Magistrski študijski program Biokemija

Podatki o študijskem programu

Drugostopenjski magistrski študijski program **BIOKEMIJA** traja 2 leti (4 semestre) in obsega skupaj 120 kreditnih točk.
Strokovni naslov, ki ga pridobi diplomant je:
- magister biokemije,
- magistrica biokemije oziroma
- mag. biokem.

Temeljni cilji programa in splošne kompetence

Temeljni cilj magistrskega študijskega programa Biokemija je usposobiti strokovnjake, ki bodo sposobni samostojno nadgrajevati znanje pridobljeno na dodiplomski in magistrski stopnji, bodo imeli poglobljeno znanje na področju biokemije, bodo imeli sposobnosti in veščine, s katerimi bodo zadostili pogojem za zaposlitev kot poklicni biokemiki v farmacevtski, kemijski in drugih z biokemijo povezanih industrijah ter v javnem sektorju in bodo pridobili takšen standard znanj in kompetenc, s kakršnimi bodo lahko vstopili v tretji cikel sklopov predavanj oziroma programov.

Splošne kompetence

- sposobnost uporabe znanja, razumevanja in sposobnosti reševanja problemov v novih oziroma neznanih okoljih, v širših (multidisciplinarnih) okoljih, povezanih z vedami o življenju;
- sposobnost samostojnega spremljanja strokovne literature na področju ved o življenju;
- sposobnost povezovanja svojega znanja in soočanja s kompleksnostjo, oblikovanja ocene na podlagi nepopolnih ali omejenih informacij, ki zajema tudi razmislek o etični odgovornosti;
- sposobnost jasnega in nedvoumnega posredovanja sklepov, znanja in argumentov strokovni in laični publiki sposobnost prilagajanja novim situacijam in sprejemanja odločitev;
- sposobnost neodvisnega in samostojnega nadaljnjega izobraževanja

Vpisni pogoji

V drugostopenjski magistrski študijski program Biokemija se lahko vpiše, kdor je končal:
- prvostopenjski univerzitetni študijski program, na katerem je opravil obveznosti pri predmetih, ki so zajemali snov kemije v obsegu 15 ECTS ter biokemije, molekularne biologije ali genetike skupaj v obsegu 15 ECTS,
- visokošolski strokovni program na katerem je opravil obveznosti pri predmetih, ki so zajemali snov kemije v obsegu 15 ECTS ter biokemije, molekularne biologije ali genetike skupaj v obsegu 15 ECTS,
- prvostopenjski univerzitetni študijski program na drugih področjih in je pred vpisom opravil obveznosti pri predmetih, ki zajemajo snov kemije obsegu 15 ECTS ter biokemije, molekularne biologije ali genetike skupaj v obsegu 15 ECTS. Predmete na prošnjo kandidata določi komisija, ki jo imenuje senat FKKT,
- visokošolski strokovni študij na drugih področjih in je pred vpisom opravil obveznosti pri predmetih, ki zajemajo snov kemije v obsegu 15 ECTS ter biokemije, molekularne biologije ali

genetike skupaj v obsegu 15 ECTS. Predmete na prošnjo kandidata določi komisija, ki jo imenuje senat FKKT.

V programu se predvideva 40 vpisnih mest za redni študij in 3 mesta za Slovence brez slovenskega državljanstva in tujce.

Če bo število kandidatov preseglo število razpisanih mest, bodo kandidati izbrani glede na povprečno oceno na dodiplomskem študiju (40 % točk), glede na doseženo oceno pri diplomi 20% in glede na obseg opravljenih obveznosti (v ECTS) pri predmetih, ki zajemajo snov kemije in biokemije (40%).

Merila za priznavanje znanj in spretnosti, pridobljenih pred vpisom v program

Študentu se lahko priznajo znanja, ki po vsebini ustrezajo učnim vsebinam predmetov v programu Biokemija, pridobljena v različnih oblikah izobraževanja. O priznavanju znanj in spretnosti pridobljenih pred vpisom odloča Študijska komisija FKKT, na podlagi pisne vloge študenta, priloženih spričeval in drugih listin, ki dokazujejo uspešno pridobljeno znanje ter vsebino teh znanj.
Pri priznavanju znanja, pridobljenega pred vpisom, bo Študijska komisija upoštevala naslednja merila:

- ustreznost pogojev za pristop v različne oblike izobraževanja (zahtevana predhodna izobrazba za vključitev v izobraževanje),
- primerljivost obsega izobraževanja (število ur predhodnega izobraževanja glede na obseg predmeta), pri katerem se obveznost priznava,
- ustreznost vsebine izobraževanja glede na vsebino predmeta, pri katerem se obveznost priznava.

Pridobljena znanja se lahko priznajo kot opravljena obveznost, če je bil pogoj za vključitev v izobraževanje skladen s pogoji za vključitev v program Biokemija, če je predhodno izobraževanje obsegalo najmanj 75 % obsega predmeta in najmanj 75 % vsebin ustreza vsebinam predmeta pri katerem se priznava študijska obveznost. V primeru, da komisija ugotovi, da se pridobljeno znanje lahko prizna, se to ovrednoti z enakim številom točk po ECTS, kot znaša število kreditnih točk pri predmetu.

Pogoji za napredovanje po programu

Za vpis v višji letnik mora imeti študent potrjen predhodni letnik, to je podpisano inskripcijo in frekvenco iz vseh predmetov za posamezni letnik. Poleg tega veljajo še naslednji prestopni pogoji:

Za vpis v drugi letnik mora imeti kandidat zbranih 60 kreditnih točk.
Organ FKKT, določen v Pravilih fakultete lahko izjemoma odobri napredovanje v drugi letnik študentu, ki je v predhodnem letniku dosegel najmanj 30 kreditnih točk po ECTS, če ima za to opravičljive razloge. Za opravičene razloge štejejo razlogi navedeni v Statutu Univerze v Ljubljani.

Študent letnik lahko ponavlja v kolikor je zbral 20 zahtevanih kreditnih točk za letnik.
Študent lahko v času študija enkrat ponavlja letnik ali enkrat spremeni študijski program zaradi neizpolnitve obveznosti v prejšnjem študijskem programu.

Študentu se lahko po drugem letniku v skladu z zakonom in statutom podaljša status študenta za največ eno leto, če zato obstajajo upravičeni razlogi in ima opravljene vse obveznosti iz prvih dveh letnikov.
Svetovanje in usmerjanje pri izbirnih predmetih bodo opravljali mentorji letnikov in tutorji.

Pogoji za dokončanje študija

Za dokončanje študija mora študent opraviti študijske obveznosti pri vseh predmetih vpisanega študijskega programa ter izdelati in uspešno zagovarjati magistrsko delo skladno z določili Pravilnika o diplomskem delu, ki ga sprejme Senat Fakultete za kemijo in kemijsko tehnologijo Univerze v Ljubljani.

Prehodi med študijskimi programi

Za prehod med študijskimi programi šteje prenehanje študentovega izobraževanja v študijskem programu, v katerega se je vpisal in nadaljevanje izobraževanja v novem študijskem programu. Za prehod se ne šteje sprememba študijskega programa ali smeri zaradi neizpolnitve obveznosti v prejšnjem študijskem programu ali smeri. Za prehod med študijskimi programi se ne šteje vpis v začetni letnik novega študijskega programa.

Magistrski študijski program 2. stopnje Biokemija je odprt za študente drugih primerljivih magistrskih študijskih programov 2. stopnje in diplomante univerzitetnih študijskih programov, ki so bili sprejeti do 11.6.2004, zato se lahko v program vključijo študenti, ki so se usposabljali na drugih ustreznih študijskih programih.
Prehod študentov iz drugih magistrskih študijskih programov 2. stopnje in diplomantov univerzitetnih študijskih programov, ki so bili sprejeti do 11.6.2004, v 2. letnik magistrskega študijskega programa druge stopnje Biokemija je mogoč, če je kandidatu pri vpisu v ta študijski program mogoče priznati vsaj polovico obveznosti, ki jih je opravil na prvem študijskem programu.
Študent, ki želi preiti na študijski program 2. stopnje Biokemija, vloži prošnjo z dokazili o opravljenih obveznostih na dosedanjem študiju in dokazilo o izpolnjevanju pogojev za vpis na magistrski študijski program 2. stopnje Biokemija. V 2. letnik se študent vključi, če izpolnjuje prehodne pogoje po tem programu, pri čemer mora opraviti vse tiste izpite, ki so specifični za ta program.

O prehodih med programi odloča Senat Fakultete za kemijo in kemijsko tehnologijo, ali organ, ki ga določi Senat fakultete.

Načini ocenjevanja

Znanje študentov se preverja in ocenjuje po posameznih predmetih tako, da se učni proces pri vsakem predmetu konča s preverjanjem znanja. Preverjanje in ocenjevanje se izvaja z ustnimi/pisnimi izpit, kolokviji seminarskimi in projektnimi nalogami. Učni načrti predmetov določajo študijske obveznosti študentov ter oblike in način preverjanja znanja. Različne oblike sprotnega preverjanja znanja, ki so opredeljene v učnih načrtih predmetov, se upoštevajo pri končni izpitni oceni. Postopek preverjanja in ocenjevanja znanja ureja Izpitni pravilnik Fakultete za kemijo in kemijsko tehnologijo Univerze v Ljubljani, ki ga sprejme Senat Fakultete za kemijo in kemijsko tehnologijo Univerze v Ljubljani.

Ocenjevalna lestvica za končne izpite in druge oblike preverjanja znanja:
10 odlično (izjemni rezultati z zanemarljivimi napakami)
9 prav dobro (nadpovprečno znanje, vendar z nekaj napakami)
7 dobro (dobro znanje z večjimi napakami)
6 zadostno (znanje ustreza minimalnim kriterijem)
5-1 nezadostno (znanje ne ustreza minimalnim kriterijem)

Ocene iz ocenjevalne lestvice se pretvarjajo v ECTS sistem ocenjevanja:
10 = A
9 = B
8 = C
7 = D
6 = E
5-1 = F (fail)

Predmetnik s kreditnim ovrednotenjem študijskih obveznosti

		Nosilec predmeta	
	1. letnik		
	1. semester		
1	Tehnologija DNA	izr. prof. dr. Marko Dolinar	
2	Metode določanja 3D strukture makro-molekul	izr. prof. dr. Kristina Djinović Carugo	prof. dr. Janez Plavec
3	Biofizikalna kemija I	prof. dr. Jurij Lah	
4	Izbirni predmet 1		
5	Izbirni predmet 2		
6	Uvod v raziskovalno delo		
	2. semester		
7	Bioanorganska kemija	prof. dr. Iztok Turel	
8	Molekularna humana genetika	prof. dr. Radovan Komel	izr. prof. dr. Boris Rogelj
9	Izbirni predmet 3		
10	Raziskovalno delo		
	2. letnik		
	3. semester		
11	Temeljni predmet 1		
12	Temeljni predmet 2		
13	Izbirni predmet 5		
14	Izbirni predmet 6		
15	Magistrsko delo		
	4. semester		
16	Izbirni predmet 7		
17	Izbirni predmet 8		
18	Izbirni predmet 4		
19	Magistrsko delo		

	Temeljni predmeti*		
	Sintezna biologija	izr. prof. dr. Marko Dolinar	
	Biokemija večceličnih sistemov	prof. dr. Brigita Lenarčič	doc. dr. Marko Novinec
	Bioorganska kemija	prof. dr. Jurij Svete	
	Bioanalizna kemija	izr. prof. dr. Helena Prosen	

*Študent izbere dva predmeta.

	Strokovni izbirni predmeti		
	Biološke membrane	prof. dr. Igor Križaj	
	Celično inženirstvo	prof. dr. Robert Zorec	
	Biokemija bolezni človeka	prof. dr. Zoran Grubič	
	Biokemija raka	prof. dr. Tamara Lah Turnšek	
	Strukturni in funkcijski vidiki bioloških	doc. dr. Marko Novinec	

	interakcij		
	Genomska biologija	doc. dr. Dušan Kordiš	
	Izbrana poglavja iz biomedicinske kemije	prof. ddr. Boris Turk	
	Moderni in komplementarni pristopi v strukturni biologiji	prof. dr. Janez Plavec	izr. prof. dr. Kristina Djinović Carugo
	Monoklonska protitelesa	prof. dr. Vladka Čurin-Šerbec	
	Biofizikalna kemija II	prof. dr. Jurij Lah	
	Bionanotehnologija	doc. dr. Gregor Gunčar	
	Molekularna biotehnologija	izr. prof. dr. Marko Dolinar	
	Molekularna razlaga bioloških sistemov	prof. dr. Barbara Hribar Lee	
	Kemija biomolekul	doc. dr. Bogdan Štefane	
	Usmerjena organska sinteza s kemijo zdravil	prof. dr. Marijan Kočevar	
	Pretvorba bioaktivnih spojin	doc. dr. Bogdan Štefane	
	Biomimetika	prof. dr. Iztok Turel	
	Predmeti drugih programov*		

* študent lahko izbere največ tri predmete iz drugih programov (15 ECTS)

Kreditno ovrednotenje celotnega programa in posameznih učnih enot, letno in celotno število ur študijskih obveznosti študenta ter letno in celotno število organiziranih skupnih oz. kontaktnih ur programa

1. letnik		***Kontaktne ure***								
		P	***S***	***SV***	***LV***	***TD***	***DO***	***Σ***	***ECTS***	***ŠOŠ***
	1. semester									
1	Tehnologija DNA	45		25	5			75	5	150
2	Metode določanja 3D strukture makromolekul	60			15			75	5	150
3	Biofizikalna kemija I	40	10		25			75	5	150
4	Izbirni predmet 1	i	i	i	i			75	5	150
5	Izbirni predmet 2	i	i	i	i			75	5	150
6	Uvod v raziskovalno delo						75	75	5	150
	Skupaj	**145 + i**	**10 + i**	**25 + i**	**45+ i**		**75**	**450**	**30**	**900**
	2. semester									
7	Bioanorganska kemija	30	15		30			75	5	150
8	Molekularna humana genetika	55	20					75	5	150
9	Izbirni predmet 3	i	i	i	i			75	5	150
10	Raziskovalno delo						225	225	15	450
	Skupaj	**85 + i**	**35 + i**	**i**	**30 + i**		**225**	**450**	**30**	**900**
	Skupaj 1. letnik	**230 + i**	**45 + i**	**25 + i**	**75 + i**		**300**	**900**	**60**	**1800**

