Ocene: 6-10 (pozitivno), 1-5 (negativno).		Seminar Written exam Grades: 6-10 (positive), 1-5 (negative)

Reference nosilca / Lecturer's references:

- MAJC, Bernarda, HABIČ, Anamarija, NOVAK, Metka, ROTTER, Ana, PORČNIK, Andrej, MLAKAR, Jernej, ŽUPUNSKI, Vera, PEČAR FONOVIĆ, Urša, KNEZ, Damijan, ZIDAR, Nace, GOBEC, Stanislav, KOS, Janko, LAH TURNŠEK, Tamara, PIŠLAR, Anja, **BREZNIK, Barbara**. Upregulation of cathepsin X in glioblastoma : interplay with γ-enolase and the effects of selective cathepsin X inhibitors. International journal of molecular sciences. 2022, vol. 23, iss. 3, str. 1-22.
- PORČNIK, Andrej, NOVAK, Metka, **BREZNIK, Barbara**, MAJC, Bernarda, HRASTAR, Barbara, ŠAMEC, Neja, ZOTTEL, Alja, JOVCHEVSKA, Ivana, VITTORI, Miloš, ROTTER, Ana, KOMEL, Radovan, LAH TURNŠEK, Tamara. TRIM28 selective nanobody reduces glioblastoma stem cell invasion. Molecules. Aug. 2021, vol. 26, iss. 17, str. 1-16, ilustr. ISSN 1420-3049. https://www.mdpi.com/1420-3049/26/17/5141, DOI: 10.3390/molecules26175141.
- LAH TURNŠEK, Tamara, NOVAK, Metka, **BREZNIK, Barbara**. Brain malignancies : glioblastoma and brain metastases. Seminars in cancer biology. [Print ed.]. 2020, vol. 60, str. 262-273.

UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	BIOKEMIJA VEČCELIČNIH SISTEMOV
Course Title:	BIOCHEMISTRY OF HETEROCELLULAR SYSTEMS

Študijski program in stopnja Study Programme and Level	Študijska smer Study Field	Letnik Academic Year	Semester Semester
MAG Biokemija, 2. stopnja	/	2.	3.
USP Biochemistry, 2nd Cycle	/	2nd	3rd

Vrsta predmeta / Course Type: obvezni / Mandatory

Univerzitetna koda predmeta / University Course Code: BI2T02

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje Work	Druge oblike študija	Samost. delo Individual Work	ECTS
30	15	30 LV	/	/	75	5

Nosilec predmeta / Lecturer: izr. prof. dr. Marko Novinec / Dr. Marko Novinec, Associate Professor

Jeziki / Languages:

Predavanja / Lectures:	**slovenski / Slovenian**
Vaje / Tutorial:	**slovenski / Slovenian**

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	Prerequisites:
Študent oz. kandidat mora imeti predmet opredeljen kot študijsko obveznost.	The course has to be assigned to the student.

Vsebina:	Content (Syllabus outline):
Celice v socialnem kontekstu: medcelični stiki, stiki celica-matriks, medcelična komunikacija, prenos signalov iz ECM v celico, migracije. Struktura in komponente matriksa: fizikalno-kemijske lastnosti ECM, kolageni, elastična vlakna, glikoproteini, proteoglikani, glikozaminoglikani, bazalne membrane, mehanske lastnosti matriksa. Eksperimentalne metode pri študiju ECM: izolacija komponent, analiza in detekcija komponent ECM. Dinamika zunajceličnih procesov: sinteza komponent matriksa, procesi preoblikovanja	Cells in their social context: cell junctions, cell-extracellular matrix (ECM) interactions, intercellular communication, transmission of signals from the ECM into the cell, migrations. Structure and components of the ECM: physical and chemical properties, collagens, elastic fibers, glycoproteins, proteoglycans, glycosaminoglycans, basal membranes, mechanical properties of the ECM. Experimental methods in ECM studies: purification, analysis and detection of ECM components. Dynamics of extracellular processes: synthesis of ECM components, ECM turnover (angiogenesis, bone formation, etc.) ECM-ECM

matriksa (angiogeneza, tvorba kosti ...), interakcije matriks-matriks, matricelične interakcije, matrikini. Tkiva in organi: splošne lastnosti različnih vrst tkiv in organov, specializirane oblike matriksa (ledvica, mielin, itd.), razvojna biologija tkiv, vrste tkiv in matriksa pri različnih evolucijskih skupinah živali. Encimska aktivnost izven celic: zunajcelične peptidaze (metalopeptidaze, serinske peptidaze, cisteinski katepsini), glikozidaze, sekretorne fosfolipaze, zunajcelična superoksid-dismutaza. Patološke spremembe ECM: rakasta obolenja, obolenja krvno-žilnega sistema, obolenja dihal, revmatoidni artritis, osteoartroza, osteoporoza, staranje.	interactions, matricellular interactions, matrikines. Tissues and organs: basic properties of different types of tissues and organs, specialized ECM structures (kidney, myelin, etc.), tissue developmental biology, types of tissue and ECM in different evolutionary lineages of animals. Enzyme activity outside the cell: extracellular peptidases (metallopeptidases, serine peptidases, cysteine cathepsins), glycosidases, secretory phospholipases, extracellular superoxide dismutase. Pathological ECM changes: cancer, cardiovascular diseases, pulmonary diseases, rheumatoid and osteoarthritis, osteoporosis, ageing.

Temeljna literatura in viri / Readings:

- Molecular Cell Biology, Lodish. H et al., 2008, W.H. Freeman and Company, NY, 1150 strani (801-845).
- The Extracellular Matrix: an Overview, Mecham RP, 2011, Springer, strani 400 (60%).

Cilji in kompetence:	**Objectives and Competences:**
Predmet obravnava zunajcelični prostor (ECM) z vidika njegove organizacije, biomehanskih lastnosti in pretvorbe ter metod njegovega preučevanja. Študenti bodo povezali dosedanje znanje s tistim, ki ga bodo pridobili pri tem predmetu, tako da bodo sposobni na molekulskem nivoju interpretirati spremembe ECM, ki nastanejo kot posledica rasti, staranja in bolezni.	The course discusses the extracellular space (ECM) from the perspectives of its organisation, biomechanical properties and conversion, as well as the methods used in ECM research. Students will integrate prior knowledge with new knowledge and will be able to interpret the molecular basis of ECM changes that occur during growth, ageing and disease.

Predvideni študijski rezultati:	**Intended Learning Outcomes:**
<u>Znanje in razumevanje</u> Študenti pridobijo znanje o biokemijskih lastnostih in sestavi ECM, o procesih njegovega nastajanja, organizacije in preoblikovanja ter spremembah, povezanih z razvojem različnih bolezni. Pridobljeno znanje jim v povezavi s predhodnim znanjem omogoča razumevanje znanstvenega pristopa preučevanja ECM in strategij zdravljenja	<u>Knowledge and Comprehension</u> Students gain knowledge of the biochemical properties and composition of the ECM, and of the processes involved in its synthesis, organisation, remodelling and pathological changes. Together with prior knowledge this enables students to understand experimental approaches used to study the ECM and the strategies used for treatment of various

nekaterih bolezni.	diseases.
Uporaba Pridobljeno znanje je podlaga za delo na področjih biokemije, celične biologije, biomedicine, histologije, itd.	Application The obtained knowledge is the basis for successful work in the fields of biochemistry, cell biology, biomedicine, histology, etc.
Refleksija Študenti reflektirajo prej pridobljene teoretične in praktične osnove in jih povežejo s pridobljenim znanjem.	Analysis Students reflect on prior knowledge and integrate it with new knowledge.
Prenosljive spretnosti Vsebina predmeta je tesno povezana in nadgrajuje študentovo znanje iz biokemije, celične biologije, fiziologije. Spodbuja sposobnost uporabe literature, reševanja zadanih nalog, interpretacije rezultatov ter ustnega in pisnega sporočanja.	Skill-transference Ability The course is linked to and increases the students' prior knowledge of biochemistry, cell biology and physiology. It facilitates the students' abilities to use literature, solve problems, interpret results and report orally and in writing.

Metode poučevanja in učenja:	**Learning and Teaching Methods:**
Predavanja, raziskovalni seminarji, projektno delo in vaje.	Lectures, research seminars, project work, practical tutorial.

Načini ocenjevanja:	Delež (v %) / Weight (in %)	**Assessment:**
Kolokvij iz laboratorijskih vaj		Laboratory tutorial colloquium
Seminarska naloga		Seminar work
Pisni izpit		Written examination

Reference nosilca / Lecturer's references:

- KLEMENČIČ, Marina, **NOVINEC, Marko**, MAIER, Silke, HARTMANN, Ursula, LENARČIČ, Brigita. The heparin-binding activity of secreted modular calcium-binding protein 1 (SMOC-1) modulates its cell adhesion properties. PloS one, ISSN 1932-6203, 2013, vol. 8, no. 2, art. no. e56839
- **NOVINEC, Marko**, LENARČIČ, Brigita, BAICI, Antonio. Clusterin is a specific stabilizer and liberator of extracellular cathepsin K. FEBS letters, ISSN 0014-5793. [Print ed.], 2012, vol. 586, no. 7, p. 1062-1066
- **NOVINEC, Marko**, GRASS, Robert N., STARK, Wendelin J., TURK, Vito, BAICI, Antonio, LENARČIČ, Brigita. Interaction between human cathepsins K, L, and S, Mechanism of elastinolysis and ihibition by macromolecular inhibitors. The Journal of biological chemistry, ISSN 0021-9258, 2007, vol. 282, no. 11, p. 7893-78902.

UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	BIOLOŠKE MEMBRANE
Course Title:	BIOLOGICAL MEMBRANES

Študijski program in stopnja Study Programme and Level	Študijska smer Study Field	Letnik Academic Year	Semester Semester
MAG Biokemija, 2. stopnja	**/**	**1.**	**1.**
USP Biochemistry, 2nd Cycle	**/**	**1st**	**1st**

Vrsta predmeta / Course Type: izbirni strokovni / Elective Professional

Univerzitetna koda predmeta / University Course Code: BI2I01

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje Work	Druge oblike študija	Samost. delo Individual Work	ECTS
30	**15**	**30 LV**	**/**	**/**	**75**	**5**

Nosilec predmeta / Lecturer: prof. dr. Igor Križaj / Dr. Igor Križaj, Full Professor

Jeziki / Languages:

Predavanja / Lectures:	**slovenski / Slovenian**
Vaje / Tutorial:	**slovenski / Slovenian**

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	Prerequisites:
Študent oz. kandidat mora imeti predmet opredeljen kot študijsko obveznost.	The course has to be assigned to the student.

Vsebina:	Content (Syllabus outline):
Predstavitev izvajanja predmeta in uvod. Struktura in dinamika bioloških membran (funkcija, lastnosti, sestava, membranski lipidi, membranski proteini …). Čiščenje celic in njihovih delov (priprava membranskih struktur, izolacija in karakterizacija membranskih proteinov in lipidov, metodologija). Transport snovi čez biološke membrane (pasivni transport – difuzija in olajšana difuzija: transporterji in kanalčki; aktivni transport – ATP-gnane črpalke, V- in F-tip ATP-aza, ABC transporterji). Struktura in funkcija lipidnih mikrodomen (metodologija študija, lipidna in proteinska	Presentation of the course and introduction. Structure and dynamics of biological membranes (function, characteristics, composition, membrane lipids, and membrane proteins …). Purification of cells and their parts (preparation of membrane structures, isolation and characterization of membrane proteins and lipids, methodology) Transport of substances through biological membranes (passive transport – diffusion and facilitated diffusion: transporters and channels; active transport – ATP-driven pumps, V- and F-type ATP-ases, ABC-transporters). Structure and function of lipid microdomains

sestava, kaveole, vloga v signalizaciji, homeostazi Ca^{2+}, razvrščanju in transportu bioloških molekul, patologija). Medcelična signalizacija (endokrina, parakrina, in kontaktna; signalizacijske molekule; receptorji: povezani z G-proteini, ionski kanalčki, z lastno encimsko aktivnostjo; prenos živčnega signala; ukrivljanje membran). Povezovanje celic v tkiva (pritrjevanje in združevanje celic v tkiva, pritrjevanje celic na medcelično, kolageni v medcelični, nekolagenske sestavine medcelične …). Encimi, ki delujejo na membranah in na membrane (fosfolipaze A_2 kot primer, medfazna encimatika). Lipidi in signalizacija (derivati glicerola, derivati sfingozina, eikozanoidi, derivati holesterola …).	(methodology of study, lipid and protein composition, caveolae, roles in signalization, Ca^{2+}-homeostasis, sorting and transport of molecules, pathology). Signalization between cells (endocrine, paracrine and contact, signalization molecules, receptors: G-protein coupled, ion channels: voltage- and ligand-gated, with enzyme activity; nerve signal transduction; membrane bending). Association of cells into tissues (attaching and integration of cells into tissues, attachment of cells on extra cellular matrix (ECM), collagens in ECM, non-collagen components of ECM …). Enzymes that act on membranes on the membranes (phospholipases A_2 as an example, interfacial enzymology). Lipids and signalization (derivatives of glycerol, derivatives of sphingosine, eicosanoids, derivatives of cholesterol …).

Temeljna literatura in viri / Readings:

Izbrana poglavja iz splošnih učbenikov biokemije in molekularne biologije (Lodish, Voet, Stryer, Alberts); Mouritsen: Life – As a Matter of Fat. Springer 2005; Znanstveni in pregledni članki.

Cilji in kompetence:	**Objectives and Competences:**
Cilji predmeta so, da študent spozna sestavo bioloških membran, njihovo vlogo v celicah, procesih, ki na, v ali preko njih potekajo, da spozna metodologijo za analizo membranskih komponent, predvsem lipidov in membranskih proteinov. Kompetence: Predmet usmerja študenta k samostojnemu teoretičnemu (analiza literature, sinteza zaključkov, sposobnost učenja in reševanja problemov) in eksperimentalnemu delu (organiziranje in načrtovanje dela, verbalna in pisna komunikacija).	Aims of the course are to familiarize the student with composition of biological membranes, roles of membranes in cells, processes that are occurring on, in or over the membranes, with methodology to analyse membrane components, in first place lipids and membrane proteins. Competences: The course encourages student's autonomous theoretical (analysis of literature, formulation of conclusions, problem solving capability) and experimental work (organization and planning of the work, verbal and writing communication).

Predvideni študijski rezultati:	**Intended Learning Outcomes:**
<u>Znanje in razumevanje</u> Študent pri predmetu poglobi znanje o strukturnih elementih, organizaciji in procesih, ki potekajo na in preko bioloških membran. Spozna moderne raziskovalne pristope študija	<u>Knowledge and Comprehension</u> Student deepens his knowledge about structural elements, organization and processes that are conducted on and over the biological membranes. Student is familiarized with

membranskih sistemov in procesov na membranah. Skozi praktične primere iz literature spoznava pomembnost bioloških membran in dogajanj na njih.	modern approaches of the study of membrane systems and processes on membranes. Through practical examples from the literature the importance of biological membranes and processes involving them are brought closer to students.
Uporaba Znanje pridobljeno pri tem predmetu omogoča razumevanje (pato)fiziološke vloge lipidov, proteinov in ostalih molekul, gradnikov bioloških membran, pa tudi molekul, ki vplivajo na lastnosti bioloških membran. To znanje je osnova za raziskave mehanizmov številnih patologij, ki so povezane z lipidno signalizacijo in procesi na membranah ter načrtovanja ustreznih terapij.	Application The knowledge acquired during this course enables understanding of (patho)physiological role of lipids, proteins and other molecules, building blocks of biological membranes as well as molecules that influence characteristics of biological membranes. This knowledge is fundamental for the research of mechanisms of diverse pathologies linked to lipid signalization and other processes on membranes and development of suitable therapies.
Refleksija Študent naj bi pridobil občutek za razmišljanje o bioloških membranah kot posebnem okolju, v katerem mnogokrat veljajo zakonitosti, ki se precej razlikujejo od tistih v raztopinah.	Analysis Student should acquire awareness to think about biological membranes as a special environment in which many times different laws apply from those in solutions.
Prenosljive spretnosti Izkušnje pri reševanju problemov. Timsko delo (pri seminarskih in laboratorijskih vajah). Zbiranje in interpretiranje rezultatov ter njihovo kritično vrednotenje. Uporaba domače in tuje literature. Podajanje poročil o opravljenem delu.	Skill-transference Ability Experience at solving problems. Team work (at seminar and laboratory exercises). Collection and interpretation of results and their critical evaluation. The use of domestic and foreign literature. Delivering reports about accomplished tasks.

Metode poučevanja in učenja:	**Learning and Teaching Methods:**
Predavanja, seminarji z vodeno diskusijo, problemsko osnovano učenje, demonstracije v laboratoriju, konzultacije.	Lectures, seminars with tutorial discussion, problem based learning, laboratory demonstrations, consultations.

Načini ocenjevanja:	Delež (v %) / Weight (in %)	**Assessment:**
Pisni izpit	90 %	Writing examination
Seminarska naloga	10 %	Seminar work
Ocene: pozitivno 6-10; negativno 1-5		Grades: positive 6-10; negative 1-5

Reference nosilca / Lecturer's references:

1. SKOČAJ, Matej, BAKRAČ, Biserka, **KRIŽAJ, Igor**, MAČEK, Peter, ANDERLUH, Gregor, SEPČIĆ, Kristina. The sensing of membrane microdomains based on pore-forming toxins. Current medicinal chemistry, ISSN 0929-8673, 2013, vol. 20, no. 4, str. 491-501, doi: 10.2174/092986713804910094. [COBISS.SI-ID 2710351].
2. OTA, Katja, LEONARDI, Adrijana, MIKELJ, Miha, SKOČAJ, Matej, WOHLSCHLAGER, Therese, KÜNZLER, Markus, AEBI, Markus, NARAT, Mojca, **KRIŽAJ, Igor**, ANDERLUH, Gregor, SEPČIĆ,

Kristina, MAČEK, Peter. Membrane cholesterol and sphingomyelin, and ostreolysin A are obligatory for pore-formation by a MACPF/CDC-like pore-forming protein, pleurotolysin B. Biochimie, ISSN 0300-9084, 2013, vol. 95, iss. 10, str. 1855-1864, doi: 10.1016/j.biochi.2013.06.012. [COBISS.SI-ID 26868007]

3. MATTIAZZI, Mojca, SUN, Yidi, WOLINSKI, Heimo, BAVDEK, Andrej, PETAN, Toni, ANDERLUH, Gregor, KOHLWEIN, Sepp D., DRUBIN, David, **KRIŽAJ, Igor**, PETROVIČ, Uroš. A neurotoxic phospholipase A [sub] 2 impairs yeast amphiphysin activity and reduces endocytosis. PloS one, ISSN 1932-6203, 2012, vol. 7, iss. 7, str. 1-13, e40931, doi: 10.1371/journal.pone.0040931. [COBISS.SI-ID 5026074].

