ANORGANSKA KEMIJA

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Anorganska kemija
Course title:	Inorganic Chemistry
Članica nosilka/UL Member:	UL FKKT

Študijski programi in stopnja	Študijska smer	Letnik	Semestri	Izbirnost
Biokemija, prva stopnja, univerzitetni	Ni členitve (študijski program)	1. letnik	2. semester	obvezni

Univerzitetna koda predmeta/University course code:	0072058
Koda učne enote na članici/UL Member course code:	BK108

Predavanja /Lectures	Seminar /Seminar	Vaje /Tutorials	Klinične vaje /Clinical tutorials	Druge oblike študija /Other forms of study	Samostojno delo /Individual student work	ECTS
45	30				75	5

Nosilec predmeta/Lecturer:	prof. dr. Anton Meden
Vrsta predmeta/Course type:	obvezni/mandatory
Jeziki/Languages:	Predavanja/Lectures: Slovenščina Vaje/Tutorial: Slovenščina

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

Vsebina:	Content (Syllabus outline):
Periodni sistem kot osnova sistematike elementov in anorganskih spojin. **Vodik in kisik.** Voda. Vodikov peroksid. Protolitske reakcije oksidnega peroksidnega in superoksidnega iona. Nomenklatura. **Elementi 17. skupine**. Spojine elementov 17. skupine z vodikom. Spojine s kisikom, oksokisline in oksosoli. Medhalogenske spojine. Reakcije disproporcionacije in vpliv sinteznih pogojev na kemijsko ravnotežje pri pripravi oksospojin halogenov. Nomenklatura. **Elementi 16. skupine**. Spojine elementov 16. skupine z vodikom. Protoliza sulfidnih ionov. Oksidi in oksospojine žvepla, selena in telurja. Primeri homogene in heterogene katalize pri sintezi žveplove kisline. Spojine s halogeni. Nomenklatura.	**Periodic table** as a basis of the systematic of elements and inorganic compounds. **Hydrogen, Oxygen**, Water, Hydrogen peroxide. Protolytic reactions of oxide, peroxide and superoxide ion, Nomenclature. **Elements of Group 17**. Compounds of Group 17 elements with hydrogen. Compounds with oxygen, oxo-acids and oxo-salts. Interhalogen compounds. Disproportionation reactions and the influence of synthesis conditions on the preparations of oxo-compounds of halogens. Nomenclature. **Elements of Group 16**. Compounds of Group 16 elements with hydrogen. Protolysis of sulfide ions. Oxides and oxo-compounds of sulfur, selenium and tellurium. Examples of homogeneous and

Elementi 15. skupine. Spojine elementov 15. skupine z vodikom. Sinteza amoniaka: vpliv reakcijskih pogojev in katalizatorja na ravnotežje in hitrost reakcije. Oksidi in oksospojine. Spojine elementov V. skupine s halogeni in žveplom. Nomenklatura. **Elementi 14. skupine**. Spojine elementov 14. skupine z vodikom. Oksidi, oksospojine in soli. Boudouardovo ravnotežje. Halogenidi in sulfidi elementov 14. skupine. Ogljikov dioksid v vodni raztopini: kombinacija molekularne in protolitske reakcije. Silikati. Nomenklatura. **Elementi 13. skupine**. Bor in spojine bora. Razlaga strukture boranov z uporabo kombinacije teorije VV in MO. Aluminij in spojine aluminija. Pregled lastnosti spojin galija, indija in talija. Nomenklatura. **Elementi 1. in 2. skupine**. Lastnosti zemeljskoalkalijskih kovin in njihovih spojin. Lastnosti alkalijskih kovin in njihovih spojin. Nomenklatura. **Elementi 18. skupine**. Spojine žlahtnih plinov in njihove lastnosti. **Pregled kemije prehodnih elementov**. d-orbitale in njihova vloga v kemiji prehodnih elementov. Pregled lastnosti prve vrste kovin prehoda. Pregled lastnosti druge in tretje vrste kovin prehoda. Lantanoidi in aktinoidi. Jedrske reakcije. Pregled elementov in njihovih spojin po skupinah. Oksidi, hidroksidi in oksokisline prehodnih elementov. Koordinacijske spojine in njihova uporaba.	heterogeneous catalysis at the synthesis of sulfuric acid. Compounds with halogens. Nomenclature. **Elements of Group 15**. Compounds of Group 15 elements with hydrogen. Synthesis of ammonia: the influence of reaction conditions and catalyst on the equilibrium and velocity of reaction. Oxides and oxo-compounds. Compounds of group 15 elements with halogens and sulfur. Nomenclature. **Elements of Group 14**. Compounds of Group 14 elements with hydrogen. Oxides oxo-compounds and salts. Influence of reaction conditions on the equilibrium of CO and CO2. Halogenides and sulfides of the Group 14 elements. Carbonic acid in aqueous solution: combination of protolytic and molecular compounds. Silicates. Nomenclature. **Elements of Group 13**. Boron and boron compounds. Explanation of the structures of boranes applying a combination of VB and MO theories. Aluminum and aluminum compounds. Survey of the properties of gallium, indium and thallium compounds. Nomenclature. **Elements of Groups 1 and 2**. Properties of earth-alkali metals and their compounds. Properties of alkali metals and their compounds. Nomenclature. **Elements of Group 18**. Compounds of noble gases and their properties. **Survey of the chemistry of transition elements**. d-orbitals and their role in the transition elements chemistry. Survey of the properties of the first row of transition elements. Survey of the properties of the second and third row of transition elements. Lanthanoids and actinoids. Nuclear reactions. Survey of the groups of transition elements. Oxides, hydroxides and oxo-acids of the transition elements. Coordination compounds and their application.

Temeljna literatura in viri/Readings:

Osnovni učbenik:

- F. Lazarini, J. Brenčič: Splošna in anorganska kemija, Visokošolski učbenik Založba FKKT, Ljubljana, 2004, str. 262-521.

Dodatna literatura:

- C. E. Housecroft, A. G. Sharpe, Inorganic Chemistry, Pearson, Prentice Hall, 2nd, 2005; (http://files.rushim.ru/books/neorganika/housecroft.pdf) (40%)

Cilji in kompetence:	**Objectives and competences:**
Cilji: Študenti usvojijo temeljno in celostno znanje anorganske kemije, poznavanje določenih anorganskih spojin, njihovih lastnosti in reaktivnosti. Pri tem študent na specifičnih primerih utrjuje in poglablja znanje splošnih kemijskih zakonitosti. **Kompetence:** Študent bo pridobljeno znanje znal uporabiti pri nadaljnjem študiju in v praksi, znal se bo pogovarjati o kemijskih problemih s področja, ki ga obravnava predmet; znal bo povezati znanje splošne in anorganske kemije za reševanje, razlago ali analizo določenega problema. Poznal bo strukturne značilnosti in reaktivnost anorganskih spojin,	**Objectives: s**tudents acquire basic and complete knowledge of inorganic chemistry, knowledge of given inorganic compounds, their properties and reactivity. Along with this, the student confirms ad deepens the knowledge of general chemical principles. **Competences:** student will be able to apply the acquired knowledge at further study and in practice, he will be able to discuss chemical problems in the field of the subject and will be able to integrate the knowledge of general and inorganic chemistry to solve, explain or analyze a given problem. He will

značilne in pomembne kemijske reakcije anorganskih spojin ter nomenklaturo anorganskih spojin	know the structural characteristics and reactivity of inorganic compounds and the nomenclature thereof.