2. letnik		***Kontaktne ure***								
		P	***S***	***SV***	***LV***	***TD***	***DO***	***Σ***	***ECTS***	***ŠOŠ***

	3. semester									
11	Temeljni predmet 1	t	t	t	t			75	5	150
12	Temeljni predmet 2	t	t	t	t			75	5	150
13	Izbirni predmet 4	i	i	i	i			75	5	150
14	Izbirni predmet 5	i	i	i	i			75	5	150
15	Magistrsko delo						150	150	10	300
	Skupaj	**t + i**	**t + i**	**t + i**	**t + i**		**150**	**450**	**30**	**900**
	4. semester									
16	Izbirni predmet 6	i	i	i	i			75	5	150
17	Izbirni predmet 7	i	i	i	i			75	5	150
18	Izbirni predmet 8	i	i	i	i			75	5	150
19	Magistrsko delo						225	225	15	450
	Skupaj	**i**	**i**	**i**	**i**		**225**	**450**	**30**	**900**
	Skupaj 2. letnik	**t + i**	**t + i**	**t + i**	**t + i**		**375**	**900**	**60**	**1800**
	Skupaj oba letnika	**230+t+ i**	**45+t+ i**	**25+t+ i**	**75 +t+ i**	0	**675**	**1800**	**120**	**3600**

Temeljni predmeti*	***Kontaktne ure***								
	P	***S***	***SV***	***LV***	***TD***	***DO***	***Σ***	***ECTS***	***ŠOŠ***
Sintezna biologija	30	25		20			75	5	150
Biokemija večceličnih sistemov	30	15		30			75	5	150
Bioorganska kemija	30	15		30			75	5	150
Bioanalizna kemija	30	30		15			75	5	150

* Študent izbere dva predmeta.

Strokovni izbirni predmeti	***Kontaktne ure***								
	P	***S***	***SV***	***LV***	***TD***	***DO***	***Σ***	***ECTS***	***ŠOŠ***
Biološke membrane	30	15		30			75	5	150
Celično inženirstvo	30	15		30			75	5	150
Biokemija bolezni človeka	45	15	15				75	5	150
Biokemija raka	30	15		30			75	5	150
Strukturni in funkcijski vidiki bioloških interakcij	30	15		30			75	5	150
Genomska biologija	30	15		30			75	5	150
Izbrana poglavja iz biomedicinske kemije	30	15		30			75	5	150
Moderni in komplementarni pristopi v strukturni biologiji	40	10		25			75	5	150
Monoklonska protitelesa	30	15	15	15			75	5	150
Biofizikalna kemija II	30	20		25			75	5	150
Bionanotehnologija	30	30		15			75	5	150
Molekularna biotehnologija	30	30		15			75	5	150
Molekularna razlaga	30	15	30				75	5	150

biokemijskih sistemov						
Kemija biomolekul	30		45	75	5	150
Usmerjena organska sinteza s kemijo zdravil	30	15	30	75	5	150
Pretvorba bioaktivnih spojin	45	30		75	5	150
Biomimetika	15	15	45	75	5	150
Predmeti drugih programov*				75	5	150

* študent lahko izbere največ tri predmete iz drugih programov (15 ECTS)

Legenda:

P – predavanja
S – seminar
SV – seminarske vaje
LV – laboratorijske vaje
TD – terensko delo
DO – druge oblike dela, v kolikor obstojajo
ECTS – kreditne točke
ŠOŠ – študijska obremenitev na študenta

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 temeljni / Elective Fundamental

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: izr. prof. dr. Helena Prosen / Dr. Helena Prosen, Associate Professor

Jeziki / Languages:

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

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	Prerequisites:
Študent mora imeti predmet vpisan v VIS.	The course has to be assigned to the student in the VIS system.

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, nano-LC na reverzni fazi; spektroskopske tehnike: spektrometrične, fluorescenčne, luminiscenčne metode; masna spektrometrija: ionizacije - electrospray, MALDI, DIOS; masni analizatorji - kvadrupol, ionska past, čas preleta, orbitrap; načini fragmentacije in snemanja produktnih ionov v	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, nano-LC on reverse phase; 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, potentiometry,

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, centrifugiranje, imobilizacija encimov in protiteles) - 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.	conductometry; other: radioactivity measurement) - theory and practical approaches to isolation and separation of compounds from biological systems (extraction, preparative electrophoretic and chromatographic separation, centrifugation, immobilization of enzymes and antibodies) - 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 - zmožnost, da izboljšajo in razvijejo nove analizne metode in postopke - 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 - ability to improve and develop new analytical methods and 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 razumevanje člankov iz znanstvenih publikacij.	<u>Analysis</u> Student will interpret, critically evaluate the contents and present their understanding of the scientific articles to their peers. They will use

Pri tem bo uporabil pridobljena teoretična znanja ter jih vrednotil s predstavljenimi praktičnimi problemi oziroma izkušnjami.	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:**
Pisni izpit esejskega tipa (8 vprašanj). Ocene 6-10 pozitivno	**60%**	Written exam, essay type (8 questions). Pass grades 6-10
Seminarska naloga z ustno predstavitvijo	**30%**	Seminar coursework with oral presentation
Laboratorijske vaje	**10%**	Laboratory work
Opravljene laboratorijske vaje in seminarska naloga so pogoj za pristop k pisnemu izpitu.		Concluded laboratory work and seminar coursework are prerequisites for the written exam.

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 mora imeti predmet vpisan v VIS.	The course has to be assigned to the student in the VIS system.

Vsebina:	Content (Syllabus outline):
- Uvod, definicije, izomerija, koordinacijsko število,… - 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 Tematika vaj se smiselno povezuje z vsebinami. Študenti spoznajo različne sintezne poti med kovinskimi ioni in aminokislinami in 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). The content of lab course is complementary to lectures. The students meet different synthetic approaches between metal ions and amino acids 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:**
Znanje in razumevanje 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 (točka 14).	Knowledge and Comprehension 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 (above).
Uporaba 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.	Application 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.
Refleksija Tematika vaj je tesno povezana s seminarskimi temami, zato se študent nauči kritičnega razmišljanja o skladnosti med teoretičnimi načeli in prakso.	Analysis The topics of seminars are closely related with lab course. The student is learned about critical thinking between theoretical and practical principles.

Prenosljive spretnosti Poznavanje vsebin omogoča tudi boljše razumevanje zakonitosti pri drugih predmetih študija (npr. biokemija)kar omogoča širši vpogled na celoto.	Skill-transference Ability 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:**
Ustni izpit: ocene od 6-10 (pozitivno) oz. 1-5 (negativno), ob upoštevanju Statuta UL in fakultetnih pravil Ocena iz vaj: sestavljena iz pisnega testa in ustne ocene ter ocene seminarske naloge		Oral exam: Assessments 6-10 (positive) and 1-5 (negative), in accordance to the UL Statute and faculty rules. The practical training grade is composed of written exam, oral exam and seminars.

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
40	**10**	**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:	Prerequisites:
Študent mora imeti predmet vpisan v VIS.	The course has to be assigned to the student in the VIS system.

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:**
a.) Vaje: napisana poročila o opravljenih vajah in opravljen zaključni test. Izpit: povprečna ocena pisnega in ustnega izpita. c.) Ocenjevalna lestvica: od 6-10 (pozitivno) oz. 1-5 (negativno) oz. opravil/ ni opravil; ob upoštevanju Statuta UL in fakultetnih pravil		

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:	**Prerequisites:**
Študent mora imeti predmet vpisan v VIS.	The course has to be assigned to the student in the VIS system.

Vsebina:	**Content (Syllabus outline):**
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:**	**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 - poročilo - predstavitev rezultatov projektne vaje Ocenjevalna lestvica: od 6-10 (pozitivno) oz. 1-5 (negativno) oz. opravil/ ni opravil; ob upoštevanju Statuta UL in fakultetnih pravil	**40 %** **30 %** **30 %**	

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: prof. dr. Zoran Grubič / Zoran Grubič, Full Professor, M.D., Ph.D.

Jeziki / Languages:

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

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	Prerequisites:
Študent mora imeti predmet vpisan v VIS.	The course has to be assigned to the student in the VIS system.

Vsebina:	Content (Syllabus outline):
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 plazmi. Motnje pH krvi.	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 disorders, acid-base imbalances.

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

Temeljna literatura in viri / Readings:

Patofiziologija s temelji fiziologije, 3. izdaja, Bresjanac M. In Rupnik M. (ur.) , Medicinska fakulteta, Inštitut za patološko fiziologijo; Ljubljana, 2000, 150 strani – v pripravi je 4., predelana izdaja tega učbenika – izšla bo predvidoma v aprilu 2014.

Izbrana poglavja iz učbenikov :
- Seminarji iz patološke fiziologije, 2. izdaja, Ribarič S. (ur.) Medicinska fakulteta, Inštitut za patološko fiziologijo; Ljubljana 2011.
- Temelji patološke fiziologije, 2. Izdaja, Ribarič S. (ur.) Medicinska fakulteta, Inštitut. za patološko fiziologijo; Ljubljana 2012.

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, testna vprašanja z več možnimi odgovori, ocene 6-10 so pozitivne (60-100% možnih točk), 1-5 negativno.	**100**	Oral exam based on multiple choice questions; grades 6-10 (corresponding to 60 – 100% of the total points score) are positive. Grades 1-5 are negative.

Reference nosilca / Lecturer's references:

- Pirkmajer S., Filipovic D., Mars T., Mis K., and **Grubic Z.** (2010). HIF-1α response to hypoxia is functionally separated from the glucocorticoid stress response in the in vitro regenerating human skeletal muscle. Am. J. Physiol. Integr. Comp. Physiol., 299: R1693 – R1700.

- Miš K, Matkovič U, Pirkmajer S, Sciancalepore M, Lorenzon P, Marš T, **Grubič Z.** (2013). Acetylcholinesterase and agrin : different functions, similar expression patterns, multiple roles. *Chem.-biol. interact.*., 2013: 297-301.

- Marš T, Mis K, Pirkmajer S, and **Grubic Z (**2009**)** The effects of organophosphates in the early stages of human muscle regeneration. In: Gupta RC, ed. Handbook of Toxicology of Chemical Warfare Agents;. Elsevier, Amsterdam, Boston, Heidelberg 2009, 683-690 (2nd edition of the book is in preparation)

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: prof. dr. Tamara Lah Turnšek /
Dr. Tamara Lah Turnšek, Full Professor

Jeziki / Languages:

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

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

Študent mora imeti predmet vpisan v VIS.

Prerequisites:

The course has to be assigned to the student in the VIS system.

Vsebina:

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

Content (Syllabus outline):

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

metastaziranje) 7. Tumorska proteoliza 8. Prtitumorski imunski odziv 9. Epidemiologija, tumorski kazalci, diagnoza, prognoza 10. Terapija rakavih obolenj (kemoterapija, radioterapija, genska terapija, biofarmacevtiki v terapiji raka, dostavni sistemi)	11. Therapeutic approaches in cancer

Temeljna literatura in viri / Readings:

- Weinberg, RA: The Biology of Cancer, 2007 ISBN 0-8153-4078-8 - izbrana poglavja
- Tannock IF, Hill RP, Bristow RG, Harrington L. The Basic Science of Oncology, McGraw-Hill
- Medical Publishing Division, 2012 ISBN- 0-07-138774-9 ; Izbrana poglavja
- Pregledni članki /Reviews iz Nature Cancer Reviews, Cancer Research, etc.

- 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:**

Znanje in razumevanje Slušatelji bodo pridobili znanje o specifičnih lastnostih rakavih celic in pristopih zdravljenja raka:.	Knowledge and Comprehension The students will get the knowledge on - cancer incidence - 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:**
Pisni in ustni izpit. Ocenjevanje se vrši z ocenami 6-10 (pozitivno) oz. 1-5 (negativno), ob upoštevanju statuta UL in fakultatnih pravil.		

Reference nosilca / Lecturer's references:

- PLAZAR, Janja, ŽEGURA, Bojana, **LAH TURNŠEK, Tamara**, FILIPIČ, Metka. Protective effects of xanthohumol against the genotoxicity of benzo(a)pyrene (BaP), 2-amino-3-methylimidazo[4,5-f]quinoline (IQ) and tert-butyl hydroperoxide (t-BOOH) in HepG2 human hepatoma cells. *Mutat. res., Genet. toxicol. environ. mutagen.*, 2007, vol. 632, str. 1-8.
- STROJNIK, Tadej, RØSLAND, Gro Vatne, SAKARIASSEN, Per Oystein, KAVALAR, Rajko, **LAH TURNŠEK, Tamara**. Neural stem cell markers, nestin and musashi proteins, in the progression of human glioma: correlation of nestin with prognosis of patient survival. *Surg. neurol.*. [Print ed.], aug. 2007, vol. 68, no. 2, str. 133-143
- **LAH TURNŠEK, Tamara**, DURAN ALONSO, Maria Beatriz, VAN NOORDEN, Cornelis JF. Antiprotease therapy in cancer: hot or not?. *Expert opin. biol. ther.*, 2006, vol. 6, str. 257-279

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:	izbirni temeljni / Elective Fundamental
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:	prof. dr. Brigita Lenarčič / Dr. Brigita Lenarčič, Full Professor 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 mora imeti predmet vpisan v VIS.	The course has to be assigned to the student in the VIS system.