4. MATTIAZZI, Mojca, JAMBHEKAR, Ashwini, KAFERLE, Petra, DERISI, Joseph, **KRIŽAJ, Igor**, PETROVIČ, Uroš. Genetic interactions between a phospholipase A2 and the Rim101 pathway components in S. cerevisiae reveal a role for this pathway in response to changes in membrane composition and shape. Molecular genetics and genomics, ISSN 1617-4615, 2010, vol. 283, no. 6, str. 519-530, doi: 10.1007/s00438-010-0533-8. [COBISS.SI-ID 23541287].

5. KOVAČIČ, Lidija, NOVINEC, Marko, PETAN, Toni, **KRIŽAJ, Igor**. Structural basis of the significant calmodulin-induced increase in the enzymatic activity of secreted phospholipases A2. Protein engineering, design & selection, ISSN 1741-0126, 2010, vol. 23, no. 6, str. 479-487, doi: 10.1093/protein/gzq019. [COBISS.SI-ID 23512103].

UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	BIOLOŠKO AKTIVNI KOVINSKI KOMPLEKSI
Course Title:	BIOLOGICALLY ACTIVE METAL COMPLEXES

Študijski program in stopnja Study Programme and Level	Študijska smer Study Field	Letnik Academic Year	Semester Semester
MAG Biokemija, 2. stopnja	**/**	**1.**	**2.**
USP Biochemistry, 2nd Cycle	**/**	**1st**	**2nd**

Vrsta predmeta / Course Type: izbirni strokovni / Elective Professional

Univerzitetna koda predmeta / University Course Code: BI2I16

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje Work	Druge oblike študija	Samost. delo Individual Work	ECTS
15	**15**	**45 LV**	**/**	**/**	**75**	**5**

Nosilec predmeta / Lecturer: prof. dr. Iztok Turel / Dr. Iztok Turel, Full Professor

Jeziki / Languages:

Predavanja / Lectures:	**slovenski / Slovenian**
Vaje / Tutorial:	**slovenski / Slovenian**

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	**Prerequisites:**
Študent oz. kandidat mora imeti predmet opredeljen kot študijsko obveznost.	The course has to be assigned to the student.

Vsebina:	**Content (Syllabus outline):**
PREDAVANJA: Uvod in razlaga osnovnih pojmov. Vpliv kovinskih ionov na oksidativni stres in nastanek prostih radikalov. Fentonova reakcija. Interakcije kovinskih ionov in antioksidantov. Koordinacijske spojine kot mimiki nekaterih encimov. Modelne spojine. Primeri uporabe (vezava dušika; vezava reaktivnih kisikovih zvrsti; fotosinteza, itd.). Vezava kovinskih ionov na biološko pomembne makromolekule (proteine, DNA, itd). Vloga kovin pri agregaciji proteinov (npr. prionov). Pregled kovin, ki tvorijo biološko aktivne koordinacijske spojine in so že v klinični rabi ali pa v fazi preizkusov. Kovinski kompleksi, ki se	LECTURES Introduction and expalantion of general terms. Oxidation stress induced by metal ions, formation of radical species. Fenton`s reaction. Interactions of metal ions and antioxidants. Coordination compounds as mimics of enzymes. Model compounds. Examples of applications (nitrogen fixation; binding of reactive oxygen species; photosynthesis, etc.). Binding of metals to biologically important macromolecules (proteins, DNA, etc). Role of metals in aggregation of proteins (e.g. prions). The review of metals that form biologically active coordination compounds and are already used in clinical practice or are potential

uporabljajo v diagnostične namene. VSEBINA SEMINARJEV: Študentje bodo individualno ali v skupini pripravili projekt z določeno specifično tematiko s poudarkom na najnovejših dognanjih. Praktični del projekta bodo izvedli pri laboratorijskih vajah. VSEBINA LABORATORIJSKIH VAJ: Študentje bodo načrtovali in izvedli sinteze biološko aktivnih koordinacijskih spojin. Sestavo in druge lastnosti kovinskih kompleksov bodo določali z različnimi spektroskopskimi metodami (NMR spektroskopijo, IR spektroskopijo, UV spektroskopijo), s termogravimetrično analizo (TGA, DSC), visokotlačno tekočinsko kromatografijo (HPLC). Pri tem delu študent spozna tudi praktične znanstvene probleme s katerimi se ukvarjamo na Katedri za anorgansko kemijo.	therapeutics. Metal complexes that are used as diagnostic agents. Seminars: Preparation (in group or individually) of certain specific up to date projects. The practical project will be performed in the lab. Practical course: The student will prepare a plan of isolation of biologically active coordination compound that is later practically performed. Composition and properties of isolated product will be studied by various methods (spectroscopic (NMR, IR, UV-vis), X-ray, thermal (TGA, DSC), chromatography (HPLC)). During this work the students are also informed with practical examples which are studied at the chair of Inorganic chemistry.

Temeljna literatura in viri / Readings:

Temeljna literatura: / Main source:

- A.E. Shilov, Metal Complexes in Biomometics Chemical reactions, CRC, 1997, 300 strani / pages (10%).

Poglavja iz: / Chapters from:

- N. Hadjiliadis, E. Sletten, (Eds.), Metal complex - DNA interactions, John Wiley & Sons, Inc.: Hoboken, NJ, 2009, 544 strani / pages (10 %).
- Macromolecules containing metal and metal-like elements, Vol 3, A.S. Abd-El-Azoz, C.E. Carraher Jr., C.U. Pittman Jr., J.E. Sheats, M. Zeldin, Wiley Interscience, 2004, 208 strani / pages (15 %).
- Mechanisms of Metallocenter Assembly, R.P. Hausinger, G.L. Eichhorn, L.G. Marzilli, VCH, 1996, 260 strani / pages, (10 %).

Cilji in kompetence:	**Objectives and Competences:**
Cilji predmeta: Nadgraditi in poglobiti znanje in razumevanje pomena kovinskih ionov v živih sistemih, seznaniti študente z nekaterimi sintetičnimi makromolekulskimi kovinskimi kompleksi, ki simulirajo delovanje naravnih bioaktivnih substance. **Predmetno specifične kompetence:** Pri predmetu študent utrjuje strategijo reševanja problemov in nadgradi svoje znanje	• To upgrade knowledge and understanding of importance of metal ions in living systems • To study synthetic (model) macromolecular metal complexes which simulate natural bioactive substances • A student is strengthening knowledge of strategy of solving problems and upgrade knowledge in interpretation of data • Student is able to connect theoretical data with experimental data.

o zbiranju in interpretaciji podatkov ter povezovanju teorije in eksperimentalnega dela.	

Predvideni študijski rezultati:	**Intended Learning Outcomes:**
Znanje in razumevanje Študent razume pomen in delovanje kovin v organizmu.	Knowledge and Comprehension To understand the importance and activity of metals in organism.
Uporaba Znanje in razumevanje osnovnih kemijskih zakonitosti vezave kovinskih ionov na biološko pomembne sisteme so pomembni pri nadgradnji nekaterim predmetom pri nadaljnjem študiju.	Application To comprehend the binding of metal ions in biological important systems in connection with other topics in his/her further study.
Refleksija Študent je sposoben oceniti pomen kovinskih ionov za razlago nekaterih pomembnih procesov, ki potekajo v organizmih.	Analysis To be able to evaluate the importance of metal ions in explanation of some important processes in organisms.
Prenosljive spretnosti Študent zna poiskati podatke iz strokovne literature, podatke iz virov medmrežja pa zna kritično oceniti; zna uporabljati strokovni jezik, tako pisno kot ustno.	Skill-transference Ability Ability of finding and usage of the literature and internet data, interpretation of data, critical analysis of texts relating the topics. Oral and written use of professional language.

Metode poučevanja in učenja:	**Learning and Teaching Methods:**
Predmet se izvaja v obliki seminarjev, seminarskih vaj in praktičnih vaj, ki jih študentje v skupinah izvedejo v laboratorijih. Študentje pripravijo seminarje o izbranih temah, ki jih nato predstavijo pred svojimi kolegi. Praktični del predmeta je zasnovan izrazito projektno. Študentom se zastavi konkretni problem, ki ga nato na osnovi zbranih podatkov iz literature in z aktivnim sodelovanjem s pedagoškim osebjem, tudi rešijo. Svoje delo opišejo v poročilu in ga tudi predstavijo.	• Seminar work, discussion, practical group lab work, project work. • Each student chooses a specific topic related with the biomimetic and prepares a non-research project work (seminar) and presents it to the group. • Students work on a specific problem, which is solved by using literature data with help of pedagogical assistant. • Preparation of written laboratory report and oral presentation.

Načini ocenjevanja:	Delež (v %) / Weight (in %)	**Assessment:**
Opravljene vaje; kolokvij	40 %	Successfully finished practical lab course
Seminarska naloga	10 %	Seminar work
Ustni izpit	50 %	Oral examination

Reference nosilca / Lecturer's references:

1. R. Hudej, J. Kljun, W. Kandioller, U. Repnik, B. Turk, C. G. Hartinger, B. K. Keppler, D. Miklavčič,

I. Turel, Synthesis and Biological Evaluation of the Thionated Antibacterial Agent Nalidixic Acid and its Organoruthenium(II) Complex, Organometallics, 31, 5867−5874 (2012).
2. **I. Turel**, J. Kljun, Interactions of metal ions with DNA, its constituents and derivatives, which may be relevant for anticancer research, Current Topics in Medicinal Chemistry, 11, No. 21, 2661-2687 (2011).
3. D. Rehder, J. Costa Pessoa, C.F.G.C. Geraldes, M.M.C.A Castro, T. Kabanos, T. Kiss, B. Meier, G. Micera, L. Pettersson, M. Rangel, A. Salifoglou, **I. Turel**, D. Wang, In vitro study of the insulin-mimetic behaviour of vanadium(IV, V) coordination compounds, J. Biol. Inorg. Chem., 7, 384-396 (2002).

UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	BIOLOŠKO POMEMBNE SPOJINE
Course Title:	BIOLOGICALLY IMPORTANT COMPOUNDS

Študijski program in stopnja Study Programme and Level	Študijska smer Study Field	Letnik Academic Year	Semester Semester
MAG Biokemija, 2. stopnja	**/**	**1.**	**2.**
USP Biochemistry, 2nd Cycle	**/**	**1st**	**2nd**

Vrsta predmeta / Course Type: Izbirni strokovni / elective proffesional

Univerzitetna koda predmeta / University Course Code: BI2I12

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje Work	Druge oblike študija	Samost. delo Individual Work	ECTS
30	**/**	**45LV**	**/**	**/**	**/**	**5**

Nosilec predmeta / Lecturer: prof. dr. Bogdan Štefane / Dr. Bogdan Štefane, Associate Professor

Jeziki / Languages:

Predavanja / Lectures:	**slovenski / Slovenian**
Vaje / Tutorial:	**slovenski / Slovenian**

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	Prerequisites:
Študent oz. kandidat mora imeti predmet opredeljen kot študijsko obveznost.	The course has to be assigned to the student.

Vsebina:	Content (Syllabus outline):
Eterična olja Pomembni viri in glavne sestavine posameznih eteričnih oljih. Lastnosti eteričnih olj (kot so eterično olje bazilike, citrusov, kadulje, evkaliptusa, sivke, rožmarina, klinčkov, konoplje, itd.), izolacija in pretvorbe njihovih glavnih sestavin. **Odoranti in flavoranti** Struktura spojin, ki so odgovorne za specifičen okus in vonj. Uporaba in najpogostejše polsintezne in sintezne poti, ki vodijo do tovrstnih spojin. **Alkaloidi** Sistematika alkaloidov. Pojavnost alkaloidov in njihove lastnosti.	**Essential oils** Important sources and main components of essential oils. Properties of essential oils (for example essential oil of basil, citrus, eukaliptus, lavanda, rosmarin, cloves, cannabis, etc.), isolation and transformations of their main components. **Odorants and flavourings** Structure of compounds responsible for specific taste and smell. The use and the main semi-synthetic and synthetic ways leading to these compounds. **Alkaloids** Systematics of alkaloids. Sources and properties of alkaloids.

Postopki za izolacijo alkaloidov. Uporaba tipičnih alkaloidov v medicinske namene. Polsintezne in sintezne poti najpomembnejših alkaloidov. **Naravni produkti kot spojine vodnice za razvoj sinteznih produktov** • primeri v medicinski kemiji • primeri v sintezni kemiji • primeri v kemiji materialov • primeri v kemiji živil	Isolations of alkaloids. The medicinal use of typical alkaloids. Semi-synthetic and synthetic ways leading to the most important alkaloids. **Natural products as leading compounds in development of synthetic products** • examples in medicinal chemistry • examples in synthetic chemistry • examples in chemistry of materials • examples in food chemistry

Temeljna literatura in viri / Readings:

1. *Modern Alkaloids: Structure, Isolation, Synthesis and Biology*, E. Fattorusso and O. Taglialatela-Scafati eds., Wiley-VHC, Weinheim, Germany, 2008 (nekatera poglavja/some chapters; **50** str. od 641).
2. *Flavours and Fragrances: Chemistry, Bioprocessing and Sustainability*, R. G. Berger ed., Springer, Berlin, Germany, 2007 (nekatera poglavja/some chapters; **100** str. od 621).
3. Titus A. M. Msagati, *Chemistry of Food Additives and Preservatives*, John Wiley & Sons, Oxford, UK, 2013 (nekatera poglavja/some chapters **80** str. od 314).

Cilji in kompetence:	**Objectives and Competences:**
Učna enota prispeva k razvoju naslednih splošnih in specifičnih kompetenc: Študent se seznani z viri in uporabo naravnih spojin, • poznavanje pomembnih virov in lastnosti naravnih produktov, • študent spozna poglavitne polsintezne in sintezne pretvorbe naravnih produktov.	To became familiar with sources and applications of natural compounds • knowing important sources and properties of natural products, • knowing important semi-synthetic and synthetic transformations of natural products.
Predvideni študijski rezultati:	**Intended Learning Outcomes:**
<u>Znanje in razumevanje</u> Študent pozna: • biološko pomembne naravne produkte, • njihove najpogostejše vire, • njihove lastnosti, • uporabo, • glavne polsintezne in sintezne pretvorbe.	<u>Knowledge and Comprehension</u> student is familiar with biologically important natural products: • their sources, • properties, • applications, • main semisynthetic and synthetic transformations.
<u>Uporaba</u> Poznavanje navedene vsebine bo študent lahko uporabil pri svojem nadaljnjem strokovnem razvoju. Pridobljena znanja mu bodo omogočila hitrejši in učinkovitejši pristop	<u>Application</u> Student will be able to use the acquired knowledge during his further professional development. This knowledge will enable him to efficiently resolve the problems in the field of

k reševanju problemov s področij kemije naravnih spojin.	natural compounds.
Refleksija Študent je sposoben načrtovanja izolacije posameznih naravnih produktov, čiščenja in karakterizacije. Sposoben je kritično ovrednotiti rezultate glede na skladnost z literaturnimi opisi.	Analysis Student is capable of planning isolation procedures, purification and characterization of typical natural products. Student can critically evaluate obtained results comparing to literature facts.
Prenosljive spretnosti Študent pridobljene spretnosti in teoretična znanja uporablja pri svojem razvojnem delu, raziskovalnem delu in pri študiju ostalih vsebin na področju kemije in biokemije.	Skill-transference Ability Student can use acquired skills and knowledge during his professional development, research work and study of other subjects concerning chemistry and biochemistry.

Metode poučevanja in učenja:	**Learning and Teaching Methods:**
Predavanja in skupinski projekti.	Lectures, group projects.

Načini ocenjevanja:	Delež (v %) / Weight (in %)	**Assessment:**
Pisni izpit		**Written exam**

Reference nosilca / Lecturer's references:

- POŽGAN, Franc, **ŠTEFANE, Bogdan**, KIDEMET, Davor, SMODIŠ, Janez, ZUPET, Rok. A new synthetic route towards aliskiren intermediates. *Synthesis*, ISSN 0039-7881, str. 1-8, ilustr. doi: 10.1055/s-0034-1378616. [COBISS.SI-ID 1763375],
- BERANIČ, Nataša, **ŠTEFANE, Bogdan**, BRUS, Boris, GOBEC, Stanislav, LANIŠNIK-RIŽNER, Tea. New enzymatic assay for the AKR1C enzymes. V: PLAPP, Bryce (ur.), et al. *Enzymology and molecular biology of carbonyl metabolism*, (Chemico-Biological Interactions, ISSN 0009-2797, vol. 202, iss. 1/3). Amsterdam: Elsevier, 2013, str. 204-209, ilustr., doi: 10.1016/j.cbi.2012.12.003. [COBISS.SI-ID 30357465],
- SOSIČ, Izidor, MIRKOVIĆ, Bojana, ARENZ, Katharina, **ŠTEFANE, Bogdan**, KOS, Janko, GOBEC, Stanislav. Development of new cathepsin B inhibitors: combining bioisosteric replacements and structure-based design to explore the structure-activity relationships of nitroxoline derivatives. *Journal of medicinal chemistry*, ISSN 0022-2623, 2013, vol. 56, no. 2, str. 521-533, doi: 10.1021/jm301544x. [COBISS.SI-ID 3370865]

UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	BIONANOTEHNOLOGIJA
Course Title:	BIONANOTECHNOLOGY

Študijski program in stopnja Study Programme and Level	Študijska smer Study Field	Letnik Academic Year	Semester Semester
MAG Biokemija, 2. stopnja	**/**	**1.**	**2.**
USP Biochemistry, 2nd Cycle	**/**	**1st**	**2nd**

Vrsta predmeta / Course Type: obvezni / Mandatory

Univerzitetna koda predmeta / University Course Code: BI2I19

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje Work	Druge oblike študija	Samost. delo Individual Work	ECTS
30	**30**	**15 LV**	**/**	**/**	**75**	**5**

Nosilec predmeta / Lecturer: doc. dr. Gregor Gunčar / Dr. Gregor Gunčar, Assistant Professor

Jeziki / Languages:	**Predavanja / Lectures:**	**slovenski / Slovenian**
	Vaje / Tutorial:	**slovenski / Slovenian**

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	**Prerequisites:**
Študent oz. kandidat mora imeti predmet opredeljen kot študijsko obveznost.	The course has to be assigned to the student.