Predvideni študijski rezultati:	**Intended learning outcomes:**
Znanje in razumevanje Študent pozna osnovne značilnosti kemije elementov glavnih skupin in prehodnih elementov v periodnem sistemu ter pozna in razume osnovne kemijske zakonitosti , ki vplivajo na periodične lastnosti elementov in njihovih spojin (strukturne značilnosti, reaktivnost anorganskih spojin, značilne in pomembne kemijske reakcije anorganskih spojin ter nomenklaturo anorganskih spojin). Uporaba Pridobljeno znanje in razumevanje so potrebna osnovna znanja, ki jih študent uporablja za razlago eksperimentalno določenih ali drugače pridobljenih podatkov, povezanih s kemijo elementov glavnih skupin in prehodnih elementov periodnega sistema in je osnova za nadaljnji študij kemije. Prav tako je to znanje temeljno pri opravljanju poklica Refleksija Študent je sposoben oceniti pomen osnovnih kemijskih zakonitosti in teoretskega znanja za razlago eksperimentalnih dejstev in lastnosti anorganskih snovi in jih zna uporabiti v praksi. Prenosljive spretnosti Študent zna poiskati podatke iz strokovne literature, podatke iz virov medmrežja pa zna kritično oceniti. Zna uporabljati strokovni jezik (pisno in ustno).	Knowledge and Comprehension Student knows basic chemical characteristics of the main group elements and transition elements in the periodic system. He knows and understands the basic chemical principles that influence the periodic properties of the elements and their compounds (structural properties, reactivity of inorganic compounds, characteristic and important chemical reactions of the inorganic compounds and nomenclature of the inorganic compounds). Application Acquired knowledge and understanding are the necessary basis that is applied for explanation of experimental or otherwise acquired data, connected to the chemistry of the main group elements and the transition elements of the periodic system, which is the basis of the further study of chemistry. This knowledge is as well fundamental for the professional activity. Analysis Student is able to asses the meaning of basic chemical principles and theoretical knowledge for an explanation of experimental facts and properties of compounds and is able to use them in practice. Skill-transference Ability Student is able to find data from professional literature and is able to critically evaluate the data from the internet; he is able to use the professional language (written and spoken).

Metode poučevanja in učenja:	**Learning and teaching methods:**
Predavanja; sodelovalno učenje/ poučevanje ter problemsko delo na seminarjih. Sprotno preverjanje znanja s testi.	Lectures; cooperative learning/teaching and problem work at seminars; regular knowledge assessment using tests.

Načini ocenjevanja:	**Delež/Weight**	**Assessment:**
2 testa za sprotno preverjanje znanja in pisni izpit. Če študent na vsakem od obeh testov najmanj 51 % točk je lahko oproščen opravljanja izpita. Ocenjevalna lestvica v skladu z enotno lestvico na Univerzi v Ljubljani: 6 – 10 opravil izpit, 1 – 5 ni opravil izpita.		2 test for during the semester and written exam. If the student collects at least 51 % of points at each of the tests, he can be excused from the exam. Grades according to the standard levels of the University of Ljubljana: 6-10 passed, 1-5 insufficient.

Reference nosilca/Lecturer's references:

- MALI, Gregor, MEDEN, Anton, DOMINKO, Robert. [sup] 6 Li MAS NMR spectroscopy and first-principles calculations as a combined tool for the investigation of Li [sub] 2 MnSiO [sub] 4 polymorphs. *Chemical communications*, ISSN 1359-7345, 2010, issue 19, str.3306-8, doi: 10.1039/c0003065a. [COBISS.SI-ID 4386074]
- KÜZMA, Mirjana, DOMINKO, Robert, HANŽEL, Darko, KODRE, Alojz, ARČON, Iztok, MEDEN, Anton, GABERŠČEK, Miran. Detailed in situ investigation of the electrochemical processes in

Li[sub]2FeTiO[sub]4 cathodes. *Journal of the Electrochemical Society*, ISSN 0013-4651, 2009, vol. 156, no. 10, str. A809-A816. [COBISS.SI-ID 4219162]
- MOLČANOV, Krešimir, KOJIĆ-PRODIĆ, Biserka, MEDEN, Anton. [pi]-Stacking of quinoid rings in crystals of alkali diaqua hydrogen chloranilates. *CrystEngComm*, ISSN 1466-8033, 2009, vol. 11, iss. 7, str. 1407-1415, doi: 10.1039/b821011j. [COBISS.SI-ID 516331545]

BIOKEMIJA

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Biokemija
Course title:	Biochemistry
Članica nosilka/UL Member:	UL FKKT

Študijski programi in stopnja	Študijska smer	Letnik	Semestri	Izbirnost
Biokemija, prva stopnja, univerzitetni	Ni členitve (študijski program)	2. letnik	1. semester	obvezni

Univerzitetna koda predmeta/University course code:	0072068
Koda učne enote na članici/UL Member course code:	BK116

Predavanja /Lectures	Seminar /Seminar	Vaje /Tutorials	Klinične vaje /Clinical tutorials	Druge oblike študija /Other forms of study	Samostojno delo /Individual student work	ECTS
45	30				75	5

Nosilec predmeta/Lecturer:	doc. dr. Gregor Gunčar
Vrsta predmeta/Course type:	obvezni/mandatory

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

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

Vsebina:	Content (Syllabus outline):
Biosignalizacija, receptorji, G-proteini, signalne kaskade Ser/Thr in Tyr kinaz, bioenergetika, principi regulacije metabolizma, katabolične poti, uravnavanje glikolize, glukoneogeneze, metabolizem glikogena, uravnavanje oksidacije maščobnih kislin in nastanka ketonskih telesc, oksidativna fosforilacija in fotofosforilacija, biosinteza ogljikovih hidratov, biosinteza lipidov, metabolizem aminokislin, nukleotidov in sorodnih molekul, hormonska regulacija in integracija metabolizma pri sesalcih.	Biosignaling, receptors, G-proteins, Ser/Thr kinases, Tyr kinases, signaling cascades, bioenergetics, principles of metabolic regulation, catabolic pathways, regulation of glycolysis, gluconeogenesis, glycogen metabolism, regulation of fatty acid oxidation and ketogenesis, oxidative phosphorylation and photophosphorylation, carbohydrate biosynthesis, lipid biosynthesis, metabolism of amino acids, nucleotides and related molecules, hormonal regulation and integration of mammalian metabolism.

Temeljna literatura in viri/Readings:

- Nelson, D.L. in Cox, M.M. (Lehninger), Principles of Biochemistry, zadnja izdaja (trenutno 6. izdaja), W.H. Freeman & Co. 2013, (50% od str. 433-975).