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:**
Pisni izpit	**80 %**	
Ocena seminarja	**20 %**	

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 mora imeti predmet vpisan v VIS.	The course has to be assigned to the student in the VIS system.

Vsebina:	Content (Syllabus outline):
Uvod in navodila za predavanja (in seminarje). Struktura in dinamika bioloških membran (eksocitoza, endocitoza). Izolacija celic za študij membranskih procesov: celične kulture, označevanje membran v živih celicah, metode za opazovanje živih membran. Pasivni transport skozi biološke membrane. Aktivni transport skozi biološke membrane. Struktura lipidnih mikrodomen. Funkcije lipidnih mikrodomen. Znotrajcelična signalizacija: sekundarni prenašalci. Medcelična signalizacija – 1. del (hormoni in receptorji). Medcelična signalizacija – 2. del (prenos živčnega signala, uravnavanje endokrinih celic). Povezovanje celic v tkiva. Encimi, ki delujejo na membranah in na membrane na primeru fosfolipaz A_2.	Introduction and instructions for lectures (and seminars). Structure and dynamics of biological membranes (exocytosis, endocytosis). Isolation of cells to study membrane processes: cell cultures, membrane labelling in live cells, methods to observe live membranes. Passive transport through biological membranes. Active transport through biological membranes. Structure of lipid microdomains. Functions of lipid microdomains. Intracellular signalization: secondary messengers. Signalization between cells – Part 1 (hormones and receptors). Signalization between cells – Part 2 (nerve signal transduction, modulation of endocrine cells). Integration of cells into tissues. Enzymes that act on membranes on the membranes –

Medfazna encimatika: $sPLA_2$ kot paradigma medfazne encimatike. Proteini, ki delujejo na membrane in na membranah – porini. Seminarske teme: Metabotropni ali G-protein-sklopljeni receptorji. Ionotropni ali z ligandi-regulirani ionski kanalčki. Encimsko-sklopljeni receptorji. Napetostno-odvisni ionski kanalčki. Presledkovni stiki. Transport proteinov čez jedrno membrano. Transport proteinov čez mitohondrijski membrani. Penetracija proteinskih toksinov v celice. Lipidi in signalizacija. Modifikacije proteinov z lipidi – vrsta in fiziološki pomen.	secreted phospholipases A2 (sPLA2). Interfacial enzymology: sPLA2 as a paradigm. Proteins that act on membranes on the membranes – porins. Seminar themes: Metabotropic or G-protein-coupled receptors. Ionotropic or ligand-gated ion channels. Enzyme linked receptors. Voltage-dependent ion channels. Gap junctions. Transport of proteins over nuclear membrane. Transport of proteins over mitochondrial membranes. Penetration of protein toxins into cells. Lipids and signalization. Modification of proteins by lipids – types of modifications and their physiological role.

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 membranskih sistemov in procesov na membranah. Skozi praktične primere iz literature spoznava pomembnost bioloških membran in dogajanj na njih.	<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 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:**
Ocene: 6-10 (pozitivno), 1-5 (negativno); ob upoštevanju Statuta UL in fakultetnih pravil.		

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:	BIOMIMETIKA
Course Title:	BIOMIMETICS

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 mora imeti predmet vpisan v VIS.	The course has to be assigned to the student in the VIS system.

Vsebina:	**Content (Syllabus outline):**
• Uvod, razlaga osnovnih pojmov • Vpliv kovinskih ionv na oksidativni stres in nastanek prostih radikalov • Vezava kovinskih ionov na antioksidante; antioksodant/prooksidant • Vezava dušika na modelne substance • Vezava kovinskih ionov na biopolimerne molekule-lastnosti, pomen uporaba • Pomen koordinacijskih spojin pri prenosu elektronov - primer umetne fotosinteze Vloga kovinskih ionov pri agregaciji nekaterih proteinov (metalotioenini, prioni,…)	Lectures • Introduction; general terms: Oxidation stress induced by metal ions, Radical species', • Antioxidant/prooxidant, • Binding metal ions to the antioxidants, • Efficiency of antioxidants', Fenton reaction, • Biological nitrogen fixation, model substances • Binding metals to biopolymers (properties, application) • Chemical models of photosynthesis, Metalocenter assembly, Electron transfer in supramolecules, • Role of metal ions at aggregation of proteins (e.g. metalothioenins, prions,…).

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

Predvideni študijski rezultati:	**Intended Learning Outcomes:**
<u>Znanje in razumevanje</u> Študent pozna pomen in delovanje kovin v organizmu.	<u>Knowledge and Comprehension</u> To be able to understand the importance and mechanism of metals in organism.
<u>Uporaba</u> Znanje in razumevanje osnovnih kemijskih zakonitosti vezave kovinskih ionov na biološko pomembne sisteme so pomembni pri nadgradnji nekaterim predmetom pri nadaljnjem študiju.	<u>Application</u> To be able to understand the importance and mechanism of metals in organism.
<u>Refleksija</u> Študent je sposoben oceniti pomen kovinskih ionov za razlago nekaterih pomembnih procesov, ki potekajo v organizmih.	<u>Analysis</u> To be able to understand the importance and mechanism of metals in organism.
<u>Prenosljive spretnosti</u> Študent zna poiskati podatke iz strokovne literature, podatke iz virov medmrežja pa zna kritično oceniti; zna uporabljati strokovni jezik,	<u>Skill-transference Ability</u> Ability of finding and usage of the literature data, interpretation of data, critical analysis of texts relating the topics.

tako pisno kot ustno.	

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:**
Ustni izpit Ustna ocena eksperimentalnih in seminarskih vaj Ocenjevanje študentov med seboj (peer assessment) Ocene od 6-10 (pozitivno) oz. 1-5 (negativno), ob upoštevanju Statuta UL in fakultetnih pravil		Oral exam: Oral assessment of experimental and seminar exercises. Student per assessment. Assessments 6-10 (positive) and 1-5 (negative), in accordance to the UL Statute and faculty rules.

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:	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: izbirni strokovni / Elective Professional

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 mora imeti predmet vpisan v VIS.	The course has to be assigned to the student in the VIS system.

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:**
Opravljena seminarska naloga, laboratorijske vaje in pisni izpit. Ocene: 6-10 (pozitivno), 1-5 (negativno); ob upoštevanju Statuta UL in fakultetnih pravil.		

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	**/**	**2.**	**3.**
USP Biochemistry, 2nd Cycle	**/**	**2nd**	**3rd**

Vrsta predmeta / Course Type: izbirni temeljni / Elective Fundamental

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. Jurij Svete / Dr. Jurij Svete, Full Professor

Jeziki / Languages:

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

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	Prerequisites:
Študent mora imeti predmet vpisan v VIS.	The course has to be assigned to the student in the VIS system.

Vsebina:	Content (Syllabus outline):
A) Struktura in reaktivnost: intramolekulski tok elektronov, medmolekulski prenos elektronov in protonov; vplivi na kemijske transformacije organskih molekul; reaktivni intermediati v bioorganski kemiji. **B) Transformacije organskih molekul**: - termične in biomimetske transformacije ogljikovih, dušikovih, kisikovih in fosforjevih atomov - elektrokemijske in fotokemijske transformacije; biomimetske oksidacije in redukcije **C) Reakcijski sistemi:** - transformacije na polimernih sistemih - biotransformacije	A) **Structure and reactivity**: Intramolecular electron flow, intramolecular electron and proton transfer; influence on chemical transformations of organic molecules; reactive intermediates in bioorganic chemistry. B) **Transformations of organic compounds**: - thermal and biomimetic transformations of carbon, nitrogen, oxygen, and phosphorous atoms - electrochemical and photochemical transformations; biomimetic oxidations and reductions C) **Reaction systems**: - transformations on polymer systems - biotransformations

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 in predstaviti biomimetske metode pretvorb organskih molekul. Cilj je poglobljeno spoznavanje vpliva konfiguracij ogljikovih in heteroatomov, konformacij molekul ter konjugacij elektronov na donorske in akceptorske lastnosti molekul. Razumevanje intramolekularnega in medmolekularnega toka elektronov in prenosa protonov je pomembno za interpretacije biotransformacij. Poudarek je tudi na razumevanju interakcij bioaktivnih molekul s supramolekularnimi in biološkimi sistemi.	To obtain basic knowledge on the fundamentals of bioorganic chemistry and biomimetic methods for transformation of organic compounds. In-depth knowledge on the influence of configuration at carbon and heteroatoms, conformation, and conjugation of electrons to donor-acceptor properties of molecules. Understanding intramolecular and intermolecular electron flow and proton transfer is important for interpretation of biotransformations. Special focus is dedicated to understanding interactions between bioactive molecules and supramolecular biological systems.
Predvideni študijski rezultati:	**Intended Learning Outcomes:**
Znanje in razumevanje Študent pri predmetu pridobi poglobljeno razumevanje intramolekularnega in medmolekularnega toka elektronov ter prenosa protonov v transformacijah organskih molekul. Podrobneje spozna intermediate ogljikovih, dušikovih, fosforjevih in kisikovih atomov in funkcionalnih skupin (kation in anion radikali, kationi, anioni, radikali) ter vzbujena stanja molekul. Bolje razume vplive reakcijskih pogojev (agregatna stanja-trdno-tekoče-plin, energetski okvir transformacij, katalizatorji) na biomimetske in biotransformacije organskih molekul.	Knowledge and Comprehension The student acquires a profound knowledge of intra- and intermolecular electron flow and proton transfer in transformations of organic molecules. The student knows in more detail intermediates of carbon, nitrogen, phosphorous, and oxygen atom intermediates and functional groups (cation and anion radicals, cations, anions, radicals) and excited states of the molecules. The student better understands the influence of reaction conditions (solid/liquid/gaseous state of matter, energy of transformations, catalysts) on biomimetic and biotransformations of organic molecules.
Uporaba Študij tega predmeta omogoča razumevanje osnovnnih principov raziskovalnih metod. Študent bolje razume vpliv strukture	Application The study of this subject enables understanding of basic principles of research methods. The student better understands the influence of

organskih molekul in reakcijskih pogojev na biotransformacije. Z uporabo spektoskopskih in analiznih metod na vajah zna študent povezati tudi strukturo molekul z lastnostmi in reaktivnostjo spojin.	reaction conditions on biotransformations. On the basis of spectroscopic methods, the student is able to connect the structure of the molecules with their properties and reactivity.
Refleksija Kritično vrednotenje rezultatov pri vajah na osnovi teoretičnega znanja. Študent pridobi občutek za fizikalno-kemijski način razmišljanja in analizo reakcijskih sistemov ter razvije tudi zmožnost abstraktnejše predstave transformacij organskih molekul.	Analysis Critical evaluation of the results obtained in the laboratory trainings. The student acquires the sense for physico-chemical way of thinking and analysis of reaction systems. The student develops ability of abstract understanding of transformations of organic molecules.
Prenosljive spretnosti Študent pridobi laboratorijske spretnosti in zna eksperimentalne podatke ustrezno obdelati in primerno interpretirati. Uporaba že pridobljenega znanja iz organske, fizikalne in analizne kemije ter spektroskopije.	Skill-transference Ability The student better understands the influence of reaction conditions - collection, interpretation, and critical data evaluation. Application of the knowledge on physical and analytical chemistry and spectroscopy.

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:**
a) opravljene laboratorijske vaje; ocenjevanje laboratorijskih vaj se opravi pri pisnem in ustnem izpitu. b) pisni in ustni izpit: pozitivno (6-10); negativno (1-5)		Finished laboratory course, written and oral exam.

Reference nosilca / Lecturer's references:

- ŠENICA, Luka, GROŠELJ, Uroš, KASUNIČ, Marta, KOČAR, Drago, STANOVNIK, Branko, SVETE, Jurij. Synthesis of enaminone-based vinylogous peptides. *European journal of organic chemistry*, ISSN 1434-193X, str. 1-5, ilustr. http://onlinelibrary.wiley.com/doi/10.1002/ejoc.201402033/pdf, doi: 10.1002/ejoc.20140203. [COBISS.SI-ID 1695535].
- NOVAK, Ana, TESTEN, Ana, BEZENŠEK, Jure, GROŠELJ, Uroš, HRAST, Martina, KASUNIČ, Marta, GOBEC, Stanislav, STANOVNIK, Branko, **SVETE, Jurij**. Synthesis of pyrazolo[1,2-a]pyrazole-based peptide mimetics. Tetrahedron, ISSN 0040-4020. [Print ed.], aug. 2013, vol. 69, no. 32, str. 6648-6665, ilustr., doi: 10.1016/j.tet.2013.05.122. [COBISS.SI-ID 36732421]
- AHMETAJ, Sizana, VELIKANJE, Nina, GROŠELJ, Uroš, ŠTERBAL, Ines, PREK, Benjamin, GOLOBIČ, Amalija, KOČAR, Drago, DAHMANN, Georg, STANOVNIK, Branko, **SVETE, Jurij**. Parallel synthesis of 7-heteroaryl-pyrazolo [1,5-a]pyrimidine-3-carboxamides. Molecular diversity, ISSN 1381-1991, 2013, vol. 17, no. 4, str. 731-743, ilustr. http://link.springer.com/content/pdf/10.1007%2Fs11030-013-9469-3.pdf, doi: 10.1007/s11030-013-9469-3. [COBISS.SI-ID 1608495]

UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	CELIČNO INŽENIRSTVO
Course Title:	CELL ENGINEERING

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: BI2I02

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. Robert Zorec / Dr. Robert Zorec, Full Professor

Jeziki / Languages:

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

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	Prerequisites:
Študent mora imeti predmet vpisan v VIS.	The course has to be assigned to the student in the VIS system.