Vsebina:	**Content (Syllabus outline):**
Uvod- kaj je bionanotehnologija Delovanje in lastnosti nanostrojev v celici, biomateriali iz katerih so sestavljeni: proteini, DNK, polisaharidi in lipidi in njihove lastnosti povezane z uporabo v nanonapravah Biomolekularno načrtovanje: uporaba tehnik rekombinantne DNA, mutageneza, fuzijski proteini, protitielesa, uporaba metod za določevanje tridimenzionalnih struktur pri načrtovanju, molekulsko modeliranje, zvijanje proteinov, predikcija interakcij med molekulami, načrtovanje novih oblik/lastnosti z uporabo računalniških metod Strukturni principi bionanotehnologije: sile med molekulami, šaperoni, rigidnost/fleksibilnost molekul,	Introduction- what is bionanotechnology Bionanomachines in action, modern biomaterials: proteins, DNA, polysaccharides, lipids and their properties useful for their application in nanodevices. Biomolecular design: use of recombinant DNA technology, mutagenesis, fusion proteins, antibodies, use of methods for 3D structure determination, molecular modeling, protein folding, protein interaction prediction in designing new biomolecules with different folds/properties Structural principles of bionanotechnology: biomoleclar structure and stability, chaperones, rigidity/flexibility of proteins, self-assembly, symmetry, molecular recognition, structures of

samoorganizacija molekul in simetrija, molekulsko prepoznavanje, tridimenzionalne strukture proteinov, DNA, RNA, ter kompleksov med njimi Funkcionalni principi bionanotehnologije: samoorganizacija molekul, prenos energije na nivoju molekul, encimsko katalizirane transformacije, regulatorni elementi, biomateriali, biomolekularni motorji, prenos preko membrane, biosenzorji, povezava med strukturo in funkcijo Bionanotehnologija danes: načrtovanje novih proteinov, DNA, RNA, nanomedicina, uporaba molekularnih motorjev, DNA računalniki, molekularno načrtovanje z biološko selekcijo, umetno življenje, hibridni materiali, bionanosenzorji Prihodnost bionanotehnologije: novi primeri uporabe, etika uporabe, nevarnosti Seminar: teoretično načrtovanje bionanotehnološkega projekta Laboratorijske vaje: izvedba najboljšega in najbolj izvedljivega predlaganega seminarskega projekta ali posameznih delov predlaganih projektov	proteins, DNA, RNA and their complexes. Functional principles of bionanotechnology: self-organization, molecular energy transfer, enzymatic transformation, regulatory elements, biomaterials, biomolecular motors, traffic across membranes, biomolecular sensing, structure-function relationship. Bionanotechnology today: design of novel proteins, DNA, RNA, nanomedicine, harnessing molecular motors, DNA computers, molecular design using biological selection, artificial life, hybrid materials, bionanosensors. The future of bionanotechnology: new examples of use, ethical considerations, biohazard. Seminar: bionanotechnology project Laboratory practicals: practical implementation of the most feasible seminar project or parts of the projects.

Temeljna literatura in viri / Readings:

Osnovni vir/basic reading:
- Goodsell, D.S. (2004) “Bionanotechnology: Lessons from Nature”, Wiley-Liss, Hoboken.

Druga literatura/additional readings:
- Mirkin, C.A., Niemeyer, C.M. (2007) “Nanobiotechnology II”, Wiley-VCH
- Roux, B., (2011) “Molecular Machines”, World Scientific Pub. Co. Inc.
- tekoča znanstvena literatura s tega področja / current scientific literature in the field of bionanotechnology

Cilji in kompetence:	**Objectives and Competences:**
Cilj predmeta je študente spoznati z bionanotehnologijo in jih naučiti osnov delovanja, načrtovanja, izdelave, karakterizacije in uporabe bioloških materialov in naprav v nanomerilu ter spodbuditi inovativno razmišljanje o možnostih uporabe in modifikacijah že znanih	Students will learn what bionanotechnology is, principles of use, design and characterization of biological materials and nanodevices. The course will encourage innovative thinking about the use and modifications of biological nanomaterials and cellular nanodevices.

bioloških nanomaterialov in celičnih nanonaprav. Predmet usmerja študente k interdisciplinarnemu povezovanju znanja, ki so ga že osvojili in h kvalitativni nadgradnji, ki je potrebna za uspešno povezovanje tega znanja. Spodbuja kreativno in inovativno razmišljanje študentov izven okvirov posameznih temeljnih ved, ki se povezujejo v nanobiotehnologijo.	The course directs students towards interdisciplinary knowledge integration and qualitative upgrade of their current knowledge in order to achieve that. It promotes creative and innovative thinking outside the scope of the basic knowledge that is integrated in bionanotechnology.

Predvideni študijski rezultati:	**Intended Learning Outcomes:**
Znanje in razumevanje Študenti bodo pri predmetu pridobili znanje, ki je potrebno za povezovanje temeljnih ved, ki so osnova bionanotehnologije. Razumeli bodo osnove delovanja, načrtovanja, izdelave, karakterizacije in uporabe bioloških materialov in naprav v nanomerilu.	Knowledge and Comprehension Students will gain knowledge that is required for integration of the basic disciplines that make bionanotechnology. They will understand the basic principles of action, design, manufacturing, characterization and use of the biological materials and nanodevices.
Uporaba Bionanotehnologija je tehnologija prihodnosti. Študenti bodo spoznali tudi praktične primere uporabe in načrtovanja novih bioloških naprav in materialov v nanomerilu in njihovo uporabo, seznanili pa se bodo tudi z metodami, ki so potrebne za njihovo analizo. Predvsem se bodo naučili, kako lahko uporabimo čudovite materiale in nanonaprave, ki jih je ustvarila narava, jih spremenimo in izboljšamo ter uporabimo v korist človeka.	Application Students will gain knowledge that is required for integration of the basic disciplines that make bionanotechnology. They will understand the basic principles of action, design, manufacturing, characterization and use of the biological materials and nanodevices.
Refleksija Študenti bodo lahko svoje znanje in nekatere ideje, ki jih bodo predstavili tudi v obliki seminarja, preizkusili na laboratorijskih vajah in jih s tem kritično ovrednotili ter s tem dobili občutek za povezovanje teoretičnih idej in njihove implementacije v praksi.	Analysis Students will be able to apply their knowledge and some ideas, presented in the project seminar in lab practical courses. They will be able to critically access their ideas by implementing them in the lab practical courses.
Prenosljive spretnosti Inovativno reševanje problemov in rešitev, uporaba znanstvene literature in uporaba protokolov objavljenih v znanstveni literaturi v praksi, zasnova in razvoj nove ideje, načrt kako to idejo uresničiti in izvedba v praksi, pisanje projekta, javno nastopanje (predstavitev ideje), poročanje o rezultatih.	Skill-transference Ability Innovative problem solving, use of scientific literature and laboratory protocols, project development and its implementation, project writing, public presentation, scientific results presentation.

Metode poučevanja in učenja:	**Learning and Teaching Methods:**
- Predavanja - Seminarji - Laboratorijske vaje	Lectures, seminars, laboratory practical courses.

Načini ocenjevanja:	Delež (v %) / Weight (in %)	**Assessment:**
Opravljene vaje so pogoj za pristop k izpitu		Laboratory practicals completion is required to attend written exam.
Seminarska naloga		Seminar work
Pisni izpit		Written exam

Reference nosilca / Lecturer's references:

1. **GUNČAR, Gregor**, PUNGERČIČ, Galina, KLEMENČIČ, Ivica, TURK, Vito, TURK, Dušan. Crystal structure of MHC class II-associated p41 Ii fragment bound to cathepsin L reveals the structural basis for differentiation between cathapsins L and S. EMBO, 1999, vol. 18, str. 793-803. [COBISS.SI-ID 14007335]

2. WANG, Ching-I. A.*, **GUNČAR, Gregor***, FORWOOD, Jade K., TEH, Trazel, CATANZARITI, Ann-Maree, LAWRENCE, Gregory J., LOUGHLIN, Fionna E., MACKAY, Joel P., SCHIRRA, Horst Joachim, ANDERSON, Peter A., ELLIS, Jeffrey G., DODDS, Peter N., KOBE, Boštjan. Crystal structures of flax rust avirulence proteins AvrL567-A and -D reveal details of the structural basis for flax disease resistance specificity. Plant cell, 2007, vol. 19, no. 9, str. 2898-2912. [COBISS.SI-ID 3814170]
*enakovredna prva avtorja

3. KOBE, Boštjan, **GUNČAR, Gregor**. Crystallography and protein-protein interactions : biological interfaces and crystal contacts. Biochem Soc Trans, 2008, vol. 36, no. 6, str. 1438-1441. [COBISS.SI-ID 22235175]

UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	BIOORGANSKA KEMIJA
Course Title:	BIOORGANIC CHEMISTRY

Študijski program in stopnja Study Programme and Level	Študijska smer Study Field	Letnik Academic Year	Semester Semester
MAG Biokemija, 2. stopnja	**/**	**1.**	**1.**
USP Biochemistry, 2nd Cycle	**/**	**1st**	**1st**

Vrsta predmeta / Course Type: obvezni / Mandatory

Univerzitetna koda predmeta / University Course Code: BI2T03

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje Work	Druge oblike študija	Samost. delo Individual Work	ECTS
30	**15**	**30 LV**	**/**	**/**	**75**	**5**

Nosilec predmeta / Lecturer: prof. dr. Bogdan Štefane /
Dr. Bogdan Štefane, Associated Professor

Jeziki / Languages:

Predavanja / Lectures:	**slovenski / Slovenian**
Vaje / Tutorial:	**slovenski / Slovenian**

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	Prerequisites:
Študent oz. kandidat mora imeti predmet opredeljen kot študijsko obveznost.	The course has to be assigned to the student.

Vsebina:	Content (Syllabus outline):
Uvod: korelacija med strukturo, lastnostmi in reaktivnost organskih spojin: - struktura in stereo-elektronske lastnosti, - reaktivnost funkcionalnih skupin, - nekovalentne interakcije, - prebiotska kemija, - modularnost biooligomerov. Pregled organskih reakcij v bioloških sistemih: - pretvorbe na ogljikovem skeletu - pretvorbe funkcionalnih skupin Bioorganska kemija nukleinskih kislin: - aromatičnost, kislost in bazičnost, - stabilnost in modifikacija nukleinskih baz, - kemijska sinteza oligonukleotidov,	Introduction: correlation between the structure, properties, and reactivity of organic compounds: - structure and stereo-electronic properties, - reactivity of functional groups, - non-covalent interactions, - prebiotic chemistry, - modular design of biooligomers. Survey on organic reactions in biological systems: - transformations on the carbon framework - transformations of functional groups Bioorganic chemistry of nucleic acids: - aromaticity, acidity, basicity,

- fotokemija nukleinskih kislin, - nukleinske kisline kot tarča za učinkovine. <u>Bioorganska kemija peptidov in proteinov:</u> - kemijska sinteza oligopeptidov in proteinov - interakcije proteini -mala molekula, - mehanizem značilnih encimskih reakcij, - modifikacija strukture peptidov, - proteini kot tarča za učinkovine. <u>Bioorganska kemija ogljikovih hidratov:</u> - stereo elektronski efekti, - kemija glikozidne vezi, - mehanizem encimatskih glikozidacij. <u>Osnove medicinske kemije:</u> - izbira tarč iskanje spojin vodnic: pregled osnovnih tipov učinkovin - osnove "in silico" modeliranja interakcij malih molekul z biološkimi molekulami - sinteza spojin vodnic s principi kombinatorne sinteze - optimizacija spojin vodnic - primeri razvoja učinkovin	- stability and modification of nucleic bases, - photochemistry of nucleic bases, - nucleic acids as drug target. <u>Bioorganic chemistry of peptides and proteins:</u> - chemical synthesis of oligopeptides and proteins, - interactions protein-small molecule, - protein structure modification, - proteins as drug targets. <u>Bioorganic chemistry of carbohydrates:</u> - stereo electronic effects, - chemistry of glycosidic bond, - mechanisms of enzymatic glycosidations. <u>Fundamentals of medicinal chemistry:</u> - choosing a target and finding a lead: survey on drug types - introduction to "in silico" modelling of small molecule-biomolecule interactions, - lead synthesis with principles of combinatorial synthesis, - lead optimization, - examples of drug discovery.

Temeljna literatura in viri / Readings:

- D. Van Vranken, G. A. Weiss: Introduction to Bioorganic Chemistry and Chemical Biology, Garland Science 2012. (selected topcs, 40%)

Dodatna literatura / Supplementary Readings:

- J. Clayden, N. Graves, S. Warren: Organic Chemistry, 2nd Edition, Oxford University Press, 2012, 1264 strani (izbrane tematike iz bioorganske kemije / selected topics related to bioorganic chemistry).
- Pregledni članki, ki pokrivajo posamezne vsebine iz bioorganske kemije (praviloma v zadnjih 10 letih) / Review articles covering selected topics of bioorganic chemistry (recent papers published in the last decade).

Cilji in kompetence:	**Objectives and Competences:**
Namen predmeta je študenta seznaniti z osnovami bioorganske kemije, predstaviti in razložiti osnove reaktivnosti in pretvorb v bioloških sistemih in podati primere uporabe metod organske kemije v študijah bioloških procesov. Cilj je poznavanje in razumevanje povezave med strukturo, lastnostmi in reaktivnostjo bioloških molekul, poznavanje uporabe organsko-kemijskih metod v biokemiji in biologiji, ter poznavanje osnovnih	To obtain knowledge on fundamentals of bioorganic chemistry, to present and explain the fundamentals of reactivity and transformations in biological systems and to give examples of application of organic-chemical methods in study of biological processes. The aim is knowledge and understanding of correlation between the structure, properties, and reactivity of and biomolecules, application of organo-chemical

principov bioorganske sinteze.	methods in biochemistry and biology, and knowledge on the principles of bioorganic synthesis.

Predvideni študijski rezultati:	**Intended Learning Outcomes:**
<u>Znanje in razumevanje</u> Študent pri predmetu pridobi: - znanje in razumevanje korelacije med strukturo, lastnostmi in reaktivnostjo biomolekul, - pozna in razume interakcije med malimi in biološkimi molekulami, - principe organsko-kemijskih metod v bioloških študijah, - namen in načine modifikacij biomolekul, - osnovne principe razvoja učinkovin.	<u>Knowledge and Comprehension</u> Student acquires knowledge and understanding on: - correlation between the structure, properties, and reactivity of biomolecules, - interactions between small and biomolecules, - principles of organo-chemical methods in biological studies, - the purpose and ways of modification of biomolecules, - basic principles of drug discovery.
<u>Uporaba</u> Pridobljeno znanje je uporabno na širokem področju biokemije in medicinske kemije, zlasti pa pri uporabi metod organske kemije v biokemijskih študijah in pri uporabi biokemijskih metod v organski kemiji.	<u>Application</u> This knowledge is applicable in a wide area of biochemistry and medicinal chemistry with emphasis on application of organo-chemical methods in biochemistry and biochemical methods in organic chemistry.
<u>Refleksija</u> Študent je na osnovi pridobljenega znanja sposoben razumeti relacijo med lastnostmi specifičnega tipa biomolekul in njihovo strukturo. Razume njihove interakcije z malimi molekulami in je sposoben načrtovati modifikacije in sintezo malih- in biomolekul in to tudi preizkusiti v praksi. Študent pozna in razume osnovne principe razvoja učinkovin.	<u>Analysis</u> The student is able to understand structure-properties relationship for a given type of biomolecules. The student understands interaction between small molecules and biomolecules and is able to plan their modifications and synthesis. The student knows and understands the basic principles of drug discovery.
<u>Prenosljive spretnosti</u> identifikacija in reševanje problemov, - kritična analiza in sinteza, - dostopanje do literaturnih virov, - poznavanje in uporaba specializiranih računalniških programov -zbiranje, interpretacija in kritično vrednotenje podatkov.	<u>Skill-transference Ability</u> identification and solving the problems - critical analysis and synthesis - accessing and the use of literature sources - knowing and the use of specialized software - collection, interpretation, and critical data evaluation

Metode poučevanja in učenja:	**Learning and Teaching Methods:**
Predavanja; seminarji in laboratorijske vaje	Lectures, seminars, and laboratory trainings

Načini ocenjevanja:	Delež (v %) / Weight (in %)	**Assessment:**

Pisni in ustni izpit. Opravljene vaje so pogoj za pristop k izpitu. Ocene: 6-10 (pozitivno), 1-5 (negativno).		Written and oral examination. Completed laboratory course is prerequisite for the exam. Grades: 6-10 (positive), 1-5 (negative

Reference nosilca / Lecturer's references:

1. **ŠTEFANE, Bogdan**. Selective addition of organolithium reagents to BF2-chelates of -ketoesters. Organic letters, ISSN 1523-7060, 2010, vol. 12, no. 13, str. 2900-2903, doi: 10.1021/ol100620j. [COBISS.SI-ID 34162181]
2. WANG, Jingxin, **ŠTEFANE, Bogdan**, JABER, Deana, SMITH, Jacqueline A. I., VICKERY, Christopher, DIOP, Mouhamed, SINTIM, Herman O. Remote C-H functionalization : using the N-O moiety as a atom-economical tether to obtain 1,5- and the rare 1,7-C-H insertions. Angewandte Chemie, ISSN 1433-7851. [Print ed.], 2010, vol. 49, no. 23, str. 3964-3968, doi: 10.1002/anie.201000160. [COBISS.SI-ID 34061573]
3. NAKAYAMA, Shizuka, KELSEY, Ilana, WANG, Jingxin, ROELOFS, Kevin, **ŠTEFANE, Bogdan**, LUO, Yiling, LEE, Vincent T., SINTIM, Herman O. Thiazole orange-induced c-di-GMP quadruplex formation facilitates a simple fluorescent detection of this ubiquitous biofilm regulating molecule. Journal of the American Chemical Society, ISSN 0002-7863, 2011, vol. 133, no. 13, str. 4856-4864, doi: 10.1021/ja1091062. [COBISS.SI-ID 34845957]

UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	GENOMSKA BIOLOGIJA
Course Title:	GENOME BIOLOGY

Študijski program in stopnja Study Programme and Level	Študijska smer Study Field	Letnik Academic Year	Semester Semester
MAG Biokemija, 2. stopnja	**/**	**2.**	**3.**
USP Biochemistry, 2nd Cycle	**/**	**2nd**	**3rd**

Vrsta predmeta / Course Type: izbirni strokovni / Elective Professional

Univerzitetna koda predmeta / University Course Code: BI2I06

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje Work	Druge oblike študija	Samost. delo Individual Work	ECTS
30	**15**	**30 LV**	**/**	**/**	**75**	**5**

Nosilec predmeta / Lecturer: izr. prof. dr. Dušan Kordiš /
Dr. Dušan Kordiš, Associate Professor

Jeziki / Languages:

Predavanja / Lectures:	**slovenski / Slovenian**
Vaje / Tutorial:	**slovenski / Slovenian**

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	Prerequisites:
Študent oz. kandidat mora imeti predmet opredeljen kot študijsko obveznost.	The course has to be assigned to the student.

Vsebina:	Content (Syllabus outline):
Kaj je genom? Razumevanje genomskih zaporedij. Anatomija eukariontskih in prokariontskih genomov. Regulacija delovanja genoma. Struktura in dinamika genomov. Molekularni vzroki evolucije genomov. Vzorci genomske evolucije. Filogenetika in filogenomika. Evolucija proteinov. Laboratorijske vaje (računalnik): Genomske podatkovne baze. Specializirane proteomske databaze. Evolucijske analize genomskih sekvenc. Evolucijske analize proteomov.	What is a genome? Understanding a genome sequence. Genome anatomies in eukaryotes and prokaryotes. Regulation of genome activity. Molecular basis of genome evolution. Patterns of genome evolution. Molecular phylogenetics and phylogenomics. Protein evolution. <u>Laboratory work (computational):</u> Genome databases. Protein and proteome databases. Evolutionary analyses of genome sequences. Evolutionary analyses of proteomes.

Temeljna literatura in viri / Readings:

- Lynch, M. (2007) The Origins of Genome Architecture. Sinauer.
- Brown, T.A. (2006) Genomes. 3rd Edition, Garland Science.
- Pagel, M. and Pomiankowki, A. (2007) Evolutionary genomics and proteomics. Sinauer.