Cilji in kompetence:	Objectives and competences:
Cilji: Uporaba in nadgradnja znanja, ki so ga študenti dobili pri predmetu temelji biokemije. Kompetence: Študenti bodo razumeli koncepte metaboličnih procesov in njihovega uravnavanja, znali bodo uporabljati informacije o metaboličnih procesih, ki so dostopne na svetovnem spletu in v preglednih strokovnih člankih.	Objectives: Application and upgrading of the knowledge gained by students at the course Fundamentals of Biochemistry Competences: Students will understand concepts of metabolic processes and their regulation, they will know how to use information about metabolic processes accessible on the Internet and in scientific review articles.

Predvideni študijski rezultati:	Intended learning outcomes:
Znanje in razumevanje Študenti bodo imeli pregled čez metabolične procese, vedeli bodo kakšen je pomen posameznih procesov, v katerih tkivih in v kakšnih metaboličnih stanjih potekajo in kako so uravnavani. Razumevanje: Razumevanje organizacije encimsko kataliziranih reakcij v metabolične procese, povezave med metaboličnimi procesi in njihovega uravnavanja. Razumevanje metod, ki se uporabljajo za študij metaboličnih procesov. Razumevanje povezav med motnjami v poteku metaboličnih procesov in nekaterimi obolenji. Uporaba Znanje, ki ga bodo študenti pridobili pri tem predmetu je osnova za druge biokemijske predmete, saj študenti pridobijo pregled o poteku in uravnavanju procesov v živih organizmih. Refleksija Študenti se bodo zavedali pomena poznavanja poteka in uravnavanja metaboličnih procesov za ugotavljanje delovanja različnih snovi v živih organizmih. Zavedali se bodo tudi določenih dilem na področju etike v biomedicinskih raziskavah. Prenosljive spretnosti Spretnosti uporabe domače in tuje literature in drugih virov, zbiranja in interpretiranja podatkov, uporaba IKT, uporaba različnih postopkov, poročanje (ustno in pisno), identifikacija in reševanje problemov, osnove kritičnega branja raziskovalnih člankov na področju biokemije.	Knowledge and Comprehension Student will gain an overview of the metabolic processes, their importance, where and in what metabolic states they occur and how they are regulated. They will understand the organisation of the enzyme catalysed reactions in the metabolic processes, metabolic pathways integration and regulation. They will also understand the methods used in metabolism research and link between metabolic disorders and diseases. Application Knowledge of the processes and their regulation in living organisms is fundamental for other biochemical courses. Analysis Students will be aware of the importance of metabolism and its regulation in knowing the pathways and modes of action of different molecules in our body. They will also be aware of the ethical concerns in biomedical research. Skill-transference Ability Ability to find and use current scientific literature in the field, data interpretation, use of information technologies, basic scientific writing and reporting, problem identification and solving, critical reading of the biochemistry scientific literature.

Metode poučevanja in učenja:	Learning and teaching methods:
Predavanja, seminarji.	Predavanja, seminarji.

Načini ocenjevanja:	Delež/Weight	Assessment:
Seminarska naloga Pisni izpit		Seminar work Written exam

Reference nosilca/Lecturer's references:

- **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 j., 1999, vol. 18, str. 793-803.
- **GUNČAR, Gregor**, PODOBNIK, Marjetka, PUNGERČAR, Jože, ŠTRUKELJ, Borut, TURK, Vito, TURK, Dušan. Crystal structure of porcine cathepsin H determined at 2.1 A resolution: location of the mini-

chain C-terminal carboxyl group defines cathepsin H aminopeptidase function. Structure (London), 1998, vol. 6, no. 1, 51-61.
- Ching-I A. Wang*, **Gregor Gunčar***, Jade K. Forwood, Trazel Teh, Ann-Maree Catanzariti, Gregory J. Lawrence, Fionna E Loughlin, Joel P. Mackay, Horst Joachim Schirra, Peter A.Anderson, Jeffrey G. Ellis, Peter N. Dodds, Boštjan Kobe, Crystal Structures of Flax Rust Avirulence Proteins Avr L567-A and -D Reveal Details of the Structural Basis for Flax Disease Resistance Specificity. Plant Cell, 2007, 19, 2898-2912.
*authors contributed equally

BIOKEMIJSKA INFORMATIKA

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Biokemijska informatika
Course title:	Biochemical informatics
Članica nosilka/UL Member:	UL FKKT

Študijski programi in stopnja	Študijska smer	Letnik	Semestri	Izbirnost
Biokemija, prva stopnja, univerzitetni	Ni členitve (študijski program)	2. letnik	2. semester	obvezni

Univerzitetna koda predmeta/University course code:	0072069
Koda učne enote na članici/UL Member course code:	BK122

Predavanja /Lectures	Seminar /Seminar	Vaje /Tutorials	Klinične vaje /Clinical tutorials	Druge oblike študija /Other forms of study	Samostojno delo /Individual student work	ECTS
30	10	35 LV			75	5

Nosilec predmeta/Lecturer:	doc. dr. Miha Pavšič
Vrsta predmeta/Course type:	obvezni/mandatory

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

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

Vsebina:	Content (Syllabus outline):
Biokemijske in biološke podatkovne baze: bibliografske baze, nukleotidna in aminokislinska zaporedja, geni in njihovo izražanje, genomi, bolezni, taksonomija, metabolične poti in strukture makromolekul. Nukleotidna in aminokislinska zaporedja: iskanje vzorcev, napovedi lastnosti na osnovi zaporedja, identifikacija funkcionalnih regij in motivov. Poravnave zaporedij: poravnave parov nukleotidnih in aminokislinskih zaporedij, matrike zamenjav in ocenjevalne sheme, lokalna in globalna poravnava, iskanje podobnih zaporedij, poravnava več zaporedij, osnove molekularne filogenetike. 3D-struktura makromolekul: 3D-struktura proteinov in nukleinskih kislin, zapis in vizualizacija strukturnih	Biochemical and biological databases: bibliographic databases, nucleotide and amino acid sequences, genes and gene expression, genomes, diseases, taxonomy, metabolic pathways, and structures of macromolecules. Nucleotide and amino acid sequences: pattern search, sequence-based prediction of properties, identification of functional regions and motifs. Sequence alignments: pairwise alignment of nucleotide and amino acid sequences, substitution matrices and scoring schemes, local and global alignment, search for similar sequences, multiple sequence alignment, basics of molecular phylogenetics. 3D structure of macromolecules: 3D structure of proteins and nucleic acids, format and visualization of

podatkov, zvitje, domene, analiza in podobnost struktur, modeliranje in umestitev. Obdelava biokemijskih podatkov, njihova analiza, statistična obravnava ter predstavitev s poudarkom na izbranih vidikih: mreže in grafi, grozdenje, metode optimizacije. Strojno učenje: pristopi, modeli, primeri ter uporabnost v bioinformatiki.	structural data, folds, domains, structure analysis and similarity, modeling, and docking. Processing and analysis of biochemical data, statistical analysis, and data presentation with emphasis on selected aspects: networks and graphs, clustering, optimization methods. Machine learning: approaches, models, examples and its use in bioinformatics.