Vsebina:	Content (Syllabus outline):
Študent se nauči tehnologij gojenja živalskih in humanih celic v obliki kultur, spozna načela novih strategij zdravljenja s celičnimi pripravki. Celično inženirstvo povezuje uporabo načel inženirstva in znanosti za uporabo in razumevanje temeljnih celičnih procesov (struktura-funkcija) v normalnih in patoloških celicah in tkivih sesalcev za razvoj bioloških terapevtskih pripravkov. V okviru predavanj, vaj in seminarjev študent spozna temelje priprave celičnih terapevtskih pripravkov na področju zdravljenja rakavih bolezni, korektivnih ukrepov pri zdravljenju kostnih defektov, hrustanca in kože. Spozna norme, ki jih je potrebno pri takem delu upoštevati in spozna se tudi z nadgradnjo	The student will learn new principles in treatment of diseases using cells. Cell engineering uses principles of engineering and science to develop biological therapies. Lectures and practical training will cover the principles of cell therapy development for treatment of cancer, corrections of bone defects, cartilage and skin. The student will upgrade the knowledge acquainted at the course Fundamental Physiology. The student will learn to culture primary and clonal cells, the method of staining cellular organelles in live cells, propagate the stem cells, prepare immuno-hybridoma cell products, and evaluate cell products. The course will also cover the function of ion channels in pathological

fizioloških temeljev delovanja tistih sistemov, ki so bili le omenjeni pri predmetu Temelji fiziologije (imunski sistem, debelost in adipociti, presajanje celice beta v endokrini pankreas, priprava celic za tkivna polnila: osteogene celice in fibroblasti). Ob tem se študent spozna z metodami gojenja evkariontskih celic v obliki primarnih in klonalnih kultur, z metodami za označevanje subcelularnih organelov v živih celicah, z metodami za propagacijo zarodnih celic tkiv, z metodami za pripravo imunohibridomov, z metodami evalvacije kvalitete celičnih pripravkov. Spozna se z delovanjem ionskih kanalov v bolezenskih stanjih, z metodami za študij ionskih kanalov, za študij sekrecije hormonov in nevrotransmiterjev, metode mikrospektrofluorimetrije za detekcijo anionov in kationov v posamezni evkariontski celici in molekularne sonde za spremljanje delovanja celice in celičnih predelkov. Spozna strategije za uporabo imunoterapije in imunohibridomov.	conditions, the study of hormone and neurotransmitter release, microspectrofluorimetry for the detection of ions in a single cell. The student will learn strategies in immunotherapy and immunohybridoma cells.

Temeljna literatura in viri / Readings:

- N. Sperelakis (1998). Cell Physiology 2nd edition. Academic Press, izbrana poglavja (30 %).
- Celično inženirstvo – Navodila za vaje. Avtorji: Marko Kreft, Helena Chowdhury, Nina Vardjan, Maja Potokar, Mateja Gabrijel, Robert Zorec

Dodatna literatura:

- R. P. Lanza, Robert Langer , Joseph P. Vacanti (2000) Principles of Tissue Engineering. 2nd edition, Academic Pr.
- C. Ratledge in B. Kristiansen (2001) Basic Biotechnology, 2nd edition, Cambridge University Press
- F.M. Ashcroft (2000) Ion Channels and Disease, Academic Press
- J. Phillips, P. Murray, P. Kirk (2001) The Biology of Disease, 2nd edition, Blackwell Publishing
- Tekoča periodika in zlasti pregledni članki.

Cilji in kompetence:	**Objectives and Competences:**
Cilj predmeta je povezovanje znanja o primarnih fizioloških in bioloških mehanizmih na ravni molekul in celičnih predelkov v okvir delovanja posamezne celice in celotnega organizma v normalnih in patoloških razmerah. Kompetence študentov so povezovanje znanja fizioloških in bioloških mehanizmov na ravni molekul povezati s	Ability to use the knowledge of physiology for strategies of medical treatment of disease using cell engineering. The student will learn experimental techniques in cell engineering, used in practice. Students will also learn about legislation, which regulates this new field in biotechnology.

strategijami zdravljenja nekaterih bolezni z rabo pristopov celičnega inženirstva. Študent se nauči raziskovalnih tehnologij v celičnem inženirstvu in pridobi znanja izbranih primerov celičnega inženirstva, ki se uporabljajo v praksi. Pridobi tudi okvir regulative, ki ureja to novo področje v biotehnologiji.	

Predvideni študijski rezultati:	**Intended Learning Outcomes:**
Znanje in razumevanje Pri predmetu Celično inženirstvo študent poveže znanje o primarnih fizioloških in bioloških mehanizmih na ravni molekul in celičnih predelkov v okvir delovanja posamezne celice in celotnega organizma v normalnih in patoloških razmerah. Na podlagi tega znanja študent razume strategije zdravljenja nekaterih bolezni in pristope celičnega inženirstva.	Knowledge and Comprehension The learning outcomes will be the synthesis of knowledge on primary physiological and biological mechanisms on the level of molecules and cellular compartments with the mechanisms on the level of cells and organisms in physiological and pathological conditions.
Uporaba Študij predmeta Celično inženirstvo je nujna podlaga za delo na področju celičnega inženirstva, bioinženirstva in nekaterih področij biotehnologije.	Application Ability to use the knowledge of physiology for strategies of medical treatment of disease using cell engineering.
Refleksija Študent poveže temeljno znanje fiziologije s strategijami zdravljenja nekaterih bolezni.	Analysis The student will link basic physiology knowledge with strategies in disease treatment.
Prenosljive spretnosti Študent se nauči raziskovalnih tehnologij v celičnem inženirstvu in pridobi znanja izbranih primerov celičnega inženirstva, ki se uporabljajo v praksi. Pridobi tudi okvir regulative, ki ureja to novo področje v biotehnologiji.	Skill-transference Ability The student will learn experimental techniques in cell engineering, used in practice. Students will also learn about legislation, which regulates this new field in biotechnology.

Metode poučevanja in učenja:	**Learning and Teaching Methods:**
Predavanja, laboratorijske vaje, seminarji, simulacije eksperimentov.	Lectures, seminars, practical training.

Načini ocenjevanja:	Delež (v %) / Weight (in %)	**Assessment:**
Študenti vodijo dnevnik in opravljajo pisni kolokvij, ki je namenjen preverjanju znanja, pridobljenega na vajah. Po uspešno opravljenem kolokviju študenti opravljajo še izpit. Ocene: od 6-10 pozitivno, 1-5	**50%** **50%**	Exam 50 % Test for practical training 50 %

negativno, ob upoštevanju Statuta UL in fakultetnih pravil.		

Reference nosilca / Lecturer's references:

- **Zorec R**, Henigman F, Mason WT and Kordaš M (1991) Electrophysiological Study of Hormone Secretion by single Adenohypophyseal Cells. *Methods in Neurosciences* 4: 194-210
- Lledo P-M, Vernier P, Didier J-D, Mason WT and **Zorec R** (1993) Inhibition of Rab 3B expression attenuates Ca^{2+}-dependent exocytosis in rat anterior pituitary cells. *Nature* 364: 543-544.
- Mateja Gabrijel, Urška Repnik, Marko Kreft, Sonja Grilc, Matjaž Jeras and **Robert Zorec** (**2004**) Quantitative Assesment Of Cell Hybridoma Yields With Confocal Microscopy And Flow Cytometry. *Biochemical and Biophysical Research Communications* 314: 717-723.

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 Koridiš, Associate Professor

Jeziki / Languages:

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

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

Študent mora imeti predmet vpisan v VIS.

Prerequisites:

The course has to be assigned to the student in the VIS system.

Vsebina:

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.

Content (Syllabus outline):

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:	**Objectives and Competences:**
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.	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:	**Intended Learning Outcomes:**
<u>Znanje in razumevanje</u> 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.	<u>Knowledge and Comprehension</u> 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.
<u>Uporaba</u> 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.	<u>Application</u> 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:**
Predavanja: pisni izpit; opravljanje izpita v enem delu. Laboratorijske vaje: vodenje dnevnika, pisni kolokvij. Ocene: 6-10 (pozitivno), 1-5 (negativno); ob upoštevanju Statuta UL in fakultetnih pravil.		

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:	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 mora imeti predmet vpisan v VIS.	The course has to be assigned to the student in the VIS system.

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:**
Znanje in razumevanje 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.	Knowledge and Comprehension 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.
Uporaba 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.	Application 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).
Refleksija Pri predmetu gre predvsem za refleksijo lastnega razumevanja predmeta ter poskus kritičnega ovrednotenja uporabnosti modernih tehnoloških metod in aplikacij na področju razvoja zdravil.	Analysis 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.
Prenosljive spretnosti 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.	Skill-transference Ability 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:
Seminarska naloga, pisni in po potrebi še ustni izpit. Ocene: 6-10 (pozitivno), 1-5 (negativno); ob upoštevanju Statuta UL in fakultetnih pravil.		Seminar, written exam (oral if needed).

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:	KEMIJA BIOMOLEKUL
Course Title:	CHEMISTRY OF BIOMOLECULES

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: BI2I12

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

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

Jeziki / Languages:

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

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	Prerequisites:
Študent mora imeti predmet vpisan v VIS.	The course has to be assigned to the student in the VIS system.

Vsebina:	Content (Syllabus outline):
Ogljikovi hidrati. Tipične lastnosti monosaharidov, oligosaharidov in polisaharidov. Kemijske in spektroskopske metode za določanje strukture monosaharidov. Blokada glikozidne OH skupine in pravih alkoholnih skupin. Pregled sinteznih metod: descendentne in ascendentne sinteze. Sprememba konfiguracije na enem, dveh ali več kiralnih centrih. Načini sinteze oligosaharidov. Sinteze s tvorbo nove glikozidne vezi. Sinteza na trdnem nosilcu. Polisaharidi. Heteropolisaharidi: glikoproteini in proteoglikani. Metode določanja strukture polisaharidov. *Amino kisline.* Lastnosti aminokislin. Priprava α-aminokislin. Aminiranje, reduktivno	Carbohydrates, their properties. Chemical and spectroscopic methods for structure determination of monosaccharides. Interconversion of monosaccharides: inversion of configuration at the chiral centres, other methods. Oligosaccharides and polysaccharides: synthesis of oligosaccharides, properties of glycoproteins and proteoglycans, structure determination of simple polysaccharides. Amino acids. Synthesis of α-amino acids. Asymmetricsynthesis. β-amino acids. Other amino acids. Typical transformations of α-amino acids. Formation of the peptide bond. Activation of the carboxylic component. Activation of N-terminal α-amino acid. Azide method, mixed anhydrides, application of carbodiimides, CDI

aminiranje in aminiranje s premestitvami. Sinteze preko izocianidov. Kondenzacija aldehidov z aktivnimi metilenskimi spojinami. Asimetrične sinteze. β-Aminokisline. Ostale aminokisline. Reakcije aminokislin. Oksidativno deaminiranje. *N*-Alkiliranje in *N*-aciliranje. *N*-Amino derivati. Nekatere zaščite aminskega in karboksilnega dela molekule. Primeri tvorbe peptidne vezi. *Nukleozidov in nukleotidi.* Osnovne karakteristike nukleozidov. *N*-nukleozidi. Načini sintez preko srebrovih in živosrebrovih soli. Uporaba dialkoksi pirimidinov ter sililnih derivatov purinov in pirimidinov. Tvorba heterocikličnega obroča po glikozilaciji. Inter-konverzija nukleozidov. Ciklonukleozidi. Aciklo nukleozidi. *C*-nukleozidi: interkonverzija *C*-nukleozidov, Noyori-jeva sinteza. Reakcije nukleozidov. Tvorba nukleotidov. Uvedba difosfatne skupine. Pristop k sintezi oligonukleotidov. *Terpeni in steroidi.* Karakteristike terpenov, monoterpeni, seskviterpeni, diterpeni, triterpeni in tetraterpeni. Primer izolacije in aplikacije monoterpena v večstopenjski sintezi. Steroidi, osnovni tipi steroidov, steroli in žolčne kisline. Nekatere transformacije steroidov. Laboratorijske vaje: izvedba večstopenjskih sintez s področja aminokislin, terpenov in steroidov.	and similar reagents. Synthesis on solid supports. Nucleosides and nucleotides: N-nucleosides, cyclonucleosides, acyclo nucleosides, C-nucleosides: Noyori synthesis, typical reactions ofnucleosides. Nucleotides: protection of the sugar, base and the phosphate group. Formation of internucleotide bond. Terpenes and steroids. Monoterpenes and sequiterpenes. Diterpenes. Triterpenes and tetraterpenes: squalene, β-carotene, licopene. Isolation and application of monoterpene in multistep synthesis. Steriods. Clasification and properties. Sterols. Bile acids and bile. Transformations of steroids.

Temeljna literatura in viri / Readings:

- J. Mann, R. S. Davidson, J. B. Hobbs, D. V. Banthrope, J. B. Harborne: Natural Products. Their Chemistry and Biological Significance, Longman, Harlow, 1995, 455 pp (approximately 130 pages).
- N. L. Benoiton: Chemistry of Peptide Synthesis, CRC Press, Taylor & Francis Group, 2006, 290 pp (approximately 70 pages).

Cilji in kompetence:	**Objectives and Competences:**
Študent pozna osnovne karakteristike nekaterih biološko pomembnih spojin. Obvlada principe njihove priprave, transformacij in uporabe pri sintezi primernih derivatov. Spozna uvedbo in odcep osnovnih zaščitnih skupin. Pridobljeno znanje mu omogoča načrtovanje sintez nekaterih	The course represents an upgrade of the subjects given by previous organic courses (Organic Chemistry I, Organic Chemistry II and Organic Chemistry III or similar courses). Gives the knowledge of some approaches to the synthesis of biologically important compounds, interconversion of the later as well as their

naravnih spojin in njihovih derivatov.	application in the synthesis of various derivatives. Offers typical methods for the introduction and the cleavage of the protecting groups. Competences: Ability to plan and execute the synthesis of organic compounds that are used in pharmaceutical industry, agrochemistry, material sciences etc.