Cilji in kompetence:

Genomska biologija je izbirni naravoslovni predmet, pri katerem študenti spoznajo organizacijo, delovanje, regulacijo in analizo celotnih genomov (prokariontskih in eukariontskih) ter mehanizme in vzorce evolucije genomov. Študenti bodo spoznali uporabnost izjemno kompleksnih genomskih podatkov pri reševanju različnih problemov iz sodobne biologije in razumevanja pomena informacij, ki so skrite v genomskih sekvencah. Sposobni bodo uporabljati specializirane genomske in proteomske podatkovne baze ter metode molekularne evolucije, ki so potrebne za analizo evolucije različnih genomskih komponent. Predmet usmerja študenta k samostojnemu eksperimentalnemu in teoretičnemu delu.

Objectives and Competences:

Genome Biology is an elective course, during which students learn about the organization, functioning, regulation and analysis of genomes (prokaryotic and eukaryotic), as well as familiarize themselves with the mechanisms and patterns of genome evolution. Students will be taught on the key role of very complex genomic data as to solving various problems in modern biology and of the importance of information hidden in genome sequences. They will be acquainted with specialized genomic and proteomic databases and methods of molecular evolution that are needed in the evolutionary analysis of the different genomic components. Students will be prompted to do independent experimental and theoretical work.

Predvideni študijski rezultati:

Znanje in razumevanje

Študent pri predmetu pridobi znanje o nastanku, strukturni organizaciji, delovanju, regulaciji in evoluciji genomov. Pridobljeno znanje omogoča študentom razumevanje izjemno kompleksnih genomskih podatkov. Študent se nauči uporabljati genomske podatkovne baze.

Uporaba

Študij tega predmeta je nujna podlaga za to, da bo študent razumel kako se genomi in njegove komponente spreminjajo s časom. Predstavljene raziskovalne metode bodo študenti lahko uporabljali na različnih strokovnih področjih. Pridobljeno znanje jim bo pomagalo pri uporabi izjemno kompleksnih genomskih podatkov pri reševanju različnih problemov iz sodobne biologije ter pri interpretaciji rezultatov pridobljenih iz genomskih podatkovnih baz.

Intended Learning Outcomes:

Knowledge and Comprehension

Students will acquire knowledge about the origin, structural organization, functioning, regulation and evolution of genomes. This will enable them to understand the extremely complex genomic data. Students will learn how to use genomic databases.

Application

The course gives students the indispensable basis for the understanding of the evolution of genomes and their components. Students will be able to apply research methods presented during the course to various research fields. The acquired knowledge will help them to use the highly complex genomic data when solving various problems of modern biology, as well as to interpret the results obtained from genomic and proteomic databases.

Refleksija Študent pridobi sposobnost kompleksnega biološkega načina razmišljanja in razvije zmožnost abstraktne predstave o organizaciji, delovanju in evoluciji genomov.	Analysis Students will develop the ability to complex biological thinking, as well as the capacity for the abstraction of genome organization, functioning and evolution.
Prenosljive spretnosti Izkušnje pri reševanju problemov. Timsko delo (pri vajah). Zbiranje in interpretiranje rezultatov ter njihovo kritično vrednotenje. Uporaba tuje literature. Podajanje poročil o opravljenem delu.	Skill-transference Ability Problem-solving skills. Teamwork (at Laboratory work). Obtaining and interpreting results and their critical evaluation. Use of scientific literature. Writing reports on the practical work performed.

Metode poučevanja in učenja:	**Learning and Teaching Methods:**
Predavanja, seminarji in laboratorijske vaje (računalniške)	Lectures, Seminars and Laboratory work (computational)

Načini ocenjevanja:	Delež (v %) / Weight (in %)	**Assessment:**
Kolokvij iz vaj Pisni izpit Ocene: 6-10 (pozitivno), 1-5 (negativno).		Laboratory tutorial colloquium Written exam Grades: 6-10 (positive), 1-5 (negative)

Reference nosilca / Lecturer's references:

1. KOKOŠAR, Janez, **KORDIŠ**, Dušan. Genesis and regulatory wiring of retroelement-derived domesticated genes : a phylogenomic perspective. Molecular Biology and Evolution, 2013, vol. 30, str. 1015-1031. [COBISS.SI-ID 26492711].
2. **KORDIŠ**, Dušan. Extensive intron gain in the ancestor of placental mammals. Biology Direct, 2011, vol. 6, article no. 59. [COBISS.SI-ID 25309479].
3. **KORDIŠ**, Dušan, TURK, Vito. Phylogenomic analysis of the cystatin superfamily in eukaryotes and prokaryotes. BMC Evol Biol., 2009, vol. 9, str. 266-1-266-22. [COBISS.SI-ID 23152679].
4. **KORDIŠ**, Dušan. Transposable elements in reptilian and avian (sauropsida) genomes. Cytogenet. Genome Res., 2009, vol. 127, no. 2/4, str. 94-111. [COBISS.SI-ID 23528999].
5. NOVINEC, Marko, **KORDIŠ**, Dušan, TURK, Vito, LENARČIČ, Brigita. Diversity and evolution of the thyroglobulin type-1 domain superfamily. Molecular Biology and Evolution, 2006, vol. 23, str. 744-755. [COBISS.SI-ID 19851815].

UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	INTERAKCIJE BIOLOŠKIH MOLEKUL
Course Title:	INTERACTIONS OF BIOLOGICAL MOLECULES

Študijski program in stopnja Study Programme and Level	Študijska smer Study Field	Letnik Academic Year	Semester Semester
MAG Biokemija, 2. stopnja	**/**	**1.**	**2.**
USP Biochemistry, 2nd Cycle	**/**	**1st**	**2nd**

Vrsta predmeta / Course Type: obvezni / Mandatory

Univerzitetna koda predmeta / University Course Code: BI2I05

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje Work	Druge oblike študija	Samost. delo Individual Work	ECTS
30	**15**	**30 LV**	**/**	**/**	**75**	**5**

Nosilec predmeta / Lecturer: doc. dr. Marko Novinec / Dr. Marko Novinec, Assistant Professor

Jeziki / Languages:

Predavanja / Lectures:	**slovenski / Slovenian**
Vaje / Tutorial:	**slovenski / Slovenian**

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	Prerequisites:
Študent oz. kandidat mora imeti predmet opredeljen kot študijsko obveznost.	The course has to be assigned to the student.

Vsebina:	Content (Syllabus outline):
Vezava ligandov v bioloških sistemih. Kooperativnost vezave in alosterija. Modifikacija encimske aktivnosti: mehanizmi reverzibilne in ireverzibilne inhibicije, esencialna in neesencialna aktivacija, določanje mehanizma delovanja modifikatorjev encimske aktivnosti, inhibicija s substratom in produktom. Alosterična regulacija encimske aktivnosti. Napredna encimska kinetika: reakcije z več substrati in encimi. Reakcije v heterogenih sistemih (pretvorba netopnih substratov, reakcije na fazni meji lipid-voda). Kinetika hitrih reakcij. Kinetika predravnotežnega	Ligand binding in biological systems. Cooperativity of binding and allostery. Modification of enzyme activity: mechanisms of reversible and irreversible inhibition, essential and nonessential activation, determination of the mechanism of enzyme activity modification, substrate and product inhibition. Allosteric regulation of enzyme activity. Advanced enzyme kinetics: multi-substrate and multi-enzyme reactions. Reactions in heterogeneous systems (turnover of insoluble substrates, reactions at the lipid-water interface). Fast reaction kinetics. Pre-steady-state kinetics.

stanja. Tesne interakcije. Vpliv okolja na medmolekulske interakcije. Računalniške metode analize in napovedi molekulskih interakcij. Računalniško načrtovanje regulatorjev delovanja bioloških molekul. Povezava med strukturo in aktivnostjo načrtovanih biološko aktivnih molekul. *Pri vseh obravnavanih vsebinah je poudarek na povezavi med strukturo in funkcijo bioloških molekul ter matematičnih modelih za opis interakcij.* *<u>Seminarske naloge</u> na osnovi vrhunskih aktualnih člankov s področja obravnavane tematike.*	Tight interactions. Environmental effects on molecular interactions. Computational methods for the analysis and prediction of molecular interactions. Computational design of novel regulators of biological molecules. Structure-activity relationship of designed biologically active substances. *The course is designed to emphasize the structure-function relationship involved in biological interactions as well as the mathematical models used to describe these interactions.* *<u>Seminar work</u> based on state-of-the-art scientific papers with content related to this course.*

Temeljna literatura in viri / Readings:

- Fundamentals of Enzyme Kinetics. Cornish-Bowden, A. Fourth Edition. 2012. Wiley-Blackwell. 516 strani (60 %)

<u>Dopolnilna literatura:</u>

- Enzyme Kinetics: Behavior and Analysis of Rapid Equilibrium and Steady-State Enzyme Systems Segel, I.H. 1975. John Wiley & Sons, Inc, 957 strani

Cilji in kompetence:	**Objectives and Competences:**
Predmet obravnava medmolekulske interakcije in encimsko katalizirane kemijske reakcije z vidika povezave med strukturo in funkcijo bioloških molekul ter interpretacije mehanizmov interakcij. Študenti bodo sposobni samostojno preučevati interakcije med molekulami, encimsko katalizirane reakcije in njihovo regulacijo ter rezultate ustrezno interpretirati.	The course focuses on intermolecular interactions and enzyme-catalyzed chemical reactions from the perspective of the relationship between structure and function of biological molecules, and the interpretation of the mechanisms of interaction. Students will gain the competence to independently study intermolecular interactions, enzyme-catalyzed reactions and their regulation, and interpretation.

Predvideni študijski rezultati:	**Intended Learning Outcomes:**
<u>Znanje in razumevanje</u> Študenti pridobijo znanje o interpretaciji mehanizmov interakcij med molekulami in encimsko kataliziranih reakcij ter njihove	<u>Knowledge and Comprehension</u> Students learn to interpret the mechanisms of intermolecular interactions and enzyme-catalyzed reactions. They integration this

regulacije. Pridobljeno znanje poveže s predhodnim znanjem o strukturi in funkciji proteinov in drugih bioloških molekul.	knowledge with prior knowledge of the structure and function of proteins and other biological molecules.
Uporaba Sposobnost določanja mehanizmov medmolekulskih interakcij ter delovanja in regulacije encimov je ključnega pomena pri študijah bioloških sistemov na molekulskem nivoju. Obenem je ključnega pomena pri dizajnu farmakoloških učinkovin, ki delujejo preko modifikacije aktivnosti različnih encimov ali drugih proteinov.	Application The ability to determine mechanisms of intermolecular interactions and the kinetics of enzyme catalysis and its regulation is a prerequisite for studying biological systems at the molecular level. It is also key to successful design of pharmacologically active substances that act by modifying the activity of enzymes and other proteins.
Refleksija Študenti povežejo predhodno znanje z novim znanjem.	Analysis Students reflect on prior knowledge and integrate it with new knowledge.
Prenosljive spretnosti Sposobnost načrtovanja eksperimentov in interpretacije rezultatov, sposobnost uporabe literature in drugih virov, sposobnost ustnega in pisnega poročanja.	Skill-transference Ability Ability to plan experiments and interpret the results, ability to use literature and other sources, ability of written and oral reporting.

Metode poučevanja in učenja:	**Learning and Teaching Methods:**
Predavanja, raziskovalni seminarji, laboratorijske vaje.	Lectures, seminars based on scientific research papers, laboratory tutorial.

Načini ocenjevanja:	Delež (v %) / Weight (in %)	**Assessment:**
Kolokvij iz laboratorijskih vaj Seminarska naloga Pisni izpit		Laboratory tutorial colloquium Seminar work Written examination

Reference nosilca / Lecturer's references:

- **NOVINEC, Marko**, KORENČ, Matevž, CAFLISCH, Amedeo, RANGANATHAN, Rama, LENARČIČ, Brigita, BAICI, Antonio. A novel allosteric mechanism in the cysteine peptidase cathepsin K discovered by computational methods. Nature communications, ISSN 2041-1723, feb. 2014, vol. 5, art. no. 3287
- **NOVINEC, Marko**, KOVAČIČ, Lidija, LENARČIČ, Brigita, BAICI, Antonio. Conformational flexibility and allosteric regulation of cathepsin K. Biochemical journal, ISSN 0264-6021, 2010, vol. 429, no. 2, p. 379-389
- **NOVINEC, Marko**, GRASS, Robert N., STARK, Wendelin J., TURK, Vito, BAICI, Antonio, LENARČIČ, Brigita. Interaction between human cathepsins K, L, and S, Mechanism of elastinolysis and ihibition by macromolecular inhibitors. The Journal of biological chemistry, ISSN 0021-9258, 2007, vol. 282, no. 11, str. 7893-78902

UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	IZBRANA POGLAVJA IZ BIOMEDICINSKE KEMIJE
Course Title:	SELECTED TOPICS FROM BIOMEDICAL CHEMISTRY

Študijski program in stopnja Study Programme and Level	Študijska smer Study Field	Letnik Academic Year	Semester Semester
MAG Biokemija, 2. stopnja	**/**	**2.**	**3.**
USP Biochemistry, 2nd Cycle	**/**	**2nd**	**3rd**

Vrsta predmeta / Course Type: izbirni strokovni / Elective Professional

Univerzitetna koda predmeta / University Course Code: BI2I07

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje Work	Druge oblike študija	Samost. delo Individual Work	ECTS
30	**15**	**30 LV**	**/**	**/**	**75**	**5**

Nosilec predmeta / Lecturer: prof. ddr. Boris Turk / Ddr. Boris Turk, Full Professor

Jeziki / Languages:

Predavanja / Lectures:	**slovenski / Slovenian**
Vaje / Tutorial:	**slovenski / Slovenian**

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	Prerequisites:
Študent oz. kandidat mora imeti predmet opredeljen kot študijsko obveznost.	The course has to be assigned to the student.

Vsebina:	Content (Syllabus outline):
Molekularne osnove bolezni. Osnove razvoja zdravil. Metode identifikacije in validacije tarč. Uporaba živalskih modelov kot osnova za humane bolezni. Metode z visoko zmogljivostjo (HTS metode). Biomarkerji. Izbor, optimizacija in selekcija novih potencialnih zdravil. Proteini kot tarče za zdravila. Encimi (proteaze, kinaze. ostali encimi). G-proteini in receptorji. Ionski kanali. Apoptotoza kot možnost za terapevtsko intervencijo. Strategije zdravljenje raka. Strategije zdravljenja nevrodegenerativnih obolenj. Kardiovaskularna obolenja. Metabolne bolezni (diabetes, …). Infektivne bolezni. Priprava seminarjev in projektov.	Molecular basis of disease. Basics of drug development. Target identification and validation methods. Use of animal models of disease as a basis for human disease. High-throughput methods. Biomarkers. Selection and optimization of potential new drugs. Proteins as targets for drugs. Enzymes (proteases, kinases, other enzymes). G-proteins and receptors. Ion channels. Apoptosis as a potential for therapeutic intervention. Strategies for anticancer therapy. Strategies for neurodegeneration therapies. Cardiovascular diseases. Metabolic diseases (diabetes, …). Infectious diseases. Preparation of seminars and projects.

Temeljna literatura in viri / Readings:

- Tekoče revije: Nature Reviews Drug Discovery, Current Pharmaceutical Design, ... /
- Current journals: Nature Reviews Drug Discovery, Current Pharmaceutical Design, etc.

Cilji in kompetence:	**Objectives and Competences:**
Cilj predmeta je nadgradnja dosedanjega znanja iz temeljnih predmetov in poglobitev na področju biomedicine. Študenti bodo spoznali osnove sodobnega razvoja zdravil in se na nekaterih primerih bolj podrobno spoznali s strategijami njihovega razvoja. Študenti bodo sposobni napisati predlog projekta in ga tudi kritično ovrednotiti.	Ability to understand the theoretical background of strategies of modern drug discovery. Upgrade of the knowledge from compulsory courses. Ability to link theoretical knowledge with possible transfer of the knowledge in praxis (project preparation) in the field of development of drugs and biofarmaceuticals.

Predvideni študijski rezultati:	**Intended Learning Outcomes:**
<u>Znanje in razumevanje</u> Študent pri predmetu pridobi osnove o sodobni biomedicinski znanosti in njeni vlogi pri načinu in postopkih sodobnega razvoja zdravil. Skozi praktične primere iz literature spoznava pomembnost razumevanja delovanja bioloških sistemov in poznavanja tehnologij.	<u>Knowledge and Comprehension</u> Through the course student acquires basic knowledge about modern biomedical research ant its role in the modern drug discovery and development. Through practical examples from literature student learns the importance of comprehension of biological system functioning and knowledge about technologies.
<u>Uporaba</u> Pri študiju tega predmeta gre za povezovanje med pridobljenim znanjem (teoretičnim) in možnimi načini prenosa tega znanja v prakso (poskus priprave projekta) pri razvoju zdravil in biofarmacevtikov.	<u>Application</u> This course links the theoretical knowledge acquired with possible ways of transferring it into praxis for the development of drugs and biopharmaceuticals (an attempt to write a project).
<u>Refleksija</u> Pri predmetu gre predvsem za refleksijo lastnega razumevanja predmeta ter poskus kritičnega ovrednotenja uporabnosti modernih tehnoloških metod in aplikacij na področju razvoja zdravil.	<u>Analysis</u> One of the goals of this course is to contribute to an analysis of understanding the course and an attempt to critically evaluate the usefulness of modern technological approaches and their applications in the field of drug discovery and development.
<u>Prenosljive spretnosti</u> Študent pridobi spretnosti uporabe domače in tuje literature in drugih virov, zbiranja in interpretiranja podatkov, uporabe različnih didaktičnih pripomočkov, kritične analize dela kolegov, pisanja tekstov in projektov ter poročanja o njih.	<u>Skill-transference Ability</u> Student acquires the ability to use domestic and foreign literature and other sources, to manage data collection and interpretation, to use different didactic accessories, to critically analyse the work of colleagues, to write texts and projects and to report about them.

Metode poučevanja in učenja:	**Learning and Teaching Methods:**
Predavanja, seminarji, laboratorijske vaje	Lectures, seminars, laboratory practical course

Načini ocenjevanja:	Delež (v %) / Weight (in %)	Assessment:
Opravljene vaje so pogoj za pristop k izpitu. Seminarska naloga Ustni izpit		Completed laboratory course is prerequisite for the exam. Seminar work Oral examination

Reference nosilca / Lecturer's references:

- **TURK, Boris**. Targeting proteases : successes, failures and future prospects. Nature reviews drug discovery, 2006, vol. 5, str. 785-799. JCR IF 20.97
- MIKHAYLOV, Georgy, MIKAC, Urška, MAGAEVA, Anna A., ITIN, Volia Isaevich, NAIDEN, Evgeniy P., PSAKHYE, Ivan Sergeevich, BABES, Liane, REINHECKEL, Thomas, PETERS, Christoph, ZEISER, Robert, BOGYO, Matthew, TURK, Vito, PSAHKYE, Sergej G., **TURK, Boris***, VASILJEVA, Olga*. Ferri-liposomes as an MRI-visible drug-delivery system for targeting tumours and their microenvironment. Nature nanotechnology, 2011, vol. 6, no. 9, str. 594-602, doi: 10.1038/nnano.2011.112. JCR IF 27.27
- **TURK, Boris**, TURK, Dušan, TURK, Vito. Protease signalling : the cutting edge. EMBO journal, 2012, vol. 31, no. 7, str. 1630-1643, doi: 10.1038/emboj.2012.42. JCR IF 9.82

UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	MAGISTRSKO DELO
Course Title:	MASTER'S THESIS

Študijski program in stopnja Study Programme and Level	Študijska smer Study Field	Letnik Academic Year	Semester Semester
MAG Biokemija, 2. stopnja	**/**	**2.**	**3. in 4.**
USP Biochemistry, 2nd Cycle	**/**	**2nd**	**3rd and 4th**

Vrsta predmeta / Course Type: obvezni / Mandatory

Univerzitetna koda predmeta / University Course Code: BI223

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje Work	Druge oblike študija	Samost. delo Individual Work	ECTS
/	**/**	**/**	**/**	**750**	**750**	**50**

Nosilec predmeta / Lecturer: /

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

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	Prerequisites:
Študent oz. kandidat mora imeti predmet opredeljen kot študijsko obveznost.	The course has to be assigned to the student.