Temeljna literatura in viri/Readings:

Marketa Zvelebil, Jeremy O. Baum: Understanding Bioinformatics. 1. izdaja, Garland Science, 2008.
Dodatna literatura/ Additional literature: navodila z vaje, tekoča znanstvena literatura, navodila za spletna bioinformatska orodja / Instructions for practicals, current scientific literature, instructions for online bioinformatics tools.

Cilji in kompetence:	**Objectives and competences:**
Študenti bodo spoznali orodja in pristope pri računalniško podprti analizi biokemijskih podatkov. Po uspešno opravljenih obveznostih bodo sposobni samostojnega pridobivanja podatkov iz podatkovnih baz, njihove analize, povezovanja in interpretacije.	Students will familiarize themselves with tools and approaches in computer aided biochemical data analysis. Upon successful completion of the course they will be able to independently perform data collection from databases, its analysis, integration and interpretation.

Predvideni študijski rezultati:	**Intended learning outcomes:**
Znanje in razumevanje Študenti bodo spoznali osnove iskanja, zbiranja in analize podatkov ter njihove in interpretacije. Preko poznavanja algoritmov, na katerih ti računalniški pristopi temeljijo, bodo postopke tudi razumeli in jih tako znali ustrezno uporabiti. Uporaba Znanje biokemijske informatike je danes pomembno na vseh področjih biokemije. V okviru vaj in seminarske naloge študent pridobi tudi praktična znanja. Refleksija Študenti bodo pridobili pregled biokemijskih podatkovnih baz in računalniških orodij, ob poznavanju uporabnosti pa se bodo zavedali tudi njihovih omejitev. Prenosljive spretnosti Izkušnje pri reševanju problemov in projektnem delu. Principi računalniških algoritmov. Zbiranje podatkov, njihova analiza, povezovanje, interpretacija ter predstavitev.	Knowledge and Comprehension Knowledge of modern computer approaches in data collection and analysis is critical for every biochemist. Students will apply the acquired knowledge and skills in other courses during their study as well as during their independent research work. Application Knowledge of biochemical informatics and its tools is important in all fields of biochemistry. Applicable knowledge is achieved through practical exercises and project work. Analysis Students will get an overview of the biochemical databases and computer tools, their functionality and, importantly, their limitations. Skill-transference Ability Skills in problem solving and project work. Principles of computer algorithms. Data collection, its analysis, integration, interpretation, and presentation.

Metode poučevanja in učenja:	**Learning and teaching methods:**
Predavanja. Laboratorijske vaje.	Lectures. Computer exercises.

Načini ocenjevanja:	**Delež/Weight**	**Assessment:**
Kolokvij iz vaj.	40,00 %	Practical exam.
Pisni izpit in seminarska naloga.	60,00 %	Written exam and seminar work.

Ocene: 6-10 (pozitivno), 1-5 (negativno). Pogoj za pristop h kolokviju in izpitu: opravljene vaje in seminarska naloga.		Grades: 6-10 (positive), 1-5 (negative). Requirements for exam admission: completed practicals and seminar work.

Reference nosilca/Lecturer's references:

- Tsaktanis T, Kremling H, **Pavšič M**, von Stackelberg R, Mack B, Fukumori A, Steiner H, Vielmuth F, Spindler V, Huang Z, Jakubowski J, Stoecklein NH, Luxenburger E, Lauber K, Lenarčič B, Gires O. Cleavage and Cell Adhesion Properties of Human Epithelial Cell Adhesion Molecule (HEPCAM). Journal of Biological Chemistry 2015 Oct 2;290(40):24574-91. doi: 10.1074/jbc.M115.662700
- **Pavšič M**, Ilc G, Vidmar T, Plavec J, Lenarčič B. The cytosolic tail of the tumor marker protein Trop2--a structural switch triggered by phosphorylation. Sci Rep. 2015 May 18;5:10324. doi: 10.1038/srep10324
- **Pavšič M**, Gunčar G, Djinović-Carugo K, Lenarčič B. Crystal structure and its bearing towards an understanding of key biological functions of EpCAM. Nature Communications 2014 Aug 28;5:4764. doi: 10.1038/ncomms5764

BIOKEMIJSKI PRAKTIKUM

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Biokemijski praktikum
Course title:	Practical course in biochemistry
Članica nosilka/UL Member:	UL FKKT

Študijski programi in stopnja	Študijska smer	Letnik	Semestri	Izbirnost
Biokemija, prva stopnja, univerzitetni (od študijskega leta 2023/2024 dalje)	Ni členitve (študijski program)	1. letnik	2. semester	obvezni

Univerzitetna koda predmeta/University course code:	0072059
Koda učne enote na članici/UL Member course code:	BK111

Predavanja /Lectures	Seminar /Seminar	Vaje /Tutorials	Klinične vaje /Clinical tutorials	Druge oblike študija /Other forms of study	Samostojno delo /Individual student work	ECTS
	15	60 LV			75	5

Nosilec predmeta/Lecturer:	doc. dr. Miha Pavšič
Vrsta predmeta/Course type:	obvezni/mandatory
Jeziki/Languages:	Predavanja/Lectures: Slovenščina Vaje/Tutorial: Slovenščina

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

Vsebina:	Content (Syllabus outline):
Varno delo v biokemijskem laboratoriju. Osnovne operacije: pipetiranje, redčenje raztopin, homogenizacija, centrifugiranje. Proteini: kromatografske metode za čiščenje proteinov (afinitetna in ionskoizmenjevalna kromatografija, gelska filtracija, ...), obarjanje, stabilnost, koncentriranje in dializa, kvantifikacija, elektroforezne metode in prenos na membrano, nespecifična in specifična detekcija, detekcija encimske aktivnosti in kinetika encimsko kataliziranih reakcij, struktura (od primarne do terciarne). Nukleinske kisline: izolacija kromosomske in plazmidne DNA, kvantifikacija, osnovna karakterizacija DNA (denaturacija, topološke oblike, …), elektroforezne metode in detekcija, rezanje z encimi, 3D struktura.	Safety at work in a biochemical laboratory. Basic operations: pipetting, diluting of solutions, homogenization, centrifugation. Proteins: chromatographic methods for protein purification (affinity and ion exchange chromatography, gel filtration, ...), precipitation, stability, concentrating and dialysis, quantification, electrophoretic methods and transfer to the membrane, unspecific and specific detection, detection of enzymatic activity and kinetics of enzyme-catalyzed reactions, structure (from primary to tertiary). Nucleic acids: isolation, quantification, denaturation, topological forms of DNA, electrophoretic methods and detection, enzymatic digestion, 3D structure.

Druge biološko pomembne molekule – lipidi in ogljikovi hidrati: izolacija in osnovna karakterizacija. Predstavitev eksperimentalnih rezultatov: laboratorijsko poročilo, elektroferogrami, kromatogrami, drugi diagrami in prileganje krivulj.	Other biologically important molecules – lipids and carbohydrates: isolation and basic characterization. Presentation of experimental results: laboratory report, electrophoretograms, chromatograms, other diagrams and curve fitting.