Predvideni študijski rezultati:	**Intended Learning Outcomes:**
Znanje in razumevanje Poznavanje strukture pomembnih bioloških spojin, njihove reaktivnosti in različnih možnosti njihovih transformacij.	Knowledge and Comprehension Student understands and is familiar with: -structures of important biological compounds -reactivity and basic transformations of biological compounds.
Uporaba Poznavanje navedene vsebine bo omogočilo razviti sposobnost študenta, da pridobljeno znanje uporabi v razumevanju bioloških procesov.	Application Mastered knowledge will help student to solve different synthetic problems.
Refleksija Zavedanje, da lahko z enostavnimi substrati, ki jih študent spozna pri tem predmetu, učinkovito rešimo sicer zapletene poti do številnih biološko aktivnih spojin.	Analysis Student is capable of recognising different types of biological compounds and also plans their transformations.
Prenosljive spretnosti Pri predmetu se študenti z reševanjem različnih problemov izurijo v uporabi znanja, analitičnega mišljenja in uporabe literaturnih virov.	Skill-transference Ability During the course, student will be able to solve theoretical problems, improve his analytical way of thinking and get familiar with literature sources.

Metode poučevanja in učenja:	**Learning and Teaching Methods:**
Predavanja in laboratorijske vaje.	Lectures, seminar work, training by analytically solving theoretical problems.

Načini ocenjevanja:	Delež (v %) / Weight (in %)	**Assessment:**
Ocenjene vaje in pisni izpit. 1-5 negativno, 6 zadostno, 7 dobro, 8 in 9 prav dobro, 10 odlično.		

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:	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
/	**/**	**/**	**/**	**375**	**375**	**25**

Nosilec predmeta / Lecturer: /

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

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	Prerequisites:
Študent mora imeti predmet vpisan v VIS.	The course has to be assigned to the student in the VIS system.

Vsebina:	Content (Syllabus outline):
Magistrsko delo se opravlja iz področja biokemije. Vsebina in naslov se določata v soglasju z izbranim mentorjem . 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 zagovarjanja dela pred strokovno komisijo. Študent bo v času opravljanja magistrskega dela delovni mentor najmanj enemu študentu, ki bo opravljal diplomsko delo na univerzitetnem dodiplomskem programu Biokemija, in tako dobil izkušnje pri uvajanju sodelavcev v laboratorijsko delo in pri delu v skupini.	Master's thesis is in the area of biochemistry. The topic and the tile are agreed 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 stage) 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:	**Objectives and Competences:**
Dokončno oblikovanje pričakovanega lika magistra biokemije - 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; - sposobnost 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 - sposobnost vodenja laboratorijskega dela - sposobnost neodvisnega in samostojnega nadaljnjega izobraževanja	Final formation of a Biochemistry MSc profile: - Ability for independent following current professional literature; - Ability to use previous knowledge and cope with the complexity of problems, ability to 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; - Ability 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; - Ability to guide laboratory work (of junior students); - Ability to carry on with independent and autonomous education.

Predvideni študijski rezultati:	**Intended Learning Outcomes:**
<u>Znanje in razumevanje</u> Študent bo poglobil znanje na področju teme magistrskega dela .	<u>Knowledge and Comprehension</u> Students will deepen their knowledge in the field of the chosen master thesis.
<u>Uporaba</u> Znanje in pridobljene veščine bo študent lahko uporabil pri opravljanju poklica.	<u>Application</u> Knowledge and skills will be useful for student's professional career.
<u>Refleksija</u> Povezovanje vseh pridobljenih teoretičnih znanj z reševanjem problemov na področju biokemije ter kritični pogled na uporabnost teh znanj.	<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 in zagovor magistrskega dela pred komisijo, ki jo sestavljajo predsednik, mentor in en član. Lestvica ocen vsakega dela je od 1 do 10. Ocene 1 do 5 so negativne, 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 1- 10 (grades from 6 to 10 are positive and 1 - 5 negative (6 - pass, 7 - fair, 8 and 9 - very good, 10 - excellent).

Reference nosilca / Lecturer's references:

/

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: izr. prof. dr. Kristina Djinović Carugo /
Dr. Kristina Djinović Carugo, Associate 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 mora imeti predmet vpisan v VIS.

Prerequisites:

The course has to be assigned to the student in the VIS system.

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.

Nuklearna magnetna resonanca
Osnove NMR - teoretične osnove: opis razvoja

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

Nuclear Magnetic Resonance
Basics of NMR – theoretical background:

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	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. **NMR**	<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.	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:**
- Predavanja: pisni izpit po koncu 7. semestra. - Laboratorijske vaje: pisno poročilo o delu izvedenemu na vajah v slogu poročila v Acta Cryst E. Ocene: 6-10 (pozitivno), 1-5 (negativno); ob upoštevanju Statuta UL in fakultetnih pravil.		- Lectures written exam at the end of 7th semester - Laboratory exercises: written report about work following requirements of Acta Cryst. E. Marks: 6-10 (pass), 1-5 (not passed)

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 izr. izr. prof. dr. Kristina Djinović Carugo / Dr. Kristina Djinović Carugo, Associate Professor

Jeziki / Languages:

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

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

Študent mora imeti predmet vpisan v VIS.
Predmet zahteva opravljene obveznosti iz predmeta Metod določanja 3D strukture makromolekul.

Prerequisites:

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

Vsebina:

- Uporaba mehkih rentgenskih žarkov v makromolekularni kristalografiji
- Škoda zaradi rentgenskega žarčenja v makromolekularni kristalografiji (radiation damage)
- Časovno razločeni eksperimenti v makromolekularni kristalografiji (time-resolved)
- NMR spektri višjih dimenzij v povezavi z avtomatsko asignacijo
- Moderni pristopi v NMR (asignacija preko heteroatomov, ang. *protoneless NMR*)

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)
- Dynamic properties of macromolecules (intrinsically unstructured proteins)

• Dinamične lastnosti makromolekul (naravno nestrukturirani proteini, ang. *intrinsically unstructured protein*s) • 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 • Atomic force microscopy (AFM) • Napoved in preveritev/potrditev interaktoma (napoved interakcij proteinov z uporabo informacij o njihovi 3D strukturi) • Napoved funkcije proteina (napoved funkcije novega protein preko analize znane/ih 3D struktur) • Masna spektroskopija za strukturno biologijo • Diferenčna termična kalorimetrija, izotermna kalorimetrija (DSC, ITC)	• 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 • Differential scanning calorimetry, Isothermal titration calorimetry (DSC, ITC)

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:**

Znanje in razumevanje 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. 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.	Knowledge and Comprehension 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 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:**
Predavanja: ustni izpit po koncu 8. semestra. Laboratorijske vaje: interaktivno, individualno delo z učitelji. Seminar: ustna predstavitev enega izmed študentom predlaganih preglednih člankov iz primarne literature. Ocene: 6-10 (pozitivno), 1-5 (negativno); ob upoštevanju Statuta UL in fakultetnih pravil.		

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: izr. prof. dr. Marko Dolinar / Dr. Marko Dolinar, Associate Professor

Jeziki / Languages:

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

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

Študent mora imeti predmet vpisan v VIS.

Prerequisites:

The course has to be assigned to the student in the VIS system.

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.

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.

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	Skill-transference Ability
Urejanje spletnih strani v okolju Wikimedia. Predstavljanje strokovnih vsebin in argumentirano razpravljanje o temah s področja biotehnologije.	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:**
Pri končni oceni štejejo: - priprava in predstavitev seminarja - sodelovanje pri seminarjih - poročila z vaj - odgovori na izpitna vprašanja (pri izpitu je petina vprašanj z vaj, izpit je ustni)		Seminar preparation and presentation Engagement in seminar discussions Laboratory practicals reports Oral examination (includes one fifth of questions from 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
55	**20**	**/**	**/**	**/**	**75**	**5**

Nosilec predmeta / Lecturer: prof. dr. Radovan Komel / Dr. Radovan Komel, Full Professor
izr. prof dr. Boris Rogelj / Dr. Boris Rogelj, Associate Professor

Jeziki / Languages:

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

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	Prerequisites:
Študent mora imeti predmet vpisan v VIS.	The course has to be assigned to the student in the VIS system.

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 8. Biosinteza proteinov 9. Človekov kariotip	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) Human protein expression.

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	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.

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
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	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

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 zagovarjanju stališč.	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.

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	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

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.	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.
<u>Uporaba</u> Poosebljena medicina – skorajšnja uporaba v medicinski praksi. Povezava spoznanj s sorodnih področij znanosti (genetika, molekularna genetika in molekularna biologija). Metode za analizo genoma in transkriptoma ter molekularnogenetske diagnostične metode.	<u>Application</u> Personalised medicine - the perspectives for 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.
<u>Refleksija</u> Navidezni razkorak med stabilnostjo človekovega genoma in raznolikostjo njegovega izražanja. Smisel nekodirajočih zaporedij v genomu – pojem sebičnega gena. Širjenje lastnosti polipeptidov kot posledica	<u>Analysis</u> 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

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.	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:**
Pri končni oceni šteje ocena seminarja 30 % ocene in odgovori na izpitna vprašanja 70 % končne ocene. Znanje preverjamo s pisnim izpitom. Ocenjevalna lestvica je takšna, kot jo predpisuje pravilnik o ocenjevanju.	**30 %** **70 %**	Project/seminar Written examination

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. 2014. [http://www.hindawi.com/journals/tswj/2014/260348/, doi: 10.1155/2013/260348]
- KOČEVAR Nina, FRKOVIĆ-GRAZIO Snježana, **KOMEL Radovan**: Two-dimensional gel electrophoresis of gastric tissue in an alkaline pH range. Proteomics, ISSN 1615-9853; 2014, vol. 14, iss. 2/3, pp. 311-321. [http://onlinelibrary.wiley.com/doi/10.1002/pmic.201200574/abstract;jsessionid=08F4170B5ADB048355BC3E072B59F3E7.f02t02, doi: 10.1002/pmic.201200574]
- KASTELIC Damjana, SOLER Nicolas, **KOMEL Radovan**, POMPON Denis: The Global Sequence Signature algorithm unveils a structural network surrounding heavy chain CDR3 Loop in Camelidae variable domains. Biochimica et Biophysica Acta (G). General Subjects, ISSN 0304-4165; 2013, vol. 1830, issue 6, pp. 3373-3381. [doi: 10.1016/j.bbagen.2013.02.014]

- PREGELJ Peter, NEDIĆ Gordana, VIDETIČ Alja, ZUPANC Tomaž, NIKOLAC Matea, BALAŽIC Jože, TOMORI Martina, **KOMEL Radovan**, MUCK SELER Dorotea, PIVAC Nela: The association between brain-derived neurotrophic factor polymorphism (BDNF Val66Met) and suicide. Journal of Affective Disorders, ISSN 0165-0327; 2011, vol. 128, issue 3, pp. 287-290. [doi: 10.1016/j.jad.2010.07.001]
- VIDETIČ Alja, PETERNELJ Tina Tinkara, ZUPANC Tomaž, BALAŽIC Jože, **KOMEL Radovan**: Promoter and functional polymorphisms of HTR2C and suicide victims. Genes, Brain and Behavior, ISSN 1601-1848; 2009, issue 5, vol. 8, pp. 541-545. [doi: 10.1111/j.1601-183X.2009.00505.x]
- KASTELIC Damjana, FRKOVIĆ-GRAZIO Snježana, BATY Daniel, TRUAN Gilles, **KOMEL Radovan**, POMPON Denis: A single-step procedure of recombinant library construction for the selection of efficiently produced llama VH binders directed against cancer markers. Journal of Immunological Methods, ISSN 0022-1759; 2009, vol. 350, no. 1-2, pp. 54-62. [doi: 10.1016/j.jim.2009.08.016]

- 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:	MOLEKULARNA RAZLAGA BIOLOŠKIH SISTEMOV
Course Title:	MOLECULAR INTERPRETATION OF BIOLOGICAL SYSTEMS

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: BI2I11

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

Nosilec predmeta / Lecturer: prof. dr. Barbara Hribar Lee / dr. Barbara Hribar Lee, Full Professor

Jeziki / Languages:

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

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	Prerequisites:
Študent mora imeti predmet vpisan v VIS.	The course has to be assigned to the student in the VIS system.

Vsebina:	Content (Syllabus outline):
Osnove: Opis mikroskopskega stanja in statistična vsota, kanonična porazdelitev, Boltzmannova porazdelitev, povprečja in kolebanja okoli povprečne vrednosti, povezava s termodinamiko, izoliran sistem, odprt sistem, koncentracijska kolebanja, stisljivost in stabilnost sistema. Neodvisni podsistemi: Einsteinov model kristala, razredčeni plini, kemično ravnotežje, adsorbcija (Langmuirjeva izoterma). Aplikacija na biokemijske sisteme: Vezanje ligandov na makromolekule (vezavne krivulje), kooperativnost-fazni prehodi biološko pomembnih makromolekul, lastnosti polimerov skozi mrežne modele ("lattice models"). Osnove zvijanja proteinov v naravno	Introduction: The description of microscopic state of the system; partition function; canonical ensemble; Boltzmann distribution; fluctuations; thermodynamic relations; isolated system; open system; compressibility and the system stability. Independent subsystems: Einstein crystal; diluted gasses; chemical equilibrium; adsorption (Langmuir isotherm). Application to biological systems: Ligand binding (adsorption isotherms), cooperativity – phase transitions of biological molecules; lattice models of polymers. Fundamentals of protein folding. Classical statistical thermodynamics: Microscopic structure of liquids; distribution

konformacijo (“protein folding”). Klasična statistična termodinamika: Struktura tekočin in prostorske porazdelitvene funkcije, termodinamične količine (notranja energija, enačba stanja), povezava z eksperimentom, računalniške simulacije (metoda Monte Carlo, molekulska dinamika) kot orodje za študij obnašanja raztopin makromolekul. Vloga topila v bioloških sistemih: Lastnosti vode kot univerzalnega topila, solvatacija, hidrofobnost, stabilnost raztopin proteinov-Hofmeistrova vrsta.	functions; thermodynamic functions (internal energy, equation of state); experimental interpretation; computer simulations (Monte Carlo method, molecular dynamics) as tools for studying the properties of the solutions of macromolecules. Solvent in biological systems: Properties of water as universal solvent; salvation; hydrophobicity; protein stability – Hofmeister series.