Vsebina:	Content (Syllabus outline):
Magistrsko delo mora biti s področja biokemije. Vsebino in naslov soglasno določita študent in izbrani mentor. Študent bo opravil raziskovalno nalogo pod vodstvom mentorja in se usposobil za samostojno poglabljanja znanja, iskanje informacij, načrtovanje in izvajanje raziskovalnega dela, predstavljanje dela v pisni in ustni obliki in zagovarjanje dela pred strokovno komisijo. Študent bo v času opravljanja magistrskega dela delovni mentor najmanj enemu študentu, ki bo opravljal diplomsko delo na univerzitetnem programu 1. stopnje Biokemija, in tako dobil izkušnje pri uvajanju sodelavcev v laboratorijsko delo in pri delu v skupini.	The research work for Master thesis is carried out in the field of biochemistry; the contents and the title are determined in agreement with the mentor. Mentors lead the students through the process of research to become autonomous in learning, searching information, planning and executing research as well as presenting the work in written and oral form, including defences in front of a commission. During the course students also act as working mentors to at least one undergraduate (1st cycle) Biochemistry student. In this way students acquire skills for leadership and team work and introduce other people to laboratory practice.

Temeljna literatura in viri / Readings:

- Knjige in članki, ki so povezani z vsebino magistrskega dela. /
- Books and journal articles relevant to the topic of research.

Cilji in kompetence:

- Sposobnost samostojnega spremljanja strokovne literature, sposobnost povezovanja svojega znanja in soočanja s kompleksnostjo, oblikovanja ocene na podlagi nepopolnih ali omejenih informacij, ki zajema tudi razmislek o etični odgovornosti.
- Sposobnost uporabe razumevanj meja zanesljivosti eksperimentalnih podatkov pri načrtovanju nadaljnjega dela.
- Sposobnost izvedbe raziskovalnega projekta, katerega rezultat je potencialno primeren za objavo ter objektivne uporabe, ocene in predstavitve rezultatov raziskav.
- Sposobnost jasnega in nedvoumnega posredovanja sklepov, znanja in argumentov strokovni in laični publiki.
- Sposobnost prilagajanja novim situacijam in sprejemanja odločitev.
- Sposobnost uvajanja sodelavcev v laboratorijsko delo ter sposobnost vodenja laboratorijskega dela.

Sposobnost neodvisnega in samostojnega nadaljnjega izobraževanja.

Objectives and Competences:

- Ability for independent following current professional literature, for using previous knowledge and cope with the complexity of problems, and assess the situation based on incomplete or limited information, including ethical responsibility.
- Ability to understand the limits of reliability of experimental data in planning further work.
- Ability to carry out a research project and present the results in scientific report format and to objectively assess the results of research projects and present the results.
- Ability to communicate scientific arguments clearly to professional and a lay audience.
- Ability to adapt to new situations and change decisions.
- Ability to introduce others to laboratory work as well as to guide laboratory work (of junior students).

Ability to carry on with independent and autonomous education.

Predvideni študijski rezultati:

<u>Znanje in razumevanje</u> Študent bo poglobil znanje na področju teme magistrskega dela.
<u>Uporaba</u> Znanje in pridobljene veščine bo študent lahko uporabil pri opravljanju poklica.
<u>Refleksija</u> Povezovanje vseh pridobljenih teoretičnih znanj z reševanjem problemov na področju biokemije ter kritični pogled na uporabnost teh znanj.

Intended Learning Outcomes:

<u>Knowledge and Comprehension</u> Students will deepen their knowledge in the field of the chosen master thesis.
<u>Application</u> Knowledge and skills will be useful for student's professional career.
<u>Analysis</u> Interconnection of all the previous theoretical knowledge with problem solving in the field of biochemistry, as well as a critical view of the applications.

Prenosljive spretnosti	Skill-transference Ability
Pri delu bo študent pridobil znanja o metodah reševanja kompleksnih problemov, o načinu prezentacije teh znanj v pisani in govorjeni obliki povezani z ostalimi metodami posredovanja raziskav, ugotovitev itd.	In the course of the work students will gain methodological knowledge of solving complex problems, presenting knowledge in both written and oral form, linking to other methods of communicating research, findings etc.

Metode poučevanja in učenja:	**Learning and Teaching Methods:**
Individualno delo mentorja in samostojno študijsko in raziskovalno delo.	Mentor's individual work and (student's) independent study and research.

Načini ocenjevanja:	Delež (v %) / Weight (in %)	**Assessment:**
Ocenjuje se magistrsko delo (50 %) in zagovor magistrskega dela (50 %) Komisijo sestavljajo predsednik, mentor in član. Lestvica ocen vsakega dela je od 5 do 10. Ocena 5 je negativna, ocene 6 do 10 pa pozitivne in sicer: 6--zadostno, 7--dobro, 8 in 9--prav dobro, 10--odlično		Master's thesis and its presentation are graded by a three-member commission (chairman, mentor, additional member) against the grading scale from 5- 10 (grades from 6 to 10 are positive and 5 negative (6 - pass, 7 - fair, 8 and 9 - very good, 10 - excellent).

Reference nosilca / Lecturer's references:

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UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	METODE DOLOČANJA 3D STRUKTURE MAKROMOLEKUL
Course Title:	METHODS FOR DETERMINING 3D MACROMOLECULAR STRUCTURE

Študijski program in stopnja Study Programme and Level	Študijska smer Study Field	Letnik Academic Year	Semester Semester
MAG Biokemija, 2. stopnja	**/**	**1.**	**1.**
USP Biochemistry, 2nd Cycle	**/**	**1st**	**1st**

Vrsta predmeta / Course Type: obvezni / Mandatory

Univerzitetna koda predmeta / University Course Code: BI212

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje Work	Druge oblike študija	Samost. delo Individual Work	ECTS
60	**/**	**15 LV**	**/**	**/**	**75**	**5**

Nosilec predmeta / Lecturer: prof. dr. Kristina Djinović Carugo / Dr. Kristina Djinović Carugo, Full Professor
prof. dr. Janez Plavec / Prof. dr. Janez Plavec, Full Professor

Jeziki / Languages:

Predavanja / Lectures:	**slovenski / Slovenian**
Vaje / Tutorial:	**slovenski / Slovenian**

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:

Študent oz. kandidat mora imeti predmet opredeljen kot študijsko obveznost.

Prerequisites:

The course has to be assigned to the student.

Vsebina:

Makromolekularna kristalografija
Viri roentgenskih žarkov, tehnike kristalizacije, simetrija (točkovne in prostorske skupine)
Sipanje roentgenskih žarkov na materiji, atomski sipni faktor, strukturni faktor, elektronska gostota.
Metode reševanja faznega problema: molekularna izmenjava, uporaba derivatov težkih atomov (MIR, MAD).
Graditev in piljenje molekularnega modela.
Strukturna analiza in validacija.
Single pixel detektorji in kot izvor rentgenskih žarkov metal-jet.

Content (Syllabus outline):

Macromolecular Crystallography
Sources of X-rays, crystallisation techniques, symmetry (point groups, space groups), unit cell, Bravais lattice, scattering of X-rays, atomic form factor, structure factor, electron density.
Methods for solution of phase problem: molecular replacement, multiple isomorphous replacement, multiwavelenght anomalous dispersion, density modification techniques.
Building of molecular model into electron density, refinement and structural analysis.
Single pixel detector and metal-jets as X-rays sources.

Nuklearna magnetna resonanca	Nuclear Magnetic Resonance
Osnove NMR - teoretične osnove: opis razvoja magnetizacije, produkt operatorji, elementi pulznih zaporedij NMR spektrometer: osnovni sestavni deli in delovanje Procesiranje in intepretacija NMR spektrov Dvodimenzionalni NMR eksperimenti Homo- in heteronuklearni trodimenzionalni NMR eksperimenti Strategija asignacije spektrov proteinov in nukleinskih kislin Analiza sekundarne strukture Računanje 3D strukture iz NMR podatkov	Basics of NMR – theoretical background: description of magnetisation, product operators, elements of pulse sequences NMR spectrometer: basic building units and their operation Processing and interpretation of NMR spectra Two-dimensional NMR experiments Homo and heteronuclear three-dimensional NMR experiments Strategy of spectra assignment of proteins and nucleic acids Analysis of secondary structure Calculation of 3D structure from NMR data

Temeljna literatura in viri / Readings:

- David Blow, Outline of Crystallography for Biologists, Oxford University Press, 2002.
- Crystallography Made Crystal Clear, Gale Rhodes, Academic Press; 3 edition 2006.
- Bernhard Rupp, Biomolecular Crystallography: Principles, Practice, and Application to Structural Biology,GS, 2009
- N.E.Jacobsen, NMR Spectroscopy Explained, Wiley-Interscience, 2007 (ca. 25% out of 650 pages)

Cilji in kompetence:	Objectives and Competences:
V okviru predmeta bo študent seznanjen z makromolekularno kristalografijo in nuklearno magnetno resonanco, dvema osnovnima metodama določevanja struktur makromolekul in njihovih kompleksov. Študent bo znal oceniti uporabnost in komplementarnost obeh metod ter analizirati strukture določene s tema metodama.	In the framework of this course a student will be introduced into macromolecular crystallography and nuclear magnetic resonance, two basic methods for structure determination of macromolecules and their complexes. Student will be able to evaluate efficacy and complementarity of both methods and analyse structures determined by these two methods.

Predvideni študijski rezultati:	Intended Learning Outcomes:
<u>Znanje in razumevanje</u> Študent se seznami z osnovnima tehnikama za določanje 3D strukture bioloških makromolekul z atomsko ločljivostjo. **Makromolekularna kristalografija** Študent pri predmetu pridobi razumevanje o osnovah rentgenske difrakcije za biološke makromolekule. Spozna pojem sipanja elektromagnetnega valovanja na kristalu in se seznani s problemom faznega problema ter eksperimentalnimi metodami rešitve tega problema.	<u>Knowledge and Comprehension</u> A student will be introduced to basic methods of structure determination of biological macromolecules with atomic resolution. **Macromolecular crystallography** A student will become acquainted with principles of macromolecular crystallography. A student will learn about principles of scattering of electromagnetic radiation on crystals, will be introduced to the phase problem and methods for its solution.

NMR Študent pridobi razumevanje osnov jedrske magnetne resonance in spozna uporabo večdimenzionalnih NMR metod pri študiju strukture in dinamike bioloških makromolekul. Študent se bo v praktičnem delu naučil izbrati ključne parametre v modernih NMR eksperimentih in analizirati zbrane podatke.	**NMR** A student will comprehend basics of nuclear magnetic resonance and will be introduced into the use of multidimensional NMR methods in studies of structure and dynamics of biological macromolecules. During practical courses choice of critical parameters in modern NMR experiments and analysis of acquired data will be presented.
Uporaba Študij tega predmeta je podlaga za razumevanje molekularno in strukturno usmerjenih raziskovalnih pristopov in metod, ki jih bo uporabljal na različnih strokovnih področjih.	Application Material of this course represents the basis for understanding molecular and structurally oriented research approaches and methods which can be utilized in various fields.
Refleksija Študent pridobi znanja, ki omogočajo z molekularno strukturo podprt pogled, razumevanje in razlago bioloških vprašanj na molekularni osnovi.	Analysis A student obtains knowledge which enables insight and understanding of biologically relevant challenges through a view based on molecular structure.
Prenosljive spretnosti Timsko delo (pri vajah). Uporaba tuje literature. Podajanje poročil o opravljenem delu (pismeno) in prebrani literaturi ustno.	Skill-transference Ability Team work (during lab work). Use of foreign literature. Reporting about performed work (in written) and on literature (orally).

Metode poučevanja in učenja:	**Learning and Teaching Methods:**
Predavanja. Laboratorijske vaje. Ekskurzija: ogled sinhrotrona Elettra v Trstu.	Lectures. Laboratory exercises. Excursion: visit to synchrotron Elettra in Trieste.

Načini ocenjevanja:	Delež (v %) / Weight (in %)	**Assessment:**
Opravljene vaje so pogoj za pristop k izpitu. Pisni in ustni izpit.		Completed laboratory exercises are requested for taking an exam. Written and oral exam

Reference nosilca / Lecturer's references:

- M. Marušič, R. N. Veedu, J. Wengel**, J. Plavec**, G-rich VEGF aptamer with locked and unlocked nucleic acid modifications exhibits a unique G-quadruplex fold, Nucleic Acids Res. 2013, 41(29), 9524-9536.
- M. Trajkovski, M. Webba da Silva, **J. Plavec**, Unique Structural Features of Interconverting Monomeric and Dimeric G-Quadruplexes Adopted by a Sequence from the Intron of the N-myc Gene, J. Am. Chem. Soc. 2012, 134 (9), 4132–4141.
- M. Marušič, P. Šket, L. Bauer, V. Viglasky, **J. Plavec**, Solution-state structure of an intramolecular G-quadruplex with propeller, diagonal and edgewise loops, Nucleic Acids Res. 2012, 40 (14), 6946-6956.
- I. Biljan, G. Ilc, G. Giachin, **J. Plavec**, G. Legname, Structural Rearrangements at Physiological pH:

NMR insights from the V210I Human Prion Protein Mutant, Biochemistry 2012, 51 (38), 7465-7474.
- Carugo, O., and **Djinovic Carugo, K**. (2013) Half a century of Ramachandran plots. Acta Crystallogr. D Biol. Crystallogr. 69, 1333-1341.
- de Almeida Ribeiro, E., Jr., Beich-Frandsen, M., Konarev, P. V., Shang, W., Vecerek, B., Kontaxis, G., Hammerle, H., Peterlik, H., Svergun, D. I., Blasi, U., and **Djinović-Carugo, K**. (2012) Structural flexibility of RNA as molecular basis for Hfq chaperone function. Nucleic Acids Res. 40, 8072-8084.
- Macedo, S., Pechlaner, M., Schmid, W., Weik, M., Sato, K., Dennison, C., and **Djinović-Carugo, K.** (2009) Can soaked-in scavengers protect metalloprotein active sites from reduction during data collection? J. Synchrotron. Radiat. 16, 191-204.

UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	MODERNI IN KOMPLEMENTARNI PRISTOPI V STRUKTURNI BIOLOGIJI
Course Title:	MODERN AND COMPLEMENTARY APPROACHES IN STRUCTURAL BIOLOGY

Študijski program in stopnja Study Programme and Level	Študijska smer Study Field	Letnik Academic Year	Semester Semester
MAG Biokemija, 2. stopnja	**/**	**2.**	**4.**
USP Biochemistry, 2nd Cycle	**/**	**2nd**	**4th**

Vrsta predmeta / Course Type: izbirni strokovni / Elective Professional

Univerzitetna koda predmeta / University Course Code: BI2I08

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje Work	Druge oblike študija	Samost. delo Individual Work	ECTS
40	**10**	**25 LV**	**/**	**/**	**75**	**5**

Nosilec predmeta / Lecturer: prof. dr. Janez Plavec / Prof. dr. Janez Plavec, Full Professor
prof. dr. Kristina Djinović Carugo /
Dr. Kristina Djinović Carugo, Full Professor

Jeziki / Languages:

Predavanja / Lectures:	**slovenski / Slovenian**
Vaje / Tutorial:	**slovenski / Slovenian**

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:

Študent oz. kandidat mora imeti predmet opredeljen kot študijsko obveznost.
Predmet zahteva opravljene obveznosti iz predmeta Metod določanja 3D strukture makromolekul.

Prerequisites:

The course has to be assigned to the student.
Course requires knowledge of course Methods for determining 3D macromolecular structure.

Vsebina:

- Uporaba mehkih roentgenskih žarkov v makromolekularni kristalografiji
- Škoda zaradi roentgenskega žarčenja v makromolekularni kristalografiji (radiation damage)
- Časovno razločeni eksperimenti v makromolekularni kristalografiji
- NMR spektri višjih dimenzij v povezavi z avtomatsko asignacijo
- Moderni pristopi v NMR (asignacija preko

Content (Syllabus outline):

- Use of soft X-ray in macromolecular crystallography
- X-ray induced radiation damage in macromolecular crystallography
- Time resolved experiments in macromolecular crystallography
- Higher dimensionality NMR spectra connected with automatic assignment
- Modern approaches to NMR (assignment through heteroatoms, protoneless NMR)

heteroatomov, ang. protoneless NMR) • Dinamične lastnosti makromolekul (naravno nestrukturirani proteini) • Relaksacijska disperzija • NMR v trdnem agregatnem stanju • Elektronska mikroskopija (s poudarkom na single particle reconstruction) • Nevtronska difrakcija za makromolekule • Small angle X-ray scattering (SAXS) za makromolekule v raztopini • Masna spektroskopija za strukturno biologijo • Karakterizacija interakcij s biofizikalnimi metodami (izotermna kalorimetrija, površinske plazmonske resonance, microscale thermophoresis)	• Dynamic properties of macromolecules (intrinsically unstructured proteins) • Relaxation dispersion • NMR in the solid state • Electron microscopy (with emphasis on single particle reconstruction) • Neutron diffraction for macromolecules • Small angle X-ray scattering (SAXS) for macromolecules in solution • Mass spectroscopy for structural biology Characterization of interactions with biophysical methods (Isothermal titration calorimetry, surface plasmon resonance, microscale thermophoresis)

Temeljna literatura in viri / Readings:

- David Blow, Outline of Crystallography for Biologists, Oxford University Press, 2002.
- Crystallography Made Crystal Clear, Gale Rhodes, Academic Press; 3 edition 2006.
- Bernhard Rupp, Biomolecular Crystallography: Principles, Practice, and Application to Structural Biology,GS, 2009
- J. Cavanagh, W. J. Fairbrother, A. G. Palmer, III, M. Rance, N. J. Skelton, Protein NMR Spectroscopy, Second Edition: Principles and Practice, Elsevier, 2007 (ca. 20% out of 900 pages)
- I. Bertini, K. S. McGreevy, G. Parigi (Eds.), NMR of Biomolecules, Wiley, 2012

Cilji in kompetence:	**Objectives and Competences:**
Predmet je zamišljen kot nadgradnja predmeta Metode določevanja 3D struktur makromolekul. Slušatelj bo seznanjen z modernimi in komplementarnimi metodami, katerih uporaba upodablja integriran, multidisciplinarni pristop k strukturni biologiji. Slušatelj bo znal oceniti primernost in potencial posamezne metode/tehnike za tvorbo in analizo določene strukturne informacije kakor tudi dinamičnih aspektov bioloških makromolekul.	This course is designed as an upgrade of course Methods for determining 3D macromolecular structure. Students will be acquainted with modern and complementary methods, whose use enables integrated, multidisciplinary approach to structural biology. Students will be able to assess the suitability and potential of the individual methods / techniques for the formation and analysis of certain structural information as well as the dynamic aspects of biological macromolecules.