Temeljna literatura in viri/Readings:

- Kuhelj R: Biokemija v praksi: načela in tehnike, 3. izdaja, FKKT, Ljubljana, 2003, 100 strani
- Boyer R: Biochemistry Laboratory: Modern Theory and Techniques, 2nd ed. Prentice Hall, 2011, 350 strani (50%)

Cilji in kompetence:	**Objectives and competences:**
Študent bo spoznal osnovne biokemijske tehnike in pravila, ki veljajo za delo v biokemijskih laboratorijih. Po opravljenih obveznostih bo sposoben samostojno izvesti osnovne biokemijske analize na osnovi pisnih navodil.	Students will learn the basic biochemical techniques and rules for safe work in a biochemical laboratory. After successful completion of the course students will be able to independently perform essential biochemical analyses following written instructions.

Predvideni študijski rezultati:	**Intended learning outcomes:**
Znanje in razumevanje Študent bo poznal osnovne tehnike, ki se najpogosteje uporabljajo v biokemijskih laboratorijih in razumel njihove teoretične osnove. **Uporaba** Študent bo znal uporabljati osnovne biokemijske tehnike. **Refleksija** Študent se bo zavedal uporabnosti in omejitev posameznih metod ter pomena upoštevanja pravil pri delu v laboratoriju **Prenosljive spretnosti** Osnovne spretnosti za delo v biokemijskem laboratoriju, spretnosti uporabe domače in tuje literature in drugih virov, zbiranja in interpretiranja podatkov, uporaba IKT, uporaba različnih postopkov, poročanje (ustno in pisno), identifikacija in reševanje problemov, sposobnost organiziranega in natančnega dela.	**Knowledge and Comprehension** Students will get acquainted with the basic techniques most often used in biochemical laboratories and understand their theoretical basis. **Application** Students will be able to use basis biochemical techniques. **Analysis** Students will reflect on the use and restrictions of different methods and the importance of following safety procedures during laboratory work. **Skill-transference Ability** Basic skills for working in a biochemical laboratory, use of domestic and foreign literature and other sources, collecting and interpreting data, use of ICT, use of protocols, reporting (oral and written), problem identification and solving, ability of organized and precise work.

Metode poučevanja in učenja:	**Learning and teaching methods:**
Seminarji in laboratorijske vaje.	Seminars and laboratory courses.

Načini ocenjevanja:	**Delež/Weight**	**Assessment:**
Opravljene vaje so pogoj za pristop k izpitu. Pisni izpit Ocene: 6-10 (pozitivno), 1-5 (negativno).		Completed laboratory course is prerequisite for the exam. Written exam Grades: 6-10 (positive), 1-5 (negative)

Reference nosilca/Lecturer's references:

ŽAGAR, Tomaž, **PAVŠIČ, Miha**, GABER, Aljaž. Destabilization of EpCAM Dimer Is Associated with Increased Susceptibility towards Cleavage by TACE. PeerJ, 2021, 9, e11484.
TSAKTANIS, Thanos, KREMLING, Heidi, **PAVŠIČ, Miha**, von STACKELBERG, Ricarda, MACK, Brigitte, FUKUMORI, Akio, STEINER, Harald, VIELMUTH, Franziska, SPINDLER, Volker, HUANG, Zhe, JAKUBOWSKI, Jasmine, STOECKLEIN, Nikolas H., LUXENBURGER, Elke, LAUBER, Kirsten,

LENARČIČ, Brigita, GIRES, Olivier. Cleavage and Cell Adhesion Properties of Human Epithelial Cell Adhesion Molecule (HEPCAM). Journal of Biological Chemistry, 2015, 290, 40, 24574–24591.
NOVINEC, Marko, **PAVŠIČ, Miha**, LENARČIČ, Brigita. A Simple and Efficient Protocol for the Production of Recombinant Cathepsin V and Other Cysteine Cathepsins in Soluble Form in Escherichia coli. Protein Expression and Purification, 2012, 82, 1, 1–5.

BIOLOGIJA CELICE

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Biologija celice
Course title:	Cell biology
Članica nosilka/UL Member:	UL FKKT

Študijski programi in stopnja	Študijska smer	Letnik	Semestri	Izbirnost
Biokemija, prva stopnja, univerzitetni	Ni členitve (študijski program)	2. letnik	1. semester	obvezni

Univerzitetna koda predmeta/University course code:	0072070
Koda učne enote na članici/UL Member course code:	BK115

Predavanja /Lectures	Seminar /Seminar	Vaje /Tutorials	Klinične vaje /Clinical tutorials	Druge oblike študija /Other forms of study	Samostojno delo /Individual student work	ECTS
45		30 LV			75	5

Nosilec predmeta/Lecturer:	prof. dr. Peter Veranič
Vrsta predmeta/Course type:	obvezni/mandatory
Jeziki/Languages:	Predavanja/Lectures: Slovenščina; Vaje/Tutorial: Slovenščina

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

Vsebina:	Content (Syllabus outline):
Celica kot osnovni gradnik vsega živega, primerjava med prokariontsko in evkariontsko celico. Evkariontska celica. Plazemska membrana – značilnosti lipidnega dvosloja; proteini v membrani, glikokaliks; komunikacija z okoljem in prenos sporočil. Principi transporta majhnih molekul skozi membrano; sklopljenost različnih transportnih sistemov v celici. Plazemska membrana v vlogi povezovanja s sosednjimi celicami in zunajceličnim matriksom; vrste povezovalnih molekul in vrste medceličnih stikov. Citoskelet in gibanje celic; mikrotubuli, aktinski filamenti in intermediarni filamenti. Znotrajcelični predelki in prenos proteinov na tarčna mesta v celici; pomen sporočilnih zaporedij.	Cell as a basic brick stone of organism, comparison between prokaryotic and eukaryotic cell Eukaryotic cell and its membranes, membrane domains, compartmentalization of eukaryotic cell Intercellular communication and transport of messages Cell junctions in connecting cell and extracellular matrix Molecules of extracellular matrix Cytoskeleton: microtubules, actin filaments and intermediary filaments Protein targeting and the meaning of signal sequences Endomembrane system and biosynthetic pathway of proteins. Exocytosis Endosome – lysosome system in degradation of biomolecules

Biosintetsko – sekrecijska pot in endomembranski sistemi; endoplazemski retikulum, Golgijev aparat, vezikularni transport. Lizosomi in njihova vloga pri razgradnji makromolekul. Eksocitoza; različne poti prenosa produktov iz celice na njeno površino. Endocitoza; različne poti in mehanizmi prenosa makromolekul in delcev v celico, zgodnji in pozni endosomi. Organeli energijskih pretvorb; mitohondriji, kloroplasti, semiavtonomni organeli. Jedro kot krmilo celice in nosilec genoma; jedro v interfazi, kromatin in nivoji kondenzacije kromatina, kromosomi, jedrce. Celične delitve; mitoza, mejoza. Celični ciklus; faze in kontrolne točke v celičnem ciklu, mehanizmi regulacije. Celična smrt kot ravnotežje celičnim delitvam; nekroza, apoptoza. Diferenciacija celic; matične celice, nastanek različnih celic. Morfološke značilnosti rakasto transformirane celice.	Mitochondria: energy conversion and protein entry Nucleus as a cell carrier of genome; interphase nucleus, chromatin and its condensation into chromosomes, nucleolus Regulation of transport in and out of nucleus. Differences between genetic and epigenetic changes in the genome, tumour suppressor genes, oncogenes Cell cycle, phases and checkpoints in the cell cycle Mechanisms of the regulation of cell cycle, cell division: mitosis, meiosis Cell-biological characteristic of cancer cells, causes for transformation from normal to cancer cell Types and characteristics of stem cells, cell differentiation and development of a variety of cells Cell aging, cell death as the balance to cell division: necrosis, apoptosis