Temeljna literatura in viri / Readings:

- Dill, K. A., Bromberg, S., Molecular Driving Forces: Statistical Thermodynamics in Chemistry and Biology, New York: Garland Science, 2003.
- Friedman, H. L., A Course in Statistical Mechanics, New Jersey: Prantice-Hall, 1985.
- Hill, T. L., Introduction to Statistical Thermodynamics, Reading: Addison-Wesley, 1960.

Cilji in kompetence:	**Objectives and Competences:**
Veda, ki omogoča, da iz podatkov o lastnostih atomov in molekul ter sil med njimi izpelje makroskopske lastnosti snovi, je statistična termodinamika. Na ta način omogoča razumevanje naravnih zakonitosti in molekularno interpretacijo merskih podatkov. V prvem delu predmet obravnava osnove statistične termodinamike, le-te omogočajo globje razumevanje pojavov kot so toplota, entropija, termodinamično povprečje, kolebanje okoli povprečne vrednosti in drugi. Drugi del predmeta je namenjen prikazu primerov uporabe statistične termodinamike v kemiji s poudarkom na biološko pomembnih sistemih. Ker obnašanja raztopin biološko pomembnih molekul ne moremo razložiti brez upoštevanja vloge molekul topila, predmet na koncu posebej obravnava vodo kot najpomembnejše topilo v teh sistemih.	The statistical thermodynamics uses the properties of atoms and molecules to obtain from them the macroscopic properties of the systems. As such, it contributes to understanding of the natural laws, as well as the molecular interpretation of the experimental data. In the first part of the course the basics of the statistical thermodynamics is learned that enables the deeper understanding of the quantities such as heat, entropy, thermodynamic averages, fluctuations ... In the second part of the course, the statistical thermodynamics is applied to different problems taken from biologically important systems. The last part of the course is dealing with water as the most important solvent in the biological systems.

Predvideni študijski rezultati:	**Intended Learning Outcomes:**
Znanje in razumevanje Poznavanje osnov statistične termodinamike biološko pomembnih sistemov, ki jih	Knowledge and Comprehension The basic knowledge of the statistical thermodynamics enables a deeper

obravnava ta predmet, omogoča globlje razumevanje obnašanje teh sistemov na molekularnem nivoju in interpretacijo eksperimentalnih podatkov.	understanding of these systems on the molecular level, as well as the interpretation of the experimental data.
Uporaba Principi statistične termodinamike omogočajo konstrukcijo in študij modelov, kakršne široko uporabljajo v farmacevtski industriji, pa tudi pri načrtovanju različnih drugih tehnoloških procesov kot so ionska izmenjava, desalinacija vode ...	Application The principles of the statistical thermodynamics are the starting point for the construction and interpretation of the models, that are broadly used in the pharmaceutical industry, as well as in other technological processes, such as ion exchange, desalination, ...
Refleksija Znanja in veščine, ki jih študent osvoji pri tem predmetu, mu pomagajo pri kritičnem ovrednotenju merskih podatkov, boljšem razumevanju obnašanja bioloških sistemov in s tem do novih idej pri raziskavah.	Analysis The knowledge and skills that are gained in this course help the students critically assess the experimental data, and the understanding of the biological systems.
Prenosljive spretnosti Spretnosti uporabe domače in tuje literature in drugih virov, identifikacija in reševanje problemov, kritična analiza, refleksij na prebrano literaturo, uporaba različnih postopkov poročanja (ustno in pisno).	Skill-transference Ability The ability of using different literature, as well as other resources, identification and problem solving, critical evaluation of the results, the ability to present their results in the written and oral form.

Metode poučevanja in učenja:	**Learning and Teaching Methods:**
Predavanja, individualno delo v obliki seminarjev.	-Lectures, -individual work in the form of seminars

Načini ocenjevanja:	Delež (v %) / Weight (in %)	**Assessment:**
Izvedba seminarja in ustni izpit.		Seminar and oral exam.

Reference nosilca / Lecturer's references:

- DILL, Ken A., TRUSKETT, Thomas Michael, VLACHY, Vojko, **HRIBAR-LEE, Barbara**. Modeling water, the hydrophobic effect, and ion solvation. Annu Rev Biophys Biomol Struct, 2005, vol. 34, str. 173-199.
- JARDAT, Marie, **HRIBAR, Barbara**, VLACHY, Vojko. Self-diffusion of ions in charged nanoporous media. *Soft matter*, 2012, vol. 8, no. 4, str. 954-964.
- **HRIBAR, Barbara**, LUKŠIČ, Miha, VLACHY, Vojko. Partly-quenched systems containing charges. Structure and dynamics of ions in nanoporous materials. *Annu. rep. prog. chem. Sect C. Phys. chem*, 2011, vol. 107, no. 1, str. 14-46

UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	MONOKLONSKA PROTITELESA
Course Title:	MONOCLONAL ANTIBODIES

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: BI2I09

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

Nosilec predmeta / Lecturer: prof. dr. Vladka Čurin-Šerbec / Dr. Vladka Čurin-Šerbec, Full Professor

Jeziki / Languages:

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

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

Študent mora imeti predmet vpisan v VIS.

Prerequisites:

The course has to be assigned to the student in the VIS system.

Vsebina:

Splošne značilnosti imunskega sistema. Antigeni. Zgradba in vloga protiteles. Monoklonska protitelesa. Osnove dela s celičnimi kulturami. Delo z živalmi in zakonski predpisi. Reakcije med antigeni in protitelesi. Pregled imunoloških metod. Določanje epitopov. Humana, kimerna in humanizirana protitelesa. Priprava protiteles z izražanjem na fagu. Transgene miške pri pripravu protiteles. Dobra laboratorijska in dobra proizvodna praksa. Proizvodnja protiteles. Farmakovigilanca. Uporaba monoklonskih protiteles v diagnostične namene. Uporaba protiteles v terapevtske namene. Antiidiotipska monoklonska protitelesa.

Content (Syllabus outline):

Properties of the immune system. Antigens. Structure and biological role of the antibodies. Monoclonal antibodies. Cell cultures - the principles of work. Experiments on animals and regulation. Reactions between antigens and antibodies. Immunological methods - an overview. Determination of the epitopes. Human, chimeric and humanised antibodies. Phage display antibodies. Transgenic mice and production of the antibodies. Good laboratory practice, good manufacturing practice. Farmacovigilance. The use of monoclonal antibodies for diagnostic purposes. The use of monoclonal antibodies for therapy. Antiidiotipic monoclonal antibodies.

Laboratorijske vaje: Delo v laboratoriju za celične kulture. ELISA. Western blot. Dot blot. Določanje afinitete protiteles. Pretočna citometrija. Seminarji: Projektno delo, seminarji.	Practical: Work in the cell culture laboratory, ELISA, western blot, dot blot, determination of the affinity of antibodies, flow cytometry. Project work and seminars.

Temeljna literatura in viri / Readings:

- Vozelj, M. Temelji imunologije. DZS, Ljubljana (2000).
- Abbas, A.K., Lichtman, A.H. Cellular and Molecular Immunology. Updated Edition. Elsevier Saunders, Philadelphia (2005).
- Ritter, M.A., Ladyman, H.M. Monoclonal antibodies. Production, engineering and clinical application. Cambridge University Press, published in association with the Royal Postgraduate Medical School, University of London (2005).
- Tekoča periodika / Articles.

Cilji in kompetence:	**Objectives and Competences:**
V okviru predmeta bodo slušatelji pridobili najprej teoretična znanja s področja priprave protiteles (mišjih in humanih monoklonskih, kimernih, humaniziranih ter izraženih na fagu), spoznali bodo tudi primere uporabe različnih protiteles v raziskovalne, diagnostične in terapevtske namene (zlasti na primerih uspešno izvedenih in tekočih projektov v Sloveniji). Svoje znanje bodo nadgradili z eksperimentalnim delom ter seminarji, v okviru katerih bodo poskušali načrtovati različne projekte. Slušatelji naj bi spoznali področje do takšne mere, da bodo pridobljeno znanje lahko uporabljali pri svojem delu (v raziskovalne, diagnostične ali pa terapevtske namene). Predmet omogoča reševanje problemov, razmišljanje in povezovanje.	Students will first achieve theoretical knowledge of monoclonal antibody production (mouse and human, chimeric, humanised, phage) and their use in research, diagnostics and therapy (also on the basis of successful projects, conducted in Slovenia). Experimental work and designing of different projects will proceed with seminars and round table discussions. At the end of the course, students should be able to use their knowledge in their work. The main goals are understanding of the problems and brainstorming.

Predvideni študijski rezultati:	**Intended Learning Outcomes:**
<u>Znanje in razumevanje</u> Študent se najprej seznani z osnovno terminologijo, ki je pomembna za nadaljnje razumevanje snovi. Teoretičnemu pregledu sledijo primeri uspešno izvedenih projektov s področja ter vaje v laboratoriju. Predmet se zaključi z vrsto seminarjev, v okviru katerih slušatelji pridobljeno znanje uporabijo za načrtovanje projektov. V okviru seminarskega dela in spremljajoče razprave se seznanijo z	<u>Knowledge and Comprehension</u> Knowledge and Comprehension: Students will be thought the basic terminology and some successful projects from the field will be presented. Experimental work and seminars will represent the second part, ending the course with designing of the projects.

najnovejšimi dognanji na področju.	
Uporaba Vsebine predmeta poleg teoretičnih znanj nudijo tudi praktična znanja. Predmet je zasnovan tako, da študente vzpodbuja k razmišljanju, k ustvarjanju, k povezovanju in k reševanju problemov.	Application Students will gain practical knowledge besides the theory. The content of the subject is designed in a way that encourages students to associate their knowledge, to have their own ideas, to be inventive and to solve the problems
Refleksija Študent pridobi občutek za način dela in razmišljanja na področju biomedicine in biotehnologije.	Analysis Students will gain a sense to work and brainstorm in the field of biomedicine and biotechnology.
Prenosljive spretnosti Izkušnje pri reševanju problemov. Analiza in interpretacija rezultatov ter njihovo kritično vrednotenje. Uporaba domače in tuje literature. Razumljivo in pregledno podajanje seminarjev ter tvorno sodelovanje pri razpravi.	Skill-transference Ability Experiences in solving problems. Analysis and interpretation of results and their critical evaluation. The use of adequate literature. Presentation of seminars and interaction in discussion.

Metode poučevanja in učenja:	**Learning and Teaching Methods:**
Predavanja, laboratorijske vaje, projektno in seminarske delo.	Lectures, seminars, project work, practical training.

Načini ocenjevanja:	Delež (v %) / Weight (in %)	**Assessment:**
Predavanja: pisni oz. ustni izpit (po končanem semestru). Laboratorijske vaje, seminarji: kolokvij oz. ustno preverjanje znanja. Ocene: 6-10 (pozitivno), 1-5 (negativno) ob upoštevanju Statuta UL in fakultetnih pravil.		

Reference nosilca / Lecturer's references:

ORIGINAL SCIENTIFIC ARTICLES:

- COLJA VENTURINI, Anja, BRESJANAC, Mara, VRANAC, Tanja, KOREN, Simon, NARAT, Mojca, POPOVIĆ, Mara, **ČURIN-ŠERBEC, Vladka**. Anti-idiotypic antibodies: a new approach in prion research. BMC Immunol., 2009, 10:16.
- KOSMAČ, Miha, KOREN, Simon, GIACHIN, Gabriele, **ČURIN-ŠERBEC, Vladka**. Epitope mapping of a PrP(Sc)-specific monoclonal antibody: identification of a novel C-terminally truncated prion fragment. Mol. Immunol., 2011, 48(5), 746-750.
- 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. PloSone, 2011, 6(1).

REVIEW ARTICLE:

- LUKAN, Anja and VRANAC, Tanja, **ČURIN-ŠERBEC, Vladka**. TSE diagnostics: recent advances in immunoassaying prions. Clin. Dev. Immunol., 2013, doi:10.1155/2013/360604

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: doc. 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:	Prerequisites:
Študent mora imeti predmet vpisan v VIS.	The course has to be assigned to the student in the VIS system.

Vsebina:	Content (Syllabus outline):
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	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:**
Kolokviji, testi, pisni in ustni izpit. Ocene: 6-10 pozitivno Uspešno opravljene seminarske naloge		

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:	RAZISKOVALNO DELO
Course Title:	RESEARCH WORK

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: BI217

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje Work	Druge oblike študija	Samost. delo Individual Work	ECTS
/	**/**	**/**	**/**	**225**	**225**	**15**

Nosilec predmeta / Lecturer: /

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

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	Prerequisites:
Študent mora imeti predmet vpisan v VIS.	The course has to be assigned to the student in the VIS system.

Vsebina:	Content (Syllabus outline):
Raziskovalno delo se opravlja iz področja biokemije. Vsebina in naslov se določata v soglasju z izbranim mentorjem. Študent bo začel z eksperimentalnim delom, vpeljal metode, in opravil preliminarne poskuse. O rezultatih dela bo napisal poročilo, ga oddal v oceno mentorju in ustno predstavil na seminarju.	The research work is carried out in the field of biochemistry; the contents and the title are determined in agreement with the mentor. Students start with experimental work, apply appropriate methods and perform preliminary experiments, followed by submission of a written report and seminar presentation of the results.

Temeljna literatura in viri / Readings:

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

Cilji in kompetence:	Objectives and Competences:
Namen predmeta je naučiti študenta, kako se začne z raziskovalnim projektom.	The purpose of the course is to teach students how to approach research. Students acquire the

Pri tem bo pridobil naslednje specifične kompetence: - uporaba pridobljenih znanj na specifičnem področju delovanja biokemika; - samostojno opravljanje raziskovalnega in razvojnega dela.	following competences: - Application of knowledge in the area of biochemistry research; - Independent research and development work.