Predvideni študijski rezultati:	**Intended Learning Outcomes:**
<u>Znanje in razumevanje</u> Študent se seznani s številnimi metodami, ki dajejo strukturno informacijo o bioloških makromolekulah na različnih nivojih ločljivosti in dajejo statično oziroma dinamično podobo tridimenzionalne strukture makromolekule.	<u>Knowledge and Comprehension</u> The student gets acquainted with a number of methods which provide structural information on biological macromolecules at different levels of resolution and provide a static or dynamic image of three-dimensional structure of the

Študent je seznanjen s prednostmi in omejitvami posamezne metode in predvsem z njeno komplementarnostjo k drugim strukturnim tehnikam, ki se uparabljajo pri strukturni in funkcionalni analizi makromolekul.	macromolecules. The student is familiarized with the advantages and limitations of individual method and in particular with its complementarity to other structural techniques in structural and functional analysis of macromolecules.
Uporaba Predmet je podlaga za razumevanje molekularno in strukturno usmerjenih raziskovalnih pristopov in metod, ki jih bo študent uporabljal na različnih strokovnih področjih.	Application The course is the basis for understanding molecular and structure-oriented research approaches and methods that student will use in various professional areas.
Refleksija Študent pridobi vpogled v serijo komplementarnih strukturnih metod in razvije občutek za integriran strukturno biološki pristop in razumevanje ter razlago bioloških vprašanj.	Analysis The student gains insight into a series of complementary structural methods and develops sense of an integrated structural biological approach, understanding and interpretation of biological challenges.
Prenosljive spretnosti Timsko delo (pri vajah). Uporaba tuje literature. Podajanje poročil o opravljenem delu in prebrani literaturi (pismeno in ustno).	Skill-transference Ability Teamwork (at exercises). The use of foreign literature. Submission of written reports on lab results and literature survey (written and oral).

Metode poučevanja in učenja:	**Learning and Teaching Methods:**
Predavanja. Laboratorijske vaje. Seminar iz literature.	Lectures. Laboratory work. Literature seminar.

Načini ocenjevanja:	Delež (v %) / Weight (in %)	**Assessment:**
Kolokvij iz laboratorijskih vaj Seminarska naloga. Pisni in ustni izpit (ocena > 6)		Examination of laboratory exercises Seminar Written and oral exam (mark >6)

Reference nosilca / Lecturer's references:

- Carugo, O., and **Djinovic Carugo, K**. (2013) Half a century of Ramachandran plots. Acta Crystallogr D Biol Crystallogr 69, 1333-1341
- de Almeida Ribeiro, E., Jr., Beich-Frandsen, M., Konarev, P. V., Shang, W., Vecerek, B., Kontaxis, G., Hammerle, H., Peterlik, H., Svergun, D. I., Blasi, U., and **Djinović-Carugo, K.** (2012) Structural flexibility of RNA as molecular basis for Hfq chaperone function. Nucleic Acids Res 40, 8072-8084
- Galkin, V. E., Orlova, A., Salmazo, A., **Djinović-Carugo, K.**, and Egelman, E. H. (2010) Opening of tandem calponin homology domains regulates their affinity for F-actin. Nat Struct Mol Biol 17, 614-616.
- M. Marušič, R. N. Veedu, J. Wengel**, J. Plavec**, G-rich VEGF aptamer with locked and unlocked nucleic acid modifications exhibits a unique G-quadruplex fold, Nucleic Acids Res. 2013, 41(29), 9524-9536.
- M. Trajkovski, M. Webba da Silva, **J. Plavec**, Unique Structural Features of Interconverting

Monomeric and Dimeric G-Quadruplexes Adopted by a Sequence from the Intron of the N-myc Gene, J. Am. Chem. Soc. 2012, 134 (9), 4132–4141.
- I. Biljan, G. Ilc, G. Giachin, **J. Plavec**, G. Legname, Structural Rearrangements at Physiological pH: NMR insights from the V210I Human Prion Protein Mutant, Biochemistry 2012, 51 (38), 7465-7474.

UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	MOLEKULARNA BIOTEHNOLOGIJA
Course Title:	MOLECULAR BIOTECHNOLOGY

Študijski program in stopnja Study Programme and Level	Študijska smer Study Field	Letnik Academic Year	Semester Semester
MAG Biokemija, 2. stopnja	**/**	**1.**	**2.**
USP Biochemistry, 2nd Cycle	**/**	**1st**	**2nd**

Vrsta predmeta / Course Type: izbirni strokovni / Elective Professional

Univerzitetna koda predmeta / University Course Code: BI2I18

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje Work	Druge oblike študija	Samost. delo Individual Work	ECTS
30	**30**	**15 LV**	**/**	**/**	**75**	**5**

Nosilec predmeta / Lecturer: prof. dr. Marko Dolinar / Dr. Marko Dolinar, Full Professor

Jeziki / Languages:

Predavanja / Lectures:	**slovenski / Slovenian**
Vaje / Tutorial:	**slovenski / Slovenian**

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	Prerequisites:
Študent oz. kandidat mora imeti predmet opredeljen kot študijsko obveznost.	The course has to be assigned to the student.

Vsebina:

Predavanja:

1. Uvod. Biotehnologija in molekularna biotehnologija.
2. Molekularna biotehnologija in okolje: mikrobni biosenzorji, bioremediacija/fitoremediacija.
3. Molekularna biotehnologija in hrana: določanje GS sestavin in določanje sestave živil z analizo DNA.
4. Molekularna biotehnologija za pripravo terapevtikov: interferoni, rastni hormon, dejavnik tumorske nekroze, inzulin, interlevkini,…

Content (Syllabus outline):

Lectures:

1. Introduction. Biotechnology and molecular biotechnology.
2. Molecular biotechnology and environment: microbial biosensors, bioremediation/phytoremediation.
3. Molecular biotechnology and food: determining genetically modified ingredients and composition based on DNA analysis.
4. Molecular biotechnology for preparation of therapeutics: interferons, growth hormone, tumour necrosis factor, insulin, interleukins…

5. Molekularna biotehnologija za pripravo encimov (nukleaze, lipaze).
6. Molekularna biotehnologija za pripravo diagnostičnih in terapevtskih protiteles.
7. Molekularna biotehnologija za pripravo cepiv: herpes, papilomavirus, kolera; DNA-cepiva (karies), vektorska cepiva, bakterije kot dostavni sistemi za antigene.
8. Molekularna biotehnologija za sintezo tržno zanimivih produktov: male biološke molekule, antibiotiki, biopolimeri.
9. Molekularna biotehnologija in uporaba biomase: proizvodnja fruktoze, alkoholov, mikrobna pretvorba celuloze in lignina.
10. Molekularna biotehnologija: metabolično inženirstvo.
11. Molekularna biotehnologija in novi viri energije.
12. Molekularna biotehnologija in gensko spremenjene rastline in živali.
13. Družbeni vidiki sodobne biotehnologije: varnost, okoljska tveganja, ekonomski vidiki in družbena sprejemljivost.
14. Rekombinantne bakterije v agronomiji.

Seminarji:

Primeri razvoja novih sistemov za proizvodnjo reagentov, terapevtikov, uporaba v zdravstvu, alternativni viri energije ipd. iz tekoče znanstvene periodike.

Laboratorijske vaje:

1. Določanje vrstne sestave mešanega mesa
2. Določanje vsebnosti GS rastlin v živilu
3. Načini transformacije cianobakterij

5. Molecular biotechnology for enzyme production (nucleases, lipases).
6. Molecular biotechnology for preparation of diagnostic and therapeutic antibodies.
7. Molecular biotechnology for preparation of vaccines: herpes, papilomavirus, cholera; DNA vaccines (caries), vector vaccines, bacteria as antigen delivery systems.
8. Molecular biotechnology for synthesis of commercial products: small biological molecules, antibiotics, biopolymers.
9. Molecular biotechnology and biomass utilization: production of fructose, alcohols, microbial conversion of cellulose and lignin.
10. Molecular biotechnology: metabolic engineering.
11. Molecular biotechnology and new energy sources.
12. Molecular biotechnology and genetically engineered plants and animals.
13. Open public issues of modern biotechnology: safety, environmental risks, economical issues and public acceptance.
14. Recombinant bacteria in agriculture.

Seminars:

Examples of novel systems for production of reagents, therapeutics, medical uses, alternative energy sources etc. from current scientific literature.

Laboratory work:

1. Determination of species composition in mixed meet samples
2. Determination of presence of genetically modified plants in food samples
3. Techniques for transformation of cyanobacteria

Temeljna literatura in viri / Readings:

- B.R. Glick, J.J. Pasternak in C.L. Patten: Molecular Biotechnology: Principles and applications of recombinant DNA. 4. izdaja. Washington: ASM Press, 2009 (40 %, večino preostalega učbenika uporabijo študenti pri predmetu Tehnologija DNA v 1. letniku magistrskega študija).
- B.R. Glick, J.J. Pasternak and C.L. Patten: Molecular Biotechnology: Principles and applications of recombinant DNA. 4. izdaja. Washington: ASM Press, 2009 (40%; most of the remaining textbook is recommended for the introductory DNA Technology course in the 1st year Master's programme).

Cilji in kompetence:	**Objectives and Competences:**
Študentje morajo poznati aplikativne vidike genskega inženirstva. Ob predhodnem poznavanju DNA-tehnologije bodo sposobni razumeti načine priprave gensko spremenjenih organizmov in umestiti njihovo uporabnost v širši kontekst ved o življenju in sodobnih tehnologij.	Students have to know applicative aspects of genetic engineering. With prior knowledge of DNA technology they will be able to understand how genetically engineered organisms are prepared and to put their value into the context of life sciences and modern technologies.

Predvideni študijski rezultati:	**Intended Learning Outcomes:**
<u>Znanje in razumevanje</u> Znanje: Postopki priprave rekombinantnih cepiv. Uporabnost gensko spremenjenih organizmov in produktov na različnih področjih (okoljske tehnologije, medicina, reagenti). Princip metaboličnega inženirstva in uporaba za pripravo tržno zanimivih produktov. Razumevanje: Povezovanje posameznih tehnik v postopke v molekularni biotehnologiji. Identifikacija problema – zastavitev cilja – zasnova eksperimentov – preverjanje ciljev – prenos v prakso.	<u>Knowledge and Comprehension</u> Knowledge: Procedures needed to prepare recombinant vaccines. Usefulness of genetically engineered organisms and products in different areas (environmental technologies, medicine, reagents). Principle of metabolic engineering and its use for development of commercial products. Understanding: Combining techniques into procedures in molecular biotechnology. Problem identification – goal setting – design of experiments – testing outcomes – transfer into practice.
<u>Uporaba</u> Analiza živil na osnovi DNA. Povzemanje vsebine znanstvenih člankov, utrjevanje terminologije in predstavljanje zahtevnih strokovnih vsebin. Spremljanje dnevnih novic s področja biotehnologije.	<u>Application</u> DNA-based food analysis. Abstracting contents of scientific articles, terminology practice and presenting advanced professional contents. Following daily news in the field of biotechnology.
<u>Refleksija</u> Širina spektra biotehnoloških aplikacij. Biološka zdravila pridobivamo z gensko tehnologijo. Prenos temeljnih znanj v tehnologijo.	<u>Analysis</u> Broadness of biotech applications. Biopharmaceuticals are produced using gene technology. Transfer for fundamental knowledge into technology.

Prenosljive spretnosti Urejanje spletnih strani v okolju Wikimedia. Predstavljanje strokovnih vsebin in argumentirano razpravljanje o temah s področja biotehnologije.	Skill-transference Ability Editing Web pages in Wikimedia environment. Presenting professional contents and argumented discussions on biotech topics.

Metode poučevanja in učenja:	**Learning and Teaching Methods:**
Predavanja, tri laboratorijske vaje, individualno delo pri pripravi seminarja (možnost konzultacij), predstavitve seminarjev.	Lectures, three laboratory experiments, individual seminar preparation (consultations possible), seminar presentation.

Načini ocenjevanja:	Delež (v %) / Weight (in %)	**Assessment:**
Pisni izpit. Seminarska naloga. Opravljene vaje so pogoj za pristop k izpitu.		Written and oral examination. Seminar presentation. Access to examination only with completed laboratory practicals.

Reference nosilca / Lecturer's references:

- ŠKRLJ, Nives, DREVENŠEK, Gorazd, HUDOKLIN, Samo, ROMIH, Rok, ČURIN-ŠERBEC, Vladka, **DOLINAR, Marko**. Recombinant single-chain antibody with the trojan peptide penetratin positioned in the linker region enables cargo transfer across the blood-brain barrier. Appl. biochem. biotechnol., 2013, vol. 169, no. 1, str. 159-169, ilustr., doi: 10.1007/s12010-012-9962-7. [COBISS.SI-ID 30399193]
- ŠKRLJ, Nives, ERČULJ, Nina, **DOLINAR, Marko**. A versatile bacterial expression vector based on the synthetic biology plasmid pSB1. Protein expr. purif., 2009, vol. 64, no. 2, str. 198-204, doi: 10.1016/j.pep.2008.10.019. [COBISS.SI-ID 30190085]
- VASILJEVA, Olga, **DOLINAR, Marko**, ROZMAN PUNGERČAR, Jerica, TURK, Vito, TURK, Boris. Recombinant human procathepsin S is capable of autocatalytic processing at neutral pH in the presence of glycosaminoglycans. *FEBS lett.*. [Print ed.], 2005, vol. 579, str. 1285-1290. [COBISS.SI-ID 18842407]

UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	MOLEKULARNA HUMANA GENETIKA
Course Title:	MOLECULAR HUMAN GENETICS

Študijski program in stopnja Study Programme and Level	Študijska smer Study Field	Letnik Academic Year	Semester Semester
MAG Biokemija, 2. stopnja	**/**	**1.**	**2.**
USP Biochemistry, 2nd Cycle	**/**	**1st**	**2nd**

Vrsta predmeta / Course Type: obvezni / Mandatory

Univerzitetna koda predmeta / University Course Code: BI216

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje Work	Druge oblike študija	Samost. delo Individual Work	ECTS
40	**20**	**15 LV**	**/**	**/**	**75**	**5**

Nosilec predmeta / Lecturer: prof dr. Boris Rogelj / Dr. Boris Rogelj, Full Professor
doc. dr. Vera Župunski / Dr. Vera Župunski, Assistance Professor

Jeziki / Languages:

Predavanja / Lectures:	**slovenski / Slovenian**
Vaje / Tutorial:	**slovenski / Slovenian**

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	**Prerequisites:**
Študent oz. kandidat mora imeti predmet opredeljen kot študijsko obveznost.	The course has to be assigned to the student.

Vsebina:	**Content (Syllabus outline):**
1. Mehanizmi podvojevanja DNA in rekombinacije pri človeku 2. Nestabilni genom: mutacije in popravljanje mutacij 3. Proces transkripcije pri človeku in stopnje uravnavanja izražanja 4. Regulacijski elementi cis in trans, delovanje aktivatorjev in represorjev 5. Uravnavanje izražanja z razgradnjo RNA 6. Signalne kaskade, ki vplivajo na izražanje genov 7. Alternativna transkripcija in epigenetski dejavniki	1. Mechanisms of human DNA replication and recombination. 2. Instable genome: mutations and mutation repair. 3. Transcription and regulation of human gene expression. 4. Cis and trans regulatory elements, mechanism of activation and repression. 5. Regulation of expression through RNA degradation. 6. Signal cascades influencing gene expression. 7. Alternative transcription and epigenetic factors.

8. Biosinteza proteinov 9. Človekov kariotip 10. Organizacija človekovega genoma 11. Molekulska zgradba centromerov in telomerov 12. Ponovljena zaporedja in transpozicijski elementi pri človeku 13. Preoblikovanje kromatina 14. Genetika celičnega cikla 15. Evolucija mitohondrijskega in jedrnega genoma 16. Imunogenetika 17. Projekt Človeški genom in njegovo nadaljevanje s funkcijsko genomiko 18. Iskanje in kloniranje človekovih genov 19. Monogenske bolezni: molekularna patologija in diagnostika z analizo DNA 20. Molekularna patologija kompleksnih genskih sistemov 21. Uravnavanje delovanja genov med razvojem osebka 22. Genetika in diferenciacija celic 23. Molekularna onkologija: onkogeni in antionkogeni 24. Analiza DNA za tipizacijo tkiv in za osebno identifikacijo 25. Osnove funkcijske genomike in biologije sistemov 26. Gensko zdravljenje 27. Koncept osebne medicine 28. Molekularna genetika in družba: etični, sociološki in politični vidiki 29. Funkcionalna genetika nevrodegenerativnih bolezni.	8. Human protein expression. 9. Karyotype. 10. Organization of the human genome. 11. Molecular structures of centromeres and telomeres. 12. Repeated regions and transposition elements in the human genome. 13. Chromatin rearrangements. 14. Genetics of the cell cycle. 15. Evolution of the mitochondrial and nuclear genome. 16. Immunogenetics. 17. Human genome project and functional genomics. 18. Identification and cloning of human genes. 19. Monogenic diseases: molecular pathology and diagnostics by DNA analysis. 20. Molecular pathology of complex genetic systems. 21. Gene regulation in development of a human being. 22. Genetics and cell differentiation. 23. Molecular oncology: oncogenes and antioncogenes. 24. DNA analysis for tissue typing and personal identification. 25. Fundamentals of functional genomics and systems biology. 26. Gene therapy. 27. Concept of personal medicine. 28. Molecular genetics and society: ethical, social and legal issues. 29. Functional genetics of neurodegenerative diseases

Temeljna literatura in viri / Readings:

- Trent R.J.: Molecular Medicine, 4th ed., Academic Press (2012) https://www.elsevier.com/books/molecular-medicine/trent/978-0-12-381451-7
- Strachan T. & Read A.: Human Molecular Genetics, 4th ed., Garland (2010) http://www.garlandscience.com/product/isbn/9780815341499
- Tom Strachan, Judith Goodship, Patrick Chinnery: Genetics and Genomics in Medicine, 2015

Obseg gradiv za izpit: ~300 strani.