Temeljna literatura in viri/Readings:

- Kristijan Jezernik, Peter Veranič, Maksimiljan Sterle: Celična biologija, DZS, 2012

Cilji in kompetence:	**Objectives and competences:**
Cilji: pridobiti znanje o celici kot osnovnemu gradniku vsega živega **Predmetno specifične kompetence:** poznavanje in razumevanje povezanosti zgradbe celic s funkcijo; razumevanje specifičnosti procesov v celičnih organelih; razumevanje komunikacije celic z okoljem; poznavanje mehanizmov, ki regulirajo različne celične aktivnosti.	Students are familiar with basic characteristics of cell structure, cell organelle structure and function, as well with the elements of complex molecular structure and function, especially about the communication cell to cell and cell with the extracellular environment. They learn the techniques of cell biology.

Predvideni študijski rezultati:	**Intended learning outcomes:**
Znanje in razumevanje Poznavanje zgradbe celice in razumevanje povezanosti zgradbe s funkcijo, razumevanje specifičnosti procesov v celičnih organelih, razumevanje komunikacije celice z okoljem, poznavanje metod v celični biologiji. Uporaba Poznavanje vloge celice in celičnih organelov za razumevanje zgradbe in nastanka makromolekul in potek biokemičnih procesov v celici. Refleksija Poznavanje nivojev organizacije v celici, zmožnost razumevanja pomena kompartmentalizacije v evkariontski celici ter razumevanje mehanizmov, ki regulirajo različne celične aktivnosti. Prenosljive spretnosti	Knowledge and Comprehension Understanding of concepts, and principles necessary for the studies of fundamental processes at the level of cells, tissues, organs and organisms. Application Knowledge of the role of cells and organelles in formation of macromolecules. Knowledge of the location of biochemical process in cells and tissues as a crucial factor for effective modulation of processes in cells. Analysis Comprehension of the levels of cell organisation, the benefits of cell compartmentalisation, and mechanisms controlling biochemical processes in cells. Skill-transference Ability

Sposobnost samostojnega mikroskopiranja, izbira metod za načrtovanje eksperimentalnega dela, interpretacija mikrografij, povezovanje znanja celične biologije z vsebinami molekularne biologije, biokemije in splošne biologije, uporaba literature v tujih jezikih.	Sovereignty in the use of microscopes, choosing proper methods in experimental work with cells and tissues, linking of the knowledge of cell biology with molecular biology and biochemistry.

Metode poučevanja in učenja:	**Learning and teaching methods:**
Predavanja, laboratorijske vaje	Lectures, laboratory exercises

Načini ocenjevanja:	**Delež/Weight**	**Assessment:**
Kolokvij iz vaj	30,00 %	Laboratory practical exam
Pisni izpit	70,00 %	Written exam
Ocene: 6-10 (pozitivno), 1-5 (negativno).		Grades: 6-10 (positive), 1-5 (negative)

Reference nosilca/Lecturer's references:

1. DRAGIN, Urška, **VERANIČ, Peter**, ERDANI-KREFT, Mateja. Amniotic membrane scaffolds enable the development of tissue-engineered urothelium with molecular and ultrastructural properties comparable to that of native urothelium. Tissue engineering, ISSN 1076-3279, 2013, kategorija: 1A1 (Z1, A', A1/2);
2.. BREGAR, Vladimir Boštjan, LOJK, Jasna, ŠUŠTAR, Vid, **VERANIČ, Peter**, PAVLIN, Mojca. Visualization of internalization of functionalized cobalt ferrite nanoparticles and their intracellular fate. International journal of nanomedicine, ISSN 1178-2013. [Online ed.], 2013, vol. 8, str. 919-931, kategorija: 1A1 (Z1, A', A1/2)
3. ERMAN, Andreja, KEREC KOS, Mojca, ŽAKELJ, Simon, RESNIK, Nataša, ROMIH, Rok, **VERANIČ, Peter**. Correlative study of functional and structural regeneration of urothelium after chitosan-induced injury. Histochemistry and cell biology, ISSN 0948-6143, Nov. 2013, kategorija: 1A1 (Z1, A", A', A1/2);
4. RESNIK, Nataša, SEPČIĆ, Kristina, PLEMENITAŠ, Ana, WINDOFFER, Reinhard, LEUBE, Rudolf, **VERANIČ, Peter**. Desmosome assembly and cell-cell adhesion are membrane raft-dependent processes. The Journal of biological chemistry, ISSN 0021-9258, 2011, vol. 286, issue 2, str. 1499-1507, 1A1 (Z1, A', A1/2);
5. **VERANIČ, Peter**, ERMAN, Andreja, KEREC KOS, Mojca, BOGATAJ, Marija, MRHAR, Aleš, JEZERNIK, Kristijan. Rapid differentiation of superficial urothelial cells after chitosan induced desquamation. Histochemistry and cell biology, ISSN 0948-6143, 2009, vol. 131, no. 1, str. 129-139, 1A1 (Z1, A", A', A1/2);
6. **VERANIČ, Peter**, LOKAR, Maruša, SCHÜTZ, Gerhard J., WEGHUBER, Julian, WIESER, Stefan, HÄGERSTRAND, Henry, KRALJ-IGLIČ, Veronika, IGLIČ, Aleš. Different types of cell-to-cell connections mediated by nanotubular structures. Biophys. j., 2008, letn. 95, št. 9, str.593-607. 1A1 (Z1, A', A1/2);

BIOMAKROMOLEKULE V INDUSTRIJI IN MEDICINI

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Biomakromolekule v industriji in medicini
Course title:	Biomacromolecules in industry and medicine
Članica nosilka/UL Member:	UL FKKT

Študijski programi in stopnja	Študijska smer	Letnik	Semestri	Izbirnost
Biokemija, prva stopnja, univerzitetni	Ni členitve (študijski program)	3. letnik		izbirni

Univerzitetna koda predmeta/University course code: 0640060

Predavanja /Lectures	Seminar /Seminar	Vaje /Tutorials	Klinične vaje /Clinical tutorials	Druge oblike študija /Other forms of study	Samostojno delo /Individual student work	ECTS
30	15	30 LV			75	5

Nosilec predmeta/Lecturer: doc. dr. Miha Pavšič

Vrsta predmeta/Course type: izbirni strokovni/Elective Professional

Jeziki/Languages:

Predavanja/Lectures:	Angleščina, Slovenščina
Vaje/Tutorial:	Angleščina, Slovenščina

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

Vsebina:	Content (Syllabus outline):
Pridobivanje in proizvodnja proteinov ter drugih bioloških makromolekul – naravni viri, pregled sistemov za proizvodnjo rekombinantnih proteinov v velikem merilu, priprava polisaharidov. Posebni biopolimeri – polihidroksialkanoati, poliaminokisline. Modifikacija (kemijske, metabolične in post-translacijske modifikacije) in funkcionalizacija biomakromolekul ter proteinski inženiring (usmerjena evolucija, dizajn de novo) z namenom doseganja specifičnih lastnosti (katalitična aktivnost, stabilnost, vezava). Encimi kot biokatalizatorji – proizvodnja hrane in pijač, biogoriv, tekstila in čistil. Uporaba biomakromolekul v medicini – tkivni inženiring, regenerativna medicina, 3D-tiskanje bioaktivnih struktur, terapevtske učinkovine in	Extraction and production of proteins and other biological macromolecules – natural sources, overview of systems for large scale recombinant protein production, production of polysaccharides. Special biopolymers – polyhydroxyalkanoates, polyamino acids. Modification (chemical, metabolic and post-translational modifications) and functionalization of biomacromolecules, and protein engineering (directed evolution, design de novo) with the aim to deliver specific properties (catalytic activity, stability, binding). Enzymes as biocatalysts – production of food and beverages, biofuels, textile and cleaning agents. Biomacromolecules in medicine – tissue engineering, regenerative medicine, 3D printing of bioactive structures, pharmaceuticals and drug delivery.

dostava zdravil. Biopolimeri v industriji in agronomiji – prehrambena industrija (hrana in pakiranje hrane), moderni materiali, zaščita semen in rastlin, hranila, uporaba v živinoreji. Biomakromolekule in okoljske tehnologije – biorazgradljivost, remediacija okolja in trajnostni vidiki. Patenti in inovacije v biotehnologiji ter zaščita intelektualne lastnine.	Biopolymers in industry and agriculture – food industry (food and food packaging), modern materials, protection of seeds and plants, livestock feed and farming. Biomacromolecules and environmental technologies – biodegradability, remediation and sustainability. Patents and innovations in biotechnology, and protection of intelectual property.

Temeljna literatura in viri/Readings:

Temeljna literatura in viri / Readings:
- Navodila za vaje in tekoča znanstvena literatura. / Protocols for practicals and current scientific literature.
- Gary Walsh. Proteins: Biochemistry and Biotechnology. 2. izdaja. Wiley Blackwell, 2014.
- Wolfgang Aehle. Enzymes in Industry: Production and Applications. 3. izdaja. Wiley, 2007. (izbrana poglavja / selected chapters)
- Sabu Thomas, Sreeraj Gopi, Augustine Amalraj. Biopolymers and Their Industrial Applications: From Plant, Animal, and Marine Sources, to Functional Products. 1. izdaja. Wiley, 2020. (izbrana poglavja / selected chapters)

Cilji in kompetence:	**Objectives and competences:**
Predmet daje pregled uporabe biomakromolekul v različnih vejah industrije, medicini in tudi v vsakdanjem življenju. Po opravljenih obveznostih bodo študenti znali kritično ovrednotiti prednosti biomakromolekul z vidika njihove priprave, posebnih funkcionalnosti in okoljskih vidikov.	The subject provides an overview of the use of biomacromolecules in various industrial branches, medicine and also in everyday life. Upon completing the course, the students will be able to critically evaluate the advantages of biomacromolecules from the productional, functional and environmental aspects.

Predvideni študijski rezultati:	**Intended learning outcomes:**
Znanje in razumevanje Poznavanje načinov pridobivanja bioloških makromolekul, njihovih prednosti in načinov uporabe. **Uporaba** Pridobljeno znanje predstavlja razširitev osnovnega biokemijskega znanja s poudarkom na industrijski in medicinski vrednosti biomakromolekul. **Refleksija** Študenti bodo zraven navedenega znanja pridobili sposobnost kritičnega razmišljanja o aplikativnih vidikih. **Prenosljive spretnosti** Samostojno in skupinsko delo na vajah ter pri pripravi seminarjev, sposobnost uporabe znanstvene literature in drugih virov, predstavljanje in debatiranje.	**Knowledge and Comprehension** Knowledge on production of biological macromolecules, their advantages and use. **Application** Acquired knowledge broadens the basic biochemical knowledge with emphasis on industrial and medical value of biomacromolecules. **Analysis** Students will, besides gaining the listed knowledge, develop ability to critically think about applicative aspects. **Skill-transference Ability** Individual and group work at practicals and at seminar preparation, ability to use scientific literature and other sources, presentation and debating.

Metode poučevanja in učenja:	**Learning and teaching methods:**
Predavanja, laboratorijske vaje, individualni in skupinski seminarji.	Lectures, laboratory practicals, and individual and group seminars.

Načini ocenjevanja:	**Delež/Weight**	**Assessment:**
Seminarska naloga	30,00 %	Seminar work

Pisni izpit Pogoj za pristop k izpitu: opravljene laboratorijske vaje, seminarska naloga.	70,00 %	Written exam Requirements for exam admission: completed laboratory practicals, seminar work.

Reference nosilca/Lecturer's references:

KRAJNC, Anja, GABER, Aljaž, LENARČIČ, Brigita, **PAVŠIČ, Miha.** 2020. The Central Region of Testican-2 Forms a Compact Core and Promotes Cell Migration. International Journal of Molecular Sciences. 2020. DOI 10.3390/ijms21249413. ISSN 1661-6596. [COBISS.SI-ID 42261507]

GABER, Aljaž, GUNČAR, Gregor, **PAVŠIČ, Miha**. Proper Evaluation of Chemical Cross-Linking-Based Spatial Restraints Improves the Precision of Modeling Homo-Oligomeric Protein Complexes. BMC Bioinformatics. 2019, vol. 20 (1): 464. DOI 10.1186/s12859-019-3032-x. ISSN 1471-2105. [COBISS.SI-ID 1538315971]

PAVŠIČ, Miha, GUNČAR, Gregor, DJINOVIĆ-CARUGO, Kristina, LENARČIČ, Brigita. Crystal Structure and Its Bearing towards an Understanding of Key Biological Functions of EpCAM. Nature Communications. 2014, 5: 4764. DOI 10.1038/ncomms5764. ISSN 2041-1723. [COBISS.SI-ID 1764911]

CELIČNA IN MOLEKULARNA IMUNOLOGIJA

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Celična in molekularna imunologija
Course title:	Cellular and molecular immunology
Članica nosilka/UL Member:	UL FKKT

Študijski programi in stopnja	Študijska smer	Letnik	Semestri	Izbirnost
Biokemija, prva stopnja, univerzitetni	Ni členitve (študijski program)	3. letnik	1. semester	obvezni

Univerzitetna koda predmeta/University course code:	0072082
Koda učne enote na članici/UL Member course code:	BK133