Predvideni študijski rezultati:	**Intended Learning Outcomes:**
<u>Znanje in razumevanje</u> Med opravljanjem raziskovalnega dela bo študent pridobil naslednje kompetence: - sposobnost samostojnega spremljanja strokovne literature v angleškem jeziku na področju ved o življenju; - 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.	<u>Knowledge and Comprehension</u> In the course of the research work, students will gain the following competences: - Ability of independent following of current life sciences literature in English language; - Ability of combining previously acquired knowledge and facing complexity, forming judgements based on limited or incomplete information, including ethical constraints; - Ability to understand the limits of reliability of experimental data in planning further work;
<u>Uporaba</u> Znanje in pridobljene veščine bo študent lahko uporabil pri opravljanju poklica in opravljanju magistrskega dela.	<u>Application</u> Knowledge and skills will be useful for master's thesis and further professional career.
<u>Refleksija</u> Povezovanje vseh pridobljenih teoretičnih znanj z reševanjem problemov na področju biokemije ter kritični pogled na uporabnost teh znanj.	<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.
<u>Prenosljive spretnosti</u> 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.	<u>Skill-transference Ability</u> In the course of the work students will gain methodological knowledge of solving complex problems, ways of presenting knowledge in both written and oral form, linked 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:**
Oddano poročilo o delu in ustna predstavitev poročila na seminarju. Oboje oceni mentor. Ocene: opravil/ni opravil		Submission of the report and oral seminar presentation. Both parts are graded by the mentor. Grading scale: pass/fail.

Reference nosilca / Lecturer's references:

/

UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	SINTEZNA BIOLOGIJA
Course Title:	SYNTHESIS 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 temeljni / Elective Fundamental

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: izr. prof. dr. Marko Dolinar / Dr. Marko Dolinar, Associate Professor

Jeziki / Languages:

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

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	Prerequisites:
Študent mora imeti predmet vpisan v VIS.	The course has to be assigned to the student in the VIS system.

Vsebina:	Content (Syllabus outline):
1. Sintezna biologija, biološko inženirstvo, biologija sistemov. “Synthetic Society”. 2. Poustvarjanje genomov (re-writing & refactoring). 3. Princip biokock in standardizirani način kloniranja v sintezni biologiji. 4. Register bioloških delov; značilnosti kataloških kategorij in primeri. 5. Bioinformatika v sintezni biologiji (predavanja + vaje). 6. Modeliranje bioloških procesov: CellDesigner (seminar + vaje). 7. Inverterji, represilatorji, biooscilatorji. 8. Genetska/biološka vezja. 9. Signalne kaskade v celicah. 10. Kemotaksija in zaznavanje gostote.	1. Synthetic biology, biological engineering, systems biology. “Synthetic Society”. 2. Genome rewriting and refactoring. 3. Biobricks principle and standardized cloning in synthetic biology. 4. Registry of biological parts – characteristics of catalogue categories with examples. 5. Bioinformatics in synthetic biology (lectures and practicals). 6. Modeling of cellular processes: CellDesigner (seminar + practicals). 7. Inverters, repressilators, biooscilators. 8. Genetic/biological circuits. 9. Cellular signal cascades. 10. Chemotaxis and quorum sensing. 11. New biomaterials.

11. Novi biomateriali. 12. Alternativna goriva na osnovi bioloških sistemov. 13. Nanobiotehnologija. 14. Sintezna genomika in sintezni organizmi. 15. Primeri uporabe (npr.: biosinteza rastlinskih terpenoidov v mikrobih, programirano odzivanje celic na svetlobo, biosenzorji, bioremediacija, bakterije proti raku) – seminarji. 16. Varnost, odgovornost, etika in družbena sprejemljivost sintezne biologije. Praktična vaja: 1. Kloniranje inserta v vektor pSB. 2. Merjenje relativne moči promotorjev. Računalniške vaje: 3. Bioinformatska orodja v sintezni biologiji. 4. Modeliranje bioloških procesov. 5. Ustvarjanje in urejanje wiki-strani. Seminarji: 6. Primeri uporabe sinteznobioloških pristopov za reševanje problemov pri zdravljenju, biosinteznih postopkih, pripravi novih energentov in v ekologiji.	12. Alternative fuels based on biological systems. 13. Nanobiotechnology. 14. Synthetic genomics and synthetic organisms. 15. Practical examples (e.g. microbial biosynthesis of plant terpenoids, programming cell response to light, biosensors, bioremediation, bacteria against cancer): seminars. 16. Safety, responsibility, ethics and public acceptance of Synthetic biology. Laboratory Practicals: 1. Insert cloning in pSB vectors. 2. Determination of relative promoter strength. Computer work: 1. Bioinformatic tools in synthetic biology. 2. Modelling biological processes. 3. Creation and editing Wiki pages. Seminars: Application examples – synthetic biology approaches for solving problems in medicine, biosynthesis, energy production and ecology.

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.	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

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

Predvideni študijski rezultati:	**Intended Learning Outcomes:**
Znanje in razumevanje **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).	Knowledge and Comprehension **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).
Uporaba 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.	Application 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.
Refleksija Identifikacija konkretnih problemov človeštva in možnosti uporabe najzmogljivejših tehnologij. Sinergija biologije in inženirstva. Ali lahko funkcionalne elemente elektronskih vezij prevedemo v biološke komponente?	Analysis 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

Wikipedija in druge wiki strani: vprašanje zanesljivosti in dostopnosti podatkov. Inženirski pristopi niso omejeni na stroje, pač pa so možni na živih sistemih; vzporednice celica/stroj. Vprašanje omejevanja dostopa do virov kot način zagotavljanja varnosti.	applied to biological components? Wikipedia and other wiki pages: are easily accessible data reliable? Engineering principles apply not only 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, seminarji (primeri uporabe) in individualno delo pri pripravi seminarja. Sodelovanje na spletu (wiki). Spletna gradiva za določena poglavja.	Lectures, two laboratory 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:**
Pri končni oceni štejeta seminar in wiki-stran 25 %, sodelovanje pri seminarjih 10 % in odgovori na izpitna vprašanja 65 % končne ocene. Izpit je pisni in ustni. Delo na praktičnih vajah se oceni na izpitu iz teoretičnih vsebin. Ocenjevalna lestvica je takšna, kot jo predpisuje pravilnik o ocenjevanju.	**25 %** **10 %** **65 %**	Seminar and wiki page – 25 % Engagement in seminars – 10 % Examination – 65 % Examination is both written and oral. Practicals are assessed within the examination. Grading according to examination rules.

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:	STRUKTURNI IN FUNKCIJSKI VIDIKI BIOLOŠKIH INTERAKCIJ
Course Title:	STRUCTURAL AND FUNCTIONAL ASPECTS OF BIOLOGICAL INTERACTIONS

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: 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 mora imeti predmet vpisan v VIS.	The course has to be assigned to the student in the VIS system.

Vsebina:	Content (Syllabus outline):
Teorija vezave ligandov. Eksperimentalni pristopi k merjenju medmolekulskih interakcij (kontinuirne/diskontinuirne metode, spektroskopske metode, metode sklopljenih reakcij, zasnova eksperimenta, ocena začetne hitrosti reakcije, detekcija inaktivacije encima). Izpeljave enačb za različne sisteme. Ocena napake in statistično vrednotenje parametrov medmolekulskih interakcij. Inhibicija in aktivacija encimov (reverzibilna/ireverzibilna inhibicija, vrste	Theory of ligand binding. Experimental techniques used to measure intermolecular interactions (continuous/discontinuous methods, spectroscopic methods, coupled reactions, experiment design, estimation of inititial reaction rates, detection of enzyme inactivation). Derivation of rate equations for various systems. Error estimation and statistical weighing of the parameters of intermolecular interactions. Enzyme inhibition and activation (reversible/irreversible inhibition, types of inhibition mechanisms, essential/nonessential

mehanizmov inhibicije, esencialna/neesencialna, aktivacije, določanje mehanizma delovanja inhibitorjev in aktivatorjev, inhibicija s substratom, inhibicija s produktom). Reakcije z več substrati. Kooperativnost in alosterična regulacija medmolekulskih interakcij. Vplivi okolja na medmolekulske interakcije: temperatura, pH, ionska jakost. Kinetika sistemov z več encimi, kinetika hitrih reakcij, kinetika pred ravnotežnega stanja. Encimske reakcije v heterogenih sistemih (pretvorba netopnih proteinov in ogljikovih hidratov, reakcije na fazni meji lipid-voda). Strukturna podlaga medmolekulskih interakcij s primeri.	activation, diagnosis of the mechanisms of inhibition and activation, substrate inhibition, product inhibition). Multi-substrate reactions. Cooperativity and allosteric regulation of intermolecular interactions. Environmental effects on intermolecular interactions: temperature, pH, ionic strength. Kinetics in multi-enzyme systems, kinetics of fast reactions, pre-steady-state kinetics. Enzymatic reactions in heterogeneous systems (turnover of insoluble proteins and carbohydrates, reactions at the water-lipid interface). Structural basis of intermolecular interactions with examples.

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 bo obravnaval medmolekulske interakcije in encimsko katalizirane kemijske reakcije z vidika interpretacije mehanizmov in matematičnega opisa hitrosti različnih vrst encimsko kataliziranih reakcij, eksperimentalnega pristopa k študiju encimsko kataliziranih reakcij in identifikacije in interpretacije različnih mehanizmov regulacije encimske aktivnosti. Študent bo sposoben samostojno eksperimentalno proučevati medmolekulske interakcije, encimsko katalizirane reakcije in	The course focuses on intermolecular interactions and enzymatic reactions from the perspectives of interpretation and mathematical description of the underlying mechanisms, as well as the experimental methods used in the study and interpretation of these mechanisms. Students will gain the competence to independently study intermolecular interactions, enzyme-catalysed reactions and their regulation using appropriate experimental methods and to independently interpret the

njihovo regulacijo ter rezultate ustrezno interpretirati.	obtained results.

Predvideni študijski rezultati:	**Intended Learning Outcomes:**
Znanje in razumevanje Študent pridobi znanje o interpretaciji ter matematičnem opisu mehanizmov interakcij med molekulami in encimsko kataliziranih reakcij ter njihove regulacije. Pridobljeno znanje poveže s predhodnim znanjem o strukturi in funkciji encimov.	Knowledge and Comprehension Students learn to interpret and mathematically describe mechanisms of molecular interactions and enzymatic reactions. They integrate this knowledge with prior knowledge of protein structure and function.
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 Reflektira prej pridobljene teoretične in praktične osnove in jih poveže s pridobljenim 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:**
pisni izpit	**80 %**	Written examination
ocena seminarja	**20 %**	Seminar work

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:	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	**/**	**25 SV + 5 LV**	**/**	**/**	**75**	**5**

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

Jeziki / Languages:

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

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	Prerequisites:
Študent mora imeti predmet vpisan v VIS.	The course has to be assigned to the student in the VIS system.

Vsebina:	Content (Syllabus outline):
1. Uvod. Primerjava DNA-tehnologije in sintezne biologije: metode in cilji. 2. Dvohibridni sistemi (predavanje + seminar). 3. DNA v forenzičnih analizah. 4. Analize DNA v diagnostiki. 5. Analize DNA v sistematiki in ekologiji. 6. Uporaba rekombinantnih mikroorganizmov in biomase v biotehnologiji (seminar). 7. Gensko spremenjene rastline. Rekombinantne bakterije v agronomiji. 8. Gensko spremenjena hrana. Rastline v molekularni biotehnologiji. 9. Transgenske živali. Tehnologija izbijanja genov. Utišanje genov z RNAi.	1. Introduction. Comparison of DNA-technology and synthetic biology: methods and goals. 2. Two-hybrid systems (lectures and seminar). 3. DNA in forensic analyses. 4. DNA analyses in diagnostics. 5. DNA analyses in biological systematics and ecology. 6. Recombinant microorganisms and biomass in biotechnology (seminar). 7. Genetically modified plants. Recombinant bacteria in agronomy. 8. Genetically modified food. Plants in molecular biotechnology. 9. Transgenic animals. Knock-out technology. Gene silencing with RNAi. 10. Stem cells, their genetic modifications and

10. Izvorne celice, njihovo gensko spreminjanje in uporaba. 11. Kloniranje sesalcev. 12. Projekt Človekov genom in nadaljnje analize razlik v genomih. Določanje zaporedij drugih genomov. 13. Genomike in proteomika. 14. Rekombinantna DNA v medicini. Gensko zdravljenje. 15. Zakonsko urejanje dela z rekombinantno DNA. 16. Patentiranje DNA in novih tehnologij, povezanih z DNA (seminar). 17. Novi pristopi v DNA-tehnologiji. **Vaje - praktični del:** 1. Hitra izolacija genomske DNA, pomnoževanje polimorfnih regij in analiza kratkih tandemskih ponovitev. Vaje - seminarski del: 2. Ekspresijski sistemi – primeri. Proizvodnja rekombinantnih reagentov - primeri.	usage. 11. Cloning of mammals. 12. Human genome project and analysis of intergenomic variability. Genomes of other organisms. 13. Genomics and Proteomics. 14. Recombinant DNA in medicine. Gene therapy. 15. Legal aspects of work involving recombinant DNA. 16. Patenting of DNA and new technologies involving DNA (seminar). 17. Novel approaches in DNA technology. Practicals: 1. A fast isolation procedure of human genomic DNA. Amplification of short polymorphic regions and analysis of short tandem repeats. Seminars: Examples of expression systems. Examples of recombinant protein production. Patenting examples.

Temeljna literatura in viri / Readings:

- Glick & Pasternak: Molecular Biotechnology: Principles and Applications of Recombinant DNA. Washington: ASM Press, 2003.