Cilji in kompetence: | **Objectives and Competences:**

Študenti bodo znali razložiti molekulske mehanizme ohranjanja genetske informacije pri človeku ter prenosa informacije z genoma na proteine. Razumeli bodo delovanje signalnih kaskad, ki se končajo v jedru in kako poteka uravnavanje izražanja genov na različnih ravneh. Kromosomsko zgradbo človekovega genoma bodo razumeli na citološki in molekulski ravni, hkrati pa bodo vedeli, kako se struktura kromosomskega zapisa spreminja v procesih podvojevanja in prepisovanja genov. Razen jedrnega genoma bodo razumeli tudi pomen mitohondrijskega genoma in njegovo evolucijo. Vedeli bodo, kako je mogoča izjemna heterogenost proteinov imunskega sistema kljub relativno majhnemu številu genov za te proteine. Opisati bodo znali, kako so določili zaporedje človekovega genoma in kakšne so njegove lastnosti, kako je mogoče identificirati točno določen gen in ga analizirati. Poznali bodo več primerov dednih bolezni in naravo njihovega prenosa med generacijami. Hkrati bodo razumeli, kako se v procesu diferenciacije celic ali razvoja osebka spreminja aktivnost določenih genov. Aplikativna znanja bodo vključevala metode za molekulsko diagnostiko bolezni in tipizacijo tkiv, pristope h genskemu zdravljenju, poznali pa bodo tudi genetsko naravo sprememb, povezanih z razvojem rakavih obolenj. S seminarji bodo študenti spoznali novosti pri raziskavah človekovega genoma, bolezni zaradi genetskih sprememb in pri razvoju novih metod za raziskovanje človekovega genoma. Za seminarje bodo uporabljali vire v angleškem jeziku, s čimer se bodo urili v uporabi literature in prevajanju. Z vodenimi razpravami na seminarjih bodo pridobili izkušnje v oblikovanju relevantnih vprašanj in	Students will be able to explain molecular mechanisms of preservation of human genetic information and the transfer of information from the genome to proteins. They will understand the signalling cascades that lead to nucleus and different levels of regulation of gene expression. Students will understand cytological and molecular aspects of the human genome, and know how the structure of the chromosome changes in the processes of replication and translation. They will also comprehend the role and evolution of the mitochondrial genome. They will have insight into the mechanisms that from a relatively small number of genes give rise to substantial heterogeneity of proteins in the immune system. They will be able to describe procedures to determine the sequence and properties of the human genome and how to identify and analyse individual genes. They will know several hereditary diseases and how they are transferred between generations. At the same time they will understand changes in gene expression during development. They will know applications involving molecular diagnostics and tissue typing and methods of gene therapy. They will also comprehend the genetic changes involved in oncogenesis. With seminars, the students will get acquainted with current research of the human genome and genetic diseases as well as development of new research methods for analysis of the human genome. The resources for the seminar will be in English, which will provide training in use of literature and translation. With guided discussion following presentations, the students will gain experience in shaping of relevant questions and discussion of viewpoints.

zagovarjanju stališč.	

Predvideni študijski rezultati:	**Intended Learning Outcomes:**
Znanje in razumevanje **Znanje:** Prenos genetske informacije pri človeku. Nastanek in odpravljanje mutacij. Mesta in načini uravnavanja izražanja genov. Mehanizmi aktivacije in represije pri transkripciji. Utišanje genov z razgradnjo RNA. Značilnosti kariotipa in organizacije človekovega genoma. Tipi ponavljajočih se zaporedij in delovanje transpozonov. Lastnosti mitohondrijskega genoma in njegova evolucija. Rekombinacije pri nastanku zapisov za proteine imunskega sistema. Postopki pri določanju zaporedja sesalskih genomov. Genetska narava monogenskih in kompleksnih dednih bolezni. Razvojna genetika: spremembe v aktivnosti genov med razvojem celice in človeka. Genetska osnova rakavih sprememb. Sodobne metode za analizo genoma in transkriptoma. Načini genskega zdravljenja. **Razumevanje:** Primerjava prokariontskih in evkariontskih procesov prenosa genetske informacije – razumevanje razlik med podobnosti. Raznolikost v uravnavanju izražanja genov pri človeku. Prenosi signalov iz okolice in iz notranjosti celice se lahko končajo v jedru in vplivajo na prepisovanje genov. Kemične spremembe nukleotidov lahko vplivajo na raven prepisovanja genov. Mikroskopski in molekulski ustroj kromosomov. Pomen ponavljajočih se zaporedij v genomu. Spremembe kromatina aktivnih regij kromosoma. Pomen poznavanja genomskih zaporedij in nadgradnja s spoznanji funkcijske genomike. Način identifikacije posameznih genov v genomu.	Knowledge and Comprehension **Knowledge:** Transfer of genetic information in humans. Genesis and treatment of mutations. Methods and targets of regulation of gene expression. Mechanisms of activation and repression of transcription. RNA silencing. Karyotype characteristics and organisation of the human genome. Types of repeat sequences and function of the transposons. Evolution and characteristics of the mitochondrial genome. Recombination of genes of immune system. Modern sequencing methods of the genome and the transcriptome. Genetic basis of monogenic and complex hereditary diseases. Developmental genetics: gene regulation during cell and organism development. Genetics of oncogenesis. Gene therapy methods. **Comprehension:** Comparison of prokaryotic and eukaryotic processes of transfer of genetic information – understanding of similarities and differences. Different pathways of gene regulation in humans. Environmental and internal signals can be transferred to the nucleus and influence translation. Chemical modifications of nucleotides can influence levels of transcription. Microscopic and molecular makeup of the chromosomes. The importance of repeat sequences for the genome. Chromatin changes in the active regions of chromosomes. Importance of the overview of the genome sequence. Methods of identification of individual genes.
Uporaba Poosebljena medicina – skorajšnja uporaba v	Application Personalised medicine - the perspectives for

medicinski praksi. Povezava spoznanj s sorodnih področij znanosti (genetika, molekularna genetika in molekularna biologija). Metode za analizo genoma in transkriptoma ter molekularnogenetske diagnostične metode.	general use. Connection with state-of-the-art in other fields of research (genetics, molecular genetics and molecular biology). Methods of genome and transcriptome analysis and molecular genetic diagnostics.
Refleksija Navidezni razkorak med stabilnostjo človekovega genoma in raznolikostjo njegovega izražanja. Smisel nekodirajočih zaporedij v genomu – pojem sebičnega gena. Širjenje lastnosti polipeptidov kot posledica alternativnih procesov v prenosu genetske informacije (mesta začetka transkripcije, alternativno izrezovanje intronov, urejanje mRNA ipd.). Celični cikel in življenjski cikel – spremembe v aktivnosti genov na ravni celice in organizma. Dedne bolezni so posledica različnih genskih okvar. Zakaj se nekatere mutacije popravljajo, druge pa ne? Vsak človek lahko zboli za rakom – kaj lahko naredi posameznik, da ne bi zbolel? Zakaj prve generacije genskih zdravil niso bile učinkovite in kaj je treba izboljšati, da bi lahko prišlo do širše uporabe? Molekularna biologija in genetika lahko vplivata na kakovost življenja in segata od posameznika v družbo.	Analysis The dichotomy of stability of the human genome and the variability of expression. The sense of the noncoding sequences in the genome and the concept of the selfish gene. Increase of the characteristics of polypeptides as a result of alternative processes in the transfer of genetic information (alternative start of transcription, alternative splicing, RNA editing). Cellular and life cycle – changes in gene expression on the cellular and organism level. Hereditary disease are the consequence of different genetic mutations. Why are some mutations repaired while others are not? Everyone can get cancer – what can one do to reduce this possibility? Why the first generation of gene therapies was not successful and what needs to be improved? Molecular biology and genetics influence the quality of life, therefore the reach the individual as well as the society.
Prenosljive spretnosti Predstavitve strokovnih vsebin na osnovi angleškega izvirnika; uporaba terminološkega slovarja.	Skill-transference Ability Presentation of specialist state-of-the art findings from English resources; use of technical dictionary.

Metode poučevanja in učenja:	**Learning and Teaching Methods:**
Predavanja in seminarji (individualne predstavitve, vodena razprava).	Lectures and seminars (individual presentation, guided discussion).

Načini ocenjevanja:	Delež (v %) / Weight (in %)	**Assessment:**
Seminar Pisni izpit Ocene: 6-10 (pozitivno), 1-5 (negativno).	30 % 70 %	Seminar Written exam Grades: 6-10 (positive), 1-5 (negative)

Reference nosilca / Lecturer's references:

- HUDLER Petra, KOČEVAR Nina, **KOMEL Radovan**: Proteomic approaches in biomarker discovery : new perspectives in cancer diagnostics. The Scientific World Journal, ISSN 1537-744X; 2014, vol.
- Režen T, Kovanda A, Eiken O, Mekjavic IB, **Rogelj B.** 2014, Expression changes in human skeletal muscle miRNAs following 10 days of bed rest in young healthy males. Acta Physiologica (Oxf), [Epub ahead of print]
- Bratkovic T, Glavan G, Strukelj B, Zivin M and **Rogelj B**, 2012, Exploiting microRNAs for cell engineering and therapy. Biotechnology Advances, 30:753-765.
- Tollervey JR, Curk T, **Rogelj B**, Briese M, Cereda M, Kayikci M, König J, Hortobágyi T, Nishimura AL, Zupunski V, Patani R, Chandran S, Rot G, Zupan B, Shaw CE and Ule J, 2011, Characterizing the RNA targets and position-dependent splicing regulation by TDP-43. Nature Neuroscience, 14:452-458.
- Nishimura AL, Župunski V, Troakes C, Kathe C, Fratta P, Howell M, Gallo J-M, Hortobágyi T, Shaw CE and **Rogelj B**, 2010, Nuclear import impairment causes cytoplasmic TDP-43 accumulation and is associated with frontotemporal lobar degeneration, Brain, 133:1763-1771.
- Vance C, **Rogelj B**, Hortobagyi T, De Vos KJ, Sreedharan J, Hu X, Wright P, Nishimura AL, Ganesalingam J, Tripathi V, Smith B, Ruddy D, Al-Saraj S, Al-Chalabi A, Leigh PN, Blair IP, Nicholson G, de Belleroche J, Gallo J-M, Miller CC and Shaw CE, 2009. Mutations in FUS, an RNA processing protein, cause familial amyotrophic lateral sclerosis type 6. Science, 323:1208-1211.
- Lee YB, Chen HJ, Peres JN, Gomez-Deza J, Attig J, Stalekar M, Troakes C, Nishimura AL, Scotter EL, Vance C, Adachi Y, Sardone V, Miller JW, Smith BN, Gallo JM, Ule J, Hirth F, **Rogelj B**, Houart C, Shaw CE. 2013, Hexanucleotide repeats in ALS/FTD form length-dependent RNA foci, sequester RNA binding proteins, and are neurotoxic. Cell Reports, 5:1178-1186.

UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	PRETVORBA BIOAKTIVNIH SPOJIN
Course Title:	TRANSFORMATION OF BIOLOGICALLY ACTIVE COMPOUNDS

Študijski program in stopnja Study Programme and Level	Študijska smer Study Field	Letnik Academic Year	Semester Semester
MAG Biokemija, 2. stopnja	**/**	**2.**	**4.**
USP Biochemistry, 2nd Cycle	**/**	**2nd**	**4th**

Vrsta predmeta / Course Type: izbirni strokovni / Elective Professional

Univerzitetna koda predmeta / University Course Code: BI2I14

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje Work	Druge oblike študija	Samost. delo Individual Work	ECTS
45	**30**	**/**	**/**	**/**	**75**	**5**

Nosilec predmeta / Lecturer: Prof. dr. Bogdan Štefane / Dr. Bogdan Štefane, Assistant Professor

Jeziki / Languages: **Predavanja / Lectures:** **slovenski / Slovenian**; **Vaje / Tutorial:** **/**

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:

Študent oz. kandidat mora imeti predmet opredeljen kot študijsko obveznost.

Prerequisites:

The course has to be assigned to the student.

Vsebina:

Asimetrične pretvorbe glicina (bis-laktim etri.asimetrično alkiliranje
Schiffovih baz, funkcionalizacija imidazolidinonov, oksazolidinonov, oksazolinov, priprava in pretvorbe akiralnih enolatov glicina, pretvorbe kiralnih aziridinov
Homologiranje na β-ali γ-C atomu
Elektrofilno aminiranje enolatov
Nukleofilno aminiranje α-substituiranih kislin
Asimetrična Streckerjeva sinteza
Asimetrično hidrogeniranje dehidroamino kislin (heterogeno in homogeno hidrogeniranje)
Encimatska ločba derivatov racemnih amino kislin
Asimetrična tvorba vezi na prokiralnih

Content (Syllabus outline):

Asymmetric transformations of glycine, functionalisation of imidazolidinones, oxazolines and oxazolidinones. Synthesis and enantioselective transformations of glycine enolates. Transformations of chiral aziridines. Homologation on β and γ C atom. Electrophilic amination of enolates and nucleophilic amination of α-substituted carboxylic acid derivatives. Asymmetric hydrogenation of dehydroaminoacids. Enzymatic resolution of aminoacid derivatives. Total synthesis of some complex amino acids of biological importance (kainic acid derivatives, acivicin, bulgecicine and bulgecin, echinocandin, cyclosporines, and others cyclic peptides and depsipeptides).

substratih Totalne sinteze nekaterih kompleksnih amino kislin in njihovih derivatov, kot so npr. - derivati kainove kisline - acivicin - bulgecin - ehinokandin - kompleksni ciklični peptidi in depsipeptidi - ciklosporini	

Temeljna literatura in viri / Readings:

- P. Wyatt, S. Warren, Organic Synthesis Strategy and Control, Wiley 2007, nekatera poglavja / some chapters
- R.M.Williams, Synthesis of Optically Active α-Amino Acids, Pergamon Press, Oxford 1989, nekatera poglavja / some chapters
- Chiral Reagents for Asymmetric Synthesis, L. A. Paquette, ed., Interscience,Wiley, New York, 2003.

Cilji in kompetence:	**Objectives and Competences:**
Učna enota prispeva predvsem k razvoju naslednjih splošnih in specifičnih kompetenc: --poznavanje posameznih vrst organskih spojin pomembnih v biokemijskih procesih -poznavanje reaktivnosti bioaktivnih spojin spojin -poznavanje tipičnih reakcij -poznavanje značilnih funkcionalnih skupin in njihovih pretvorb -poznavanje stereokemijskih pretvorb bioaktivnih spojin -poznavanje nomenklature organskih spojin -poznavanje reakcijskih mehanizmov in intermediatov v kemiji biokativnih spoji -poznavanje dostopa do literaturnih virov in njihove uporabe	To become familiar with types of organic compounds important in biochemical processes and to understand reactivity of bioactive compounds. Knowledge of reactivity of functional groups appearing in bioactive compounds. Understanding stereochemical transformations and reaction mechanisms typical for bioactive compounds. Acquire knowledge of complex synthesis approaches to compounds of biological importance Competences: Knowing types of bioactive compounds and understanding their structure. Ability to interpret transformations, stereochemical characteristics, and reactivity of bioactive compounds. Understanding synthesis approaches to biologically important compounds.

Predvideni študijski rezultati:	**Intended Learning Outcomes:**
<u>Znanje in razumevanje</u> Študent pozna: -biološko pomembne organske spojine -tipične funkcionalne skupine in tipične pretvorbe glavnih funkcionalnih skupin biološko pomembnih organskih spojin	<u>Knowledge and Comprehension</u> Student understands and is familiar with organic chemistry of biologically active compounds • transformations of carbohydrates • synthesis of amino acids

-značilne reagente, ki se uporabljajo pri tovrstnih pretvorbah -sintezne principe nekaterih pomembnih, tudi bolj kompleksnih, naravnih biološko pomembnih spojin	• important functional group transformations By solving the theoretical problems they review the knowledge of Organic chemistry
Uporaba Znanje organske kemije je temeljno znanje, ki je osnova za (nadaljnji) študij kemije in se hkrati navezuje na veliko večino ostalih predmetov študija kemije. Poleg tega je temeljno znanje organske kemije nujno potrebno vsakemu kemiku in biokemiku pri njegovem kasnejšem delu v praksi.	Application Mastered knowledge of organic chemistry is basic knowledge needed for studding Chemistry and Biochemistry. The knowledge is interconnected with majority of other subjects concerning the program. Course is also fundamental for understanding of structure, application and synthetic manipulations of basic bioactive compounds.
Refleksija Predmet spada med izbirne predmete v programu biokemije. Študent je pri kasnejšem praktičnem delu sposoben samostojno poiskati relevantne literaturne vire, sintetizirati, izolirati, očistiti in okarakterizirati biološko pomembne organske spojine ter kritično ovrednotiti rezultate glede na skladnost s teoretičnimi načeli.	Analysis Student is capable of recognising different types of biomolecules, predict there possible transformations, toxicity, reactivity, etc.
Prenosljive spretnosti - Poznavanje organske kemije kot temeljno znanje za specifična področja kemije -Uporaba organskih sinteznih in izolacijskih laboratorijskih tehnik na ostalih področjih kemije -Iskanje po klasičnih in elektronskih literaturnih virih in njihova uporaba pri praktičnem delu.	Skill-transference Ability The student acquires skills and knowledge that are required for a basic synthetic manipulation of important bioactive molecules.

Metode poučevanja in učenja:	**Learning and Teaching Methods:**
Predavanja; seminarji, individualni in skupinski projekti	Lectures, seminar work, training by solving of the theoretical problems.

Načini ocenjevanja:	Delež (v %) / Weight (in %)	**Assessment:**
Pisni izpit		Written exam

Reference nosilca / Lecturer's references:

- BERANIČ, Nataša, **ŠTEFANE, Bogdan**, BRUS, Boris, GOBEC, Stanislav, LANIŠNIK-RIŽNER, Tea. New enzymatic assay for the AKR1C enzymes. V: PLAPP, Bryce (ur.), et al. Enzymology and molecular biology of carbonyl metabolism, (Chemico-Biological Interactions, ISSN 0009-2797, vol. 202, iss. 1/3). Amsterdam: Elsevier, 2013, str. 204-209, ilustr., doi: 10.1016/j.cbi.2012.12.003. [COBISS.SI-

ID 30357465]
- SOSIČ, Izidor, MIRKOVIĆ, Bojana, ARENZ, Katharina, **ŠTEFANE, Bogdan**, KOS, Janko, GOBEC, Stanislav. Development of new cathepsin B inhibitors: combining bioisosteric replacements and structure-based design to explore the structure-activity relationships of nitroxoline derivatives. Journal of medicinal chemistry, ISSN 0022-2623, 2013, vol. 56, no. 2, str. 521-533. http://pubs.acs.org/doi/pdf/10.1021/jm301544x, doi: 10.1021/jm301544x. [COBISS.SI-ID 3370865]
- SOSIČ, Izidor, MIRKOVIĆ, Bojana, TURK, Samo, **ŠTEFANE, Bogdan**, KOS, Janko, GOBEC, Stanislav. Discovery and kinetic evaluation of 6-substituted 4-benzylthio-1,3,5- triazin-2(1H)-ones as inhibitors of cathepsin B. European Journal of Medicinal Chemistry, ISSN 0223-5234. [Print ed.], 2011, vol. 46, iss. 9, str. 4648-4656. doi: 10.1016/j.ejmech.2011.08.005. [COBISS.SI-ID 3068017],

UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	SINTEZNA BIOLOGIJA
Course Title:	SYNTHETIC BIOLOGY

Študijski program in stopnja Study Programme and Level	Študijska smer Study Field	Letnik Academic Year	Semester Semester
MAG Biokemija, 2. stopnja	**/**	**1.**	**2.**
USP Biochemistry, 2nd Cycle	**/**	**1st**	**2nd**

Vrsta predmeta / Course Type: Obvezni / Mandatory

Univerzitetna koda predmeta / University Course Code: BI2T01

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje Work	Druge oblike študija	Samost. delo Individual Work	ECTS
30	**25**	**20 LV**	**/**	**/**	**75**	**5**

Nosilec predmeta / Lecturer: prof. dr. Marko Dolinar / Dr. Marko Dolinar, Full Professor

Jeziki / Languages:

Predavanja / Lectures:	**slovenski / Slovenian**
Vaje / Tutorial:	**slovenski / Slovenian**

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	Prerequisites:
Študent oz. kandidat mora imeti predmet opredeljen kot študijsko obveznost.	The course has to be assigned to the student.