Predavanja /Lectures	Seminar /Seminar	Vaje /Tutorials	Klinične vaje /Clinical tutorials	Druge oblike študija /Other forms of study	Samostojno delo /Individual student work	ECTS
30	15	30 LV			75	5

Nosilec predmeta/Lecturer:	doc. dr. Gregor Gunčar
Vrsta predmeta/Course type:	obvezni/mandatory
Jeziki/Languages:	Predavanja/Lectures: Slovenščina Vaje/Tutorial: Slovenščina

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

Vsebina:	Content (Syllabus outline):
Splošne značilnosti imunskega sistema, nomenklatura, komponente imunskega sistema. Strukturne značilnosti protiteles in njihove biološke lastnosti. Organizacija imunoglobulinskih genov. Ogljikovi hidrati in njihova vloga pri delovanju imunskega sistema. Antigeni. Monoklonska protitelesa in njihova uporaba. Reakcije med antigeni in protitelesi. Pregled imunoloških metod. Zorenje in aktivacija limfocitov B. Poglavitni sistem tkivne skladnosti. Predstavljanje in T-celično spoznavanje antigena. Presajanje tkiv in organov. T-celični receptor. Zorenje, aktivacija in diferenciacija limfocitov T. Citokini in njihova vloga pri boleznih. Uravnavanje imunskega odziva. Imunska toleranca in avtoimunost.	Introduction to the immune system. Nomenclature. Basic concepts in immunology. Cells involved in the immune response. Antibodies and their structure. Generation of diversity. Organization of the immunoglobulin genes. Antigens. Monoclonal antibodies and their use. Reaction between antigens and antibodies. An overview of the immunological methods. Development of B lymphocytes. Major Histocompatibility Complex (MHC). Transplantation and rejection. T-cell receptor. Development of T-lymphocytes. Cytokines and their role in diseases. Regulation of the immune response. Immune tolerance and autoimmunity. Complement. Vaccination. Allergy and hypersensitivity. Immune deficiencies. Immune system and cancer.

Sistem komplementa. Cepljenje. Alergija in preobčutljivost. Imunske pomanjkljivosti. Imunski sistem in rak. Laboratorijske vaje: Struktura protiteles in proteolitična razgradnja IgG, posredna in neposredna ELISA, komplement: aktivacija, litična faza, liza bakterijskih celic, prenos western- uporaba poliklonskih protiteles za detekcijo določenih antigenov v bakterijskem lizatu, točkovni nanos IgG za analizo hrane, imunološka bioinformatika: struktura nekaterih makromolekul imunskega sistema (IgG, MHC, TCR) in njihove interakcije, načrtovanje peptidov in napoved njihove vezave na molekule MHC	Laboratory practical courses: Antibody structures and proteolytic degradation of IgG, ELISA, complement: activation, lytic phase, Western blot- use of polyclonal antibodies for detection of antigens in bacterial lysate, dot blot for food analysis, bioinformatics: structure of the molecules of the immune system- IgG, MHC, TCR, their interactions, peptide design and their binding to the MHC.

Temeljna literatura in viri/Readings:

- Abbas, Abul K., Andrew H. Lichtman, Shiv Pillai. Cellular and Molecular Immunology, Saunders, 2011 (60% vsebine)

Dodatna literatura / additional readings:

- Murphy, Kenneth, Paul Travers, and Mark Walport. Janeway's immunobiology. Taylor & Francis, 2011.
- Več avtorjev: Laboratorijske vaje iz celične in molekularne imunologije, FKKT, 2013

Cilji in kompetence:	**Objectives and competences:**
Molekularna imunologija z imunokemijo je predmet s področja biomedicine, ki povezuje osnovne kemijske in biokemijske zakonitosti ter spoznanja na področju biologije in medicine, od koder imunologija izvira, zato je nepogrešljiva pri naravoslovno usmerjenih študijih. Predmet usmerja študenta k samostojnemu teoretičnemu in eksperimentalnemu delu. Omogoča mu, da rešuje probleme, razume načrtovanje in izvedbo projektov s tega področja ter pridobi znanje, ki je pomembno tudi v vsakdanjem življenju.	Objectives: Molecular immunology with immunochemistry is the area of biomedicine and brings together basic knowledge of chemistry, biochemistry, biology and medicine (from the last immunology originates). It is thus indispensable for the study of life sciences. Competences: Students are encouraged to be independent in their theoretical and practical work. They are able to solve the problems, understand the design and implementation of the projects from the field and to learn the topics, which are also important for everyday life.

Predvideni študijski rezultati:	**Intended learning outcomes:**
Znanje in razumevanje Študent se pri predmetu najprej seznani z osnovami imunologije ter z nomenklaturo. Po uvodnih predavanjih pridobi dovolj znanja, da razume princip imunokemijskih metod, ki jih nato uporablja pri vajah za reševanje problemov. V nadaljevanju spozna mehanizme in dejavnike, ki sodelujejo pri imunskem odzivu. V zadnjem delu predavanj spozna osnove cepljenja ter pridobi osnovna znanja o alergijah, imunskih pomanjkljivostih ter imunskem sistemu in raku. Uporaba Vsebine predmeta spadajo med znanja, ki zaokrožujejo naravoslovno izobrazbo. Poleg teoretičnih vsebin nudi predmet mnogo praktičnih znanj, tudi takšnih, ki jih potrebujemo ne le v strokovnem, temveč tudi v vsakdanjem življenju. Zasnovan je tako, da študente vzpodbuja k	Knowledge and Comprehension Basics of immunology and nomenclature. After introductory lectures the ability to understand the principles of immunochemistry methods, which are then utilized in laboratory practical courses to solve the problems. Gain knowledge about mechanisms and cells/molecules of the immune response. Basics of vaccinations, allergies, immune deficiencies and the role of immune system in cancer. Application Course topics add to the basic knowledge in life sciences. Besides the theoretical fundaments the students also learn about practical knowledge and methods that are needed not only in the professional environment but also in everyday life. Students are encouraged to think and integrate knowledge to solve the problems.

razmišljanju, k povezovanju ter k reševanju problemov. Refleksija Poleg pregleda znanj s področja imunologije in imunokemije pridobi študent občutek za način dela in razmišljanja na področju biomedicine in biotehnologije. Prenosljive spretnosti Izkušnje pri reševanju problemov. Timsko delo, predvsem pri vajah. Zbiranje, analiza in interpretacija rezultatov ter njihovo kritično vrednotenje. Uporaba domače in tuje literature. Podajanje poročil o opravljenem delu.	Analysis Besides the overview of the immunology and immunochemistry, the student is directed towards biomedical and biotechnological way of work and problem solving. Skill-transference Ability Problem solving skills, team work in laboratory, collecting data, data analysis, interpretation and critical assessment, use of English scientific literature, writing laboratory reports.

Metode poučevanja in učenja:	**Learning and teaching methods:**
Predavanja, laboratorijske vaje.	Lectures, laboratory practical courses.

Načini ocenjevanja:	**Delež/Weight**	**Assessment:**
Opravljene vaje so pogoj za pristop k