Cilji in kompetence:	**Objectives and Competences:**
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 priprave rekombinantnih proteinov v različnih ekspresijskih sistemih, transgenskih organizmov in mehanizme utišanja genov. Poznati bo moral tudi osnovne pojme glede patentne zaščite in varnosti dela z DNA.	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 preparation of recombinant proteins in various expression systems, of transgenic organisms and mechanisms of gene silencing. Students will be acquainted with basic aspects of patent rights protection and safe work with DNA.
Predvideni študijski rezultati:	**Intended Learning Outcomes:**

Znanje in razumevanje Znanje: Zahtevne tehnike na osnovi DNA za genomske in proteomske analize. Primeri uporabe DNA-tehnologije v biotehnologiji, medicini, forenziki in drugod. Tehnologija interferenčne DNA in njena uporaba. Načini genskega zdravljenja. Zakonska urejenost dela z GSO. Razumevanje: delovanje dvohibridnih sistemov, priprava, selekcija in analiza transgenskih rastlin in živali. Mehanizem utišanja genov. Stopnje dela pri jedrnem prenosu in kloniranje sesalcev. Razločevanje med posameznimi tipi genomik.	Knowledge and Comprehension Knowledge: Advanced DNA-based techniques for genomic and proteomic analyses. Examples of DNA technology applications in biotechnology, medicine, forensics and elsewhere. Gene silencing technology and its applications. Modes of gene therapy. Legal arrangements for work with GMOs. Comprehension: Functioning of two-hybrid systems, development, selection and analysis of transgenic plants and animals. Gene silencing mechanism. Nuclear transfer: procedure stages and cloning of mammals. Differentiating between various types of genomics.
Uporaba Izolacija genomske DNA za forenzične analize in analiza kratkih tandemskih ponovitev.	Application Isolation of genomic DNA for forensic analyses and analysis of short tandem repeats.
Refleksija 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? Prednosti in slabosti patentiranja v biotehnologiji. 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.	Analysis 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. Advantages and disadvantages of patenting in biotechnology. 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.
Prenosljive spretnosti Razumevanje raziskovalnih člankov, priprava in predstavitev seminarja, slovenska strokovna terminologija.	Skill-transference Ability 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:**

Pri končni oceni šteje: - seminar, - sodelovanje pri seminarjih - odgovori na izpitna vprašanja končne ocene. Izpit je pisni in ustni. Ocenjevalna lestvica je takšna, kot jo predpisuje pravilnik o ocenjevanju.	**20 %** **10 %** **70 %**	Seminar preparation – 20 % Engagement in seminars – 10 % Final examination – 70 % Examination is both written and oral. Grading according to examination rules.

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]

UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	USMERJENA ORGANSKA SINTEZA S KEMIJO ZDRAVIL
Course Title:	TARGET ORIENTED ORGANIC SYNTHESIS WITH MEDICINAL CHEMISTRY

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: BI2I13

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. Marijan Kočevar / Dr. Marijan Kočevar, Full Professor

Jeziki / Languages:

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

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	Prerequisites:
Študent mora imeti predmet vpisan v VIS.	The course has to be assigned to the student in the VIS system.

Vsebina:	Content (Syllabus outline):
Pristopi k usmerjeni sintezi organskih spojin. Uvod. Sinteza spojin za določen namen. Klasične metode sinteze. Oblikovanje biološko aktivnih spojin na osnovi znanih struktur receptor-ligand in uporaba molekularnega modeliranja. Kombinatorialna sinteza. **Retrosintezna analiza.** Transformi, inverzija polarnosti (Umpolung), sintoni in sintezni ekvivalenti. **Kemijske metode preoblikovanja organskih spojin.** Uvod v selektivno in stereoselektivno sintezo. Zaščitne skupine. Homogena in heterogena kataliza. Asimetrična indukcija in metode, ki bazirajo na uporabi učinkovitih kiralnih pomožnikov (chiral auxiliaries) v stereoselektivni sintezi. Druge metode v	**Approach to the directed organic synthesis. Introduction**. Synthesis of the target compounds. Conventional synthetic methods. Design of biologically active compounds on the basis of the known structure receptor-ligand (enzyme-active compound) and the application of molecular modelling. Combinatorial synthesis. **Retrosynthetic analysis**. Basic principles of retrosynthetic analysis: transforms, inversion of polarity (Umpolung), synthons and synthetic equivalents. **Chemical methods of the design of organic compounds**. Introduction to selective and stereoselective synthesis. Protecting groups. Homogeneous and heterogeneous catalysis.

selektivni sintezi. Sinteza s pomočjo encimov. Uporaba prehodnih elementov v organskih reakcijah. Mehanizmi v selektivni sintezi. Specifične reakcije za tvorbo različnih kemijskih vezi. Uporaba molekularnega modeliranja v sintezi in racionalno preoblikovanje spojin. Primeri sintez nekaterih učinkovin, npr. antibakterijskih in drugih sredstev. **Osnove kemije biološko aktivnih spojin.** Strukturne lastnosti organskih spojin in odnos med strukturo in lastnostmi (npr. aktivnostjo). Struktura spojin v kristalni obliki in struktura v raztopini. Strukturni odnosi na relaciji receptor-ligand. Kvalitativna in kvantitativna zveza med strukturo in lastnostjo. Določanje strukture organskih spojin v raztopini. **Laboratorijske vaje.** Tvorba različnih tipov vezi: C-C (Diels-Alderjeva reakcija), C-H (hidrogeniranje vezi C=C), C-O (epoksidacija), primer uvedbe zaščitne skupine, primeri iz zelene kemije, večstopenjska sinteza.	Asymmetric induction and methods based on the application of chiral auxiliaries. Other methods of selective synthesis. Enzymatic reactions and the application of transition metals in organic reactions. Mechanisms in selective synthesis. Specific reactions for the formation of individual chemical bonds. The application of molecular modeling in the synthesis and rational design of the molecule. Synthesis of some biologically compounds (for example antibacterials). **Fundamentals of the synthesis of the biologically active compounds**. Structural properties of organic compounds and the relation between the structure and the property (for example biological activity). Structure of the compound in the crystalline form and in solution. Structural relation receptor-ligand. Qualitative and quantitative structure-property relationship. Structure determination of organic compounds in the solution. **Laboratory courses**. Formation of different types of bonds: C-C (Diels-Alder reaction), C-H (hydrogenation of the C=C double bond), C-O (epoxidation), introduction of the protecting group, green chemistry, multistep synthesis.

Temeljna literatura in viri / Readings:

- C. Stowell, Intermediate Organic Chemistry, J. Wiley, New York, 2. izdaja, 1994, 334 str. / pages (deli knjige; 55%).
- P. J. Kocienski, Protecting Groups, Georg Thieme Verlag, Stuttgart, popravljena izdaja, 2000, 260 str./ pages (deli knjige, 15%)

Dodatna literatura: / Supplementary reading:

- Asymmetric Synthesis, ed. R. A. Aitken and S. N. Kilenyi, Blackie Academic and Professional, London, 1994, 233 str. (deli knjige, 15%)
- J. Clayden, N. Greeves, S. Warren, P. Wothers, *Organic Chemistry*, Oxford University Press, Oxford, 2nd ed. 2012. (deli knjige) / (Parts only).
- Članki iz literature / Papers from the journals.

Cilji in kompetence:	**Objectives and Competences:**
Cilj predmeta je, da se študent se seznani s pristopom k sintezi spojin, ki bi naj služile določenemu namenu, s poudarkom na sintezi biološko aktivnih spojin oz. zdravil ter z osnovami interakcij med ligandi in receptorji.	Understanding of the rational analysis and the use of methods and reagents for the synthesis of the target organic molecules, with the emphasis on the synthesis of biologically active compounds for medicinal chemistry.

Poudarek je na kompetentnem razvijanju sposobnosti analize literaturnih virov in racionalne rabe metod in reagentov za sintezo organskih molekul.	Understanding basic principles of receptor-ligand interactions. Analysis of literature sources and the ability to apply rational design and reagents in the synthesis of organic compounds.

Predvideni študijski rezultati:	**Intended Learning Outcomes:**
<u>Znanje in razumevanje</u> Študent se nauči retrosintezne analize in pretvorb nekaterih funkcionalnih skupin.	<u>Knowledge and Comprehension</u> Understanding retrosynthetic analysis and transformation of some functional groups.
<u>Uporaba</u> Študent se nauči pravilnega načrtovanja sintez različnih organskih spojin (npr. zdravil).	<u>Application</u> To learn rational analysis and the design of the target organic molecule, with the emphasis on the synthesis of biologically active compounds.
<u>Refleksija</u> Zavedanje, da je osnova za načrtovanje sintez organskih spojin natančen študij posameznih reakcijskih stopenj.	<u>Analysis</u> Understanding that detailed studies of individual reaction steps represent fundamentals for the rational design of organic compounds.
<u>Prenosljive spretnosti</u> Pri predmetu se študenti z reševanjem znanih in neznanih problemov izurijo v uporabi znanja in analitičnega razmišljanja ter spoznajo nekatere nove laboratorijske tehnike.	<u>Skill-transference Ability</u> Students obtain the expertise for analytical thinking by solving known and unknown problems, and are introduced with some novel laboratory techniques.

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

Načini ocenjevanja:	Delež (v %) / Weight (in %)	**Assessment:**
Kolokvij iz vaj, opravljeni seminarji in končni pisni in ustni izpit. 10 (odlično), 9 in 8 (prav dobro), 7 (dobro), 6 (zadostno), 1-5 (nezadostno)		Seminars, written and oral examination.

Reference nosilca / Lecturer's references:

- KRIVEC, Marko, GAZVODA, Martin, KRANJC, Krištof, POLANC, Slovenko, **KOČEVAR, Marijan**. A way to avoid using precious metals: the application of high-surface activated carbon for the synthesis of isoindoles via the Diels-Alder reaction of 2H-pyran-2-ones. Journal of organic chemistry, ISSN 0022-3263, 2012, vol. 77, no. 6, str. 2857-2864, doi: 10.1021/jo3000783. [COBISS.SI-ID 35801349].

- CIMPEANU, Valentin, **KOČEVAR, Marijan**, PÂRVULESCU, Vasile I., LEITNER, Walter. Preparation of rhodium nanoparticles in carbon dioxide induced ionic liquids and their application to selective hydrogenation. Angewandte Chemie, ISSN 1433-7851. [Print ed.], 2009, vol. 48, no. 6, str. 1085-1088, doi: 10.1002/anie.200803773. [COBISS.SI-ID 30100997].

- KRANJC, Krištof, PERDIH, Franc, **KOČEVAR, Marijan**. Effect of ring size on the exo/endo selectivity of a thermal double cycloaddition of fused pyran-2-ones. Journal of organic chemistry, ISSN 0022-3263, 2009, vol. 74, no. 16, str. 6303-6306, doi: 10.1021/jo9011199. [COBISS.SI-ID 30678277].

UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	UVOD V RAZISKOVALNO DELO
Course Title:	INTRODUCTION TO RESEARCH WORK

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: BI214

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

Nosilec predmeta / Lecturer: /

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

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	Prerequisites:
Študent mora imeti predmet vpisan v VIS.	The course has to be assigned to the student in the VIS system.

Vsebina:	Content (Syllabus outline):
Raziskovalno delo se opravlja iz področja biokemije. Vsebina in naslov se določata v soglasju z izbranim mentorjem. Študent bo preštudiral literaturo, ki je osnova za njegovo magistrsko delo, napisal literaturni pregled in pripravil načrt dela.	Research work is performed in the field of biochemistry. The content and title are chosen with consent of the mentor. Student will study the literature that is the basis of his master's thesis, write a literature overview and prepare a work plan.

Temeljna literatura in viri / Readings:

Knjige in članki, ki so povezani z vsebino raziskovalnega dela./
Books and papers related to the topic of the research work.

Cilji in kompetence:	Objectives and Competences:
Namen predmeta je naučiti študenta, kako se začne z raziskovalnim projektom.	The objective is to tutor the student ion how to begin with a research project.

Predvideni študijski rezultati:	Intended Learning Outcomes:

Znanje in razumevanje Med opravljanjem raziskovalnega dela bo študent pridobil naslednje kompetence: - sposobnost samostojnega spremljanja strokovne literature v angleškem jeziku na področju ved o življenju; - sposobnost povezovanja svojega znanja in soočanja s kompleksnostjo, oblikovanja ocene na podlagi nepopolnih ali omejenih informacij, ki zajema tudi razmislek o etični odgovornosti.	Knowledge and Comprehension During his research work the student will gain the competence to: - independently follow scientific literature on life sciences in English - integrate his knowledge and comprehend complex topics, form a judgement on the basis of incomplete or limited information, and take into account ethical responsibility.
Uporaba Znanje in pridobljene veščine bo študent lahko uporabil pri opravljanju poklica in opravljanju magistrskega dela.	Application Students will use the gained knowledge and skills in their profession and in preparing their master's thesis.
Refleksija Povezovanje vseh pridobljenih teoretičnih znanj z reševanjem problemov na področju biokemije ter kritični pogled na uporabnost teh znanj.	Analysis Integration of theoretical knowledge with problem solving in the field of biochemistry and a critical opinion of this knowledge.
Prenosljive spretnosti Sposobnost samostojnega spremljanja strokovne literature v angleškem jeziku.	Skill-transference Ability Ability to independently follow scientific literature in English.

Metode poučevanja in učenja: **Learning and Teaching Methods:**

Individualno delo mentorja in samostojno študijsko in raziskovalno delo.	Individual tutoring by the mentor and independent study and research work.

Načini ocenjevanja:	Delež (v %) / Weight (in %)	**Assessment:**
Oddan literaturni pregled in načrt dela, ki ga oceni mentor. Ocene: opravil/ni opravil		Turning in a literature overview and work plan that is graded by the mentor.

Reference nosilca / Lecturer's references:

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