Vsebina:	Content (Syllabus outline):
1. Sintezna biologija, biološko inženirstvo, biologija sistemov. “Synthetic Society”. 2. Inženirski cikel in načela v sintezni biologiji. 3. Regulacijski sistemi za izražanje genov v sintezni biologiji. 4. Biološki deli in struktura Registra bioloških delov. 5. Standardi za sestavljanje bioloških delov. 6. Koncept logičnih vezij in njihova izvedba v sintezni biologiji. 7. Sinteznobiološke naprave. 8. Sinteznobiološki sistemi. 9. Biološka vezja in metabolično inženirstvo. 10. Bioinformatska orodja v sintezni biologiji. 11. Modeliranje in karakterizacija sistemov.	1. Synthetic biology, biological engineering, systems biology. “Synthetic Society”. 2. The engineering cycle and governing principles in synthetic biology. 3. Gene expression regulatory systems in synthetic biology. 4. Biological parts and the structure of the Registry. 5. Assembly standards for composed biological parts. 6. The concept of logic networks and execution in synthetic biology. 7. Synthetic biology devices. 8. Synthetic biology systems. 9. Biological networks and metabolic

12. Poustvarjanje genomov in sintezna genomika. 13. Sintezna biologija mikrobnih združb. 14. Značilne aplikacije sintezne biologije (zdravje, materiali, biogoriva, reagenti,…). 15. Biološka varnost, etika in družbena sprejemljivost sintezne biologije. Laboratorijski vaji: 1.Kloniranje inserta v vektor pSB. 2.Merjenje relativne moči promotorjev. Računalniški vaji: 1.Bioinformatska orodja v sintezni biologiji. 2.Modeliranje bioloških procesov. Seminarji: Aktualni primeri aplikacij v sintezni biologiji.	engineering. 10. Bioinformatic tooks in synthetic biology. 11. Systems modelling and characterization. 12. Genome rewriting / refactoring and synthetic genomics. 13. Synthetic biology of microbial communities. 14. Typical applications of synthetic biology (health, materials, biofuels, reagents,…). 15. Biosafety, biosecurity, bioethics and public acceptance of synthetic biology. Laboratory practicals: 1. Insert cloning in pSB vectors. 2. Determination of relative promoter strength. Computer tutorials: 1. Bioinformatic tools in synthetic biology. 2. Modelling biological processes. Seminars: Current examples of applications in synthetic biology.

Temeljna literatura in viri / Readings:

- Baldwin, Bayer, Dickinson, Ellis, Freemont, Kitney, Polizzi, Stan: Synthetic biology – A primer. London: Imperial College Press, 2012 (179 str./pages).

Dodatno gradivo / Additional literature:

- H. Zhao: Synthetic Biology. Tools and Applications. London: Academic Press, 2013

Cilji in kompetence:	**Objectives and Competences:**
Vsak študent mora po opravljenem izpitu razumeti razlike med molekularno in sintezno biologijo in poznati metode, ki jih sintezna biologija uporablja. Poznal bo princip kloniranja v sintezni biologiji in njegove prednosti. Vedel bo, katere so kategorije standardnih bioloških delov in razumel stopnje njihove kompleksnosti. Znati mora sestaviti preprosta biološka vezja in jih računalniško modelirati, ob tem pa poznati elemente vezij in njihove značilnosti. Predstaviti mora znati primere uporabe sintezne biologije za reševanje različnih	Students will understand differences between molecular and synthetic biology and they will become familiar with methods used in synthetic biology. They will understand the principle of standardized gene cloning and its advantages, recognize categories in the Registry of biological parts and understand their levels of complexity. Students will be able to assemble basic biological circuits and to model them on the computer by simultaneously knowing circuit elements and their properties. In addition, they will know examples of some synthetic biology solutions to a range of major problems of the humankind. The objective is also that students will be able

perečih problemov. Znal bo kompetentno razpravljati o varnostnih in etičnih vidikih spreminjanja celičnih sistemov z metodami sintezne biologije.	to discuss with arguments biosafety and ethical issues of modifying cellular systems using synthetic biology methods.

Predvideni študijski rezultati:	**Intended Learning Outcomes:**
<u>Znanje in razumevanje</u> **Znanje**: Pojem poustvarjanja genomov in organizmov. Vsebina registra bioloških delov – kaj je mogoče uporabiti in za kaj. Značilnosti bioloških vezij in njihovo načrtovanje/modeliranje. Primeri uporabe sinteznobioloških pristopov v medicini, pri varovanju okolja, razvoju novih materialov ipd. **Razumevan**je: Digitalizacija življenja in uporaba podatkov za nove lastnosti organizmov. Organiziranost sintezne biologije: register delov, elementi vezij in njihovo povezovanje. Postopek kloniranja s standardiziranim pristopom; priprava biološkega vezja na osnovi biokock; potreba po poustvarjanju genomov in način priprave; pomen odgovornosti pri uporabi sintezne biologije (etični in varnostni vidiki).	<u>Knowledge and Comprehension</u> **Knowledge:** The term 'rewriting and refactoring' of genomes and organisms. Contents of the Registry of biological parts – what can be used and with what purpose. Properties of biological circuits and their design/modelling. Examples of synthetic biology applications in medicine, environment protection, development of novel materials etc. **Comprehension:** Digitalization of life and data utilization for designing novel properties of organisms. Organisation levels in synthetic biology: Registry of parts, circuit elements and the mode of their interconnection. Cloning procedure using the standardized approach. Preparation of a genetic circuit based on biobricks. The need to refactor genomes and modes of preparation. Importance of responsible implementation of synthetic biology (ethical and safety issues).
<u>Uporaba</u> Princip poenotenega kloniranja v sintezni biologiji. Metoda za določanje moči promotorskih zaporedij. Nova orodja v bioinformatiki za simuliranje celičnih biokemijskih procesov. Vpisovanje strokovnih vsebin v formatu wiki.	<u>Application</u> Principle of standardized cloning in synthetic biology. A method to determine promoter strengths. New bioinformatics tools for simulating biochemical processes in a cell. Wiki format of professional content input.
<u>Refleksija</u> Identifikacija konkretnih problemov človeštva in možnosti uporabe najzmogljivejših tehnologij. Sinergija biologije in inženirstva. Ali lahko funkcionalne elemente elektronskih vezij prevedemo v biološke komponente? Wikipedija in druge wiki strani: vprašanje zanesljivosti in dostopnosti podatkov. Inženirski pristopi niso omejeni na stroje, pač	<u>Analysis</u> Identification of major problems of the humankind and possibilities that high performance technologies offer for solving them. Synergy of biology and engineering. Can functional elements of electronic circuits be applied to biological components? Wikipedia and other wiki pages: are easily accessible data reliable? Engineering principles apply not only

pa so možni na živih sistemih; vzporednice celica/stroj. Vprašanje omejevanja dostopa do virov kot način zagotavljanja varnosti.	to machines but also to living systems. Parallels between a cell and a machine. Is restriction to resources a reasonable way of ensuring safety?
Prenosljive spretnosti Razumevanje raziskovalnih poročil in člankov. Priprava in predstavitev seminarja. Urejanje wiki-strani. Načela varnosti pri laboratorijskem delu z DNA in genetsko spremenjenimi mikroorganizmi.	Skill-transference Ability Understanding research reports and articles; seminar preparation and presentation; editing wiki pages. Principles of biosafety in laboratory experimental work with GM microorganisms.

Metode poučevanja in učenja:	**Learning and Teaching Methods:**
Predavanja, dve laboratorijski vaji in dve računalniški vaji, seminarji (primeri uporabe) in individualno delo pri pripravi seminarja. Sodelovanje na spletu (wiki). Spletna gradiva za določena poglavja.	Lectures, two laboratory practicals and two computer practicals, seminars (application examples) and individual work for preparation of the seminar. Web cooperation (wiki). Web-based materials for some topics.

Načini ocenjevanja:	Delež (v %) / Weight (in %)	**Assessment:**
Pisni izpit in seminarska naloga. Opravljene vaje so pogoj za pristop k izpitu.		Written examination and seminary presentation. Access to examination only with completed laboratory practicals.

Reference nosilca / Lecturer's references:

- ŠKRLJ, Nives, VIDRIH, Zlatko, **DOLINAR, Marko**. A universal approach for promoter strength evaluation supported by the web-based tool PromCal. Analytical biochemistry, ISSN 0003-2697, 2010, vol. 396, no. 1, str. 83-90, doi: 10.1016/j.ab.2009.08.033. [COBISS.SI-ID 33430789]
- ŠKRLJ, Nives, ERČULJ, Nina, **DOLINAR, Marko**. A versatile bacterial expression vector based on the synthetic biology plasmid pSB1. Protein expression and purification, ISSN 1046-5928, 2009, vol. 64, no. 2, str. 198-204, doi: 10.1016/j.pep.2008.10.019. [COBISS.SI-ID 30190085]
- AVBELJ, Monika, FEKONJA, Ota, KOVAČ, Jernej, OBLAK, Alja, POHAR, Jelka, SKOČAJ, Matej, TKAVC, Rok, BENČINA, Mojca, PANTER, Gabriela, MANČEK KEBER, Mateja, **DOLINAR, Marko**, JERALA, Roman. Engineered human cells: say no to sepsis. IET synthetic biology, ISSN 1752-1394. [Print ed.], 2007, vol. 1, no. 1/2, str. 13-16. [COBISS.SI-ID 3769882]

UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	TEHNOLOGIJA DNA
Course Title:	DNA TECHNOLOGY

Študijski program in stopnja Study Programme and Level	Študijska smer Study Field	Letnik Academic Year	Semester Semester
MAG Biokemija, 2. stopnja	**/**	**1.**	**1.**
USP Biochemistry, 2nd Cycle	**/**	**1st**	**1st**

Vrsta predmeta / Course Type: obvezni / Mandatory

Univerzitetna koda predmeta / University Course Code: BI211

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje Work	Druge oblike študija	Samost. delo Individual Work	ECTS
45	**15**	**15 LV**	**/**	**/**	**75**	**5**

Nosilec predmeta / Lecturer: prof. dr. Marko Dolinar / Dr. Marko Dolinar, Full Professor

Jeziki / Languages:	
Predavanja / Lectures:	**Slovenski / Slovenian**
Vaje / Tutorial:	**Slovenski / Slovenian**

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	Prerequisites:
Študent oz. kandidat mora imeti predmet opredeljen kot študijsko obveznost.	The course has to be assigned to the student.

Vsebina:	Content (Syllabus outline):
1. Uvod. Primerjava DNA-tehnologije in sorodnih ved: metode in cilji. 2. Mutageneza. 3. Izražanje na površini. 4. Dvohibridni sistemi. 5. Gensko spremenjene rastline. 6. Gensko spremenjena hrana. 7. DNA v forenzičnih analizah. 8. Analize DNA v diagnostiki. 9. Analize DNA v sistematiki in arheologiji. 10. Transgenske živali. Tehnologija izbijanja genov. Utišanje genov z RNAi. 11. Pluripotentne celice: priprava in uporaba. 12. Kloniranje sesalcev.	1. Introduction. Comparison of DNA-technology and related disciplines: methods and goals. 2. Mutagenesis. 3. Surface display. 4. Two-hybrid systems. 5. Genetically modified plants. 6. Genetically modified food. 7. DNA in forensic analyses. 8. DNA analyses in diagnostics. 9. DNA analyses in biological systematics and archaeology. 10. Transgenic animals. Knock-out technology. Gene silencing with RNAi. 11. Pluripotent cells: preparation and

13. Določanje genomskih zaporedij in analize razlik v genomih.
14. Genomike.
15. Rekombinantna DNA v medicini. Gensko zdravljenje.

Vaje – laboratorijski del:
1. Mutageneza
2. PCR na osnovi kolonije.
3. Hitra izolacija genomske DNA, pomnoževanje polimorfnih regij in njihova analiza.

Vaje - seminarski del:
1. Vektorski sistemi v tehnologiji DNA.
2. Biološka varnost, etika in družbena sprejemljivost v tehnologiji DNA.

applications.
12. Cloning of mammals.
13. Determining genome sequences and analysis of intergenomic heterogeneity.
14. Genomics.
15. Recombinant DNA in medicine. Gene therapy.

Laboratory practicals:
1. Mutagenesis.
2. Colony PCR.
3. Quick genomic DNA isolation, amplification of polymorphic regions and their analysis.

Tutorial:
1. Vector sistems in DNA technology
2. Biosafety, ethics and social acceptance in DNA technology.

Temeljna literatura in viri / Readings:

- Glick & Pasternak: Molecular Biotechnology: Principles and Applications of Recombinant DNA. Washington: ASM Press, 2003.
- Marko Dolinar in Marina Klemenčič: Tehnologija DNA – Navodila za vaje. UL FKKT 2016

Cilji in kompetence:

Vsak študent mora biti po opravljenem izpitu sposoben razumeti tehnično zapletene postopke dela z DNA v molekularni biotehnologiji, pa tudi pri forenzičnih, biomedicinskih in drugih analizah. Znati mora izbrati ustrezne metode na osnovi DNA za reševanje konkretnih problemov v molekularni biologiji. Razen tega bo poznal načine uvedbe mutacij, interakcijske metode, ki temeljijo na DNA, postopek priprave transgenskih organizmov in mehanizme utišanja genov.

Objectives and Competences:

Students will understand technically advanced procedures involving DNA in molecular biotechnology, as well as in forensic, biomedical and other analyses. They will be able to choose adequate DNA-based methods for solving practical problems in molecular biology. Also, they will know procedures for introduction of mutations, DNA-based interaction methods, procedures for preparation of transgenic organisms and mechanisms of gene silencing.

Predvideni študijski rezultati:

Znanje in razumevanje

Znanje:

Zahtevne tehnike na osnovi DNA za genomske analize in raziskave interakcij med proteini. Metode za uvedbo mutacij v DNA. Primeri

Intended Learning Outcomes:

Knowledge and Comprehension

Knowledge:

Advanced DNA-based techniques for genomic analyses and investigations of interactions between proteins. Methods for introduction of

uporabe DNA-tehnologije v agronomiji, medicini, forenziki in drugod. Tehnologija interferenčne DNA in njena uporaba. Načini genskega zdravljenja. Razumevanje: delovanje dvohibridnih sistemov, priprava, selekcija in analiza transgenskih rastlin in živali. Možnosti za uvedbo različnih tipov mutacij v DNA. Mehanizem utišanja genov. Stopnje dela pri jedrnem prenosu. Razločevanje med posameznimi tipi genomik.	mutations into DNA. Examples of DNA technology applications in agriculture, medicine, forensics and elsewhere. Gene silencing technology and its applications. Modes of gene therapy. Comprehension: Functioning of two-hybrid systems, development, selection and analysis of transgenic plants and animals. Various approaches in DNA mutagenesis. Gene silencing mechanism. Nuclear transfer: procedure stages. Differentiating between various types of genomics.
<u>Uporaba</u> Mutageneza in PCR na osnovi kolonij. Izolacija genomske DNA za forenzične analize in analiza polimorfnih regij.	<u>Application</u> Mutagenesis, followed by colony PCR. Isolation of genomic DNA for forensic analyses and analysis of polymorphic regions.
<u>Refleksija</u> Izbor ustreznih analiznih metod glede na končni cilj raziskave. Povezovanje dela z DNA z analizo proteinov. Funkcijska genomika kot proteomika? Gensko spremenjena hrana: vplivi na zdravje? Terapevtsko in reproduktivno kloniranje. Meje detekcije DNA v sledovih – uporaba v forenziki. Ali bo mogoče vsako dedno bolezen odkriti še preden se razvije? Smisel testiranja okvarjenih genov povezanih z neozdravljivimi boleznimi. Majhne razlike v genomih – velike razlike v fenotipih.	<u>Analysis</u> Selecting the most appropriate analytical method based on the final goal of research. Combining work with DNA with protein analysis. Functional genomics as a part of proteomics? Genetically modified food: possible health effects. DNA detection limits in forensic traces. Will we be able to detect all hereditary diseases before their outbreak? Does it make sense to test for gene dysfunction linked to untreatable diseases? Small differences in genomes result in major differences in phenotypes.
<u>Prenosljive spretnosti</u> Razumevanje raziskovalnih člankov, priprava in predstavitev seminarja, slovenska strokovna terminologija.	<u>Skill-transference Ability</u> Understanding research articles, seminar preparation and presentation, professional terminology in Slovenian language.

Metode poučevanja in učenja:	**Learning and Teaching Methods:**
Predavanja, laboratorijska vaja, individualno delo pri pripravi seminarja. Spletna gradiva za določena poglavja.	Lectures, laboratory practical courses, individual work for preparing seminars. Web sources for some topics.

Načini ocenjevanja:	Delež (v %) / Weight (in %)	**Assessment:**
Pisni in ustni izpit ter seminarska naloga.		Written and oral examination. Seminary presentation.

Opravljene vaje so pogoj za pristop k izpitu.		Access to examination only with completed laboratory practicals.

Reference nosilca / Lecturer's references:

- ŠKRLJ, Nives, VRANAC, Tanja, POPOVIĆ, Mara, ČURIN-ŠERBEC, Vladka, **DOLINAR, Marko**. Specific binding of the pathogenic prion isoform: development and characterization of a humanized single-chain variable antibody fragment. PloS one, ISSN 1932-6203, 2011, vol. 6, no. 1, art. no. e15783 (9 str.). http://www.plosone.org/article/info%3Adoi%2F10.1371%2Fjournal.pone.0015783, doi: 10.1371/journal.pone.0015783. [COBISS.SI-ID 34754053]
- ŠKRLJ, Nives, ČURIN-ŠERBEC, Vladka, **DOLINAR, Marko**. Single-chain Fv antibody fragments retain binding properties of the monoclonal antibody raised against peptide P1 of the human prion protein. Applied biochemistry and biotechnology, ISSN 0273-2289, 2010, issue 6, vol. 160, str. 1808-1821. http://www.springerlink.com/content/n72368781x356488/fulltext.pdf, doi: 10.1007/s12010-009-8699-4. [COBISS.SI-ID 30601477]
- KOPITAR, Gregor, **DOLINAR, Marko**, ŠTRUKELJ, Borut, PUNGERČAR, Jože, TURK, Vito. Folding and activation of human procathepsin S from inclusion bodies produced in Escherichia coli. European journal of biochemistry, ISSN 0014-2956, 1996, vol. 236, str. 558-562. [COBISS.SI-ID 22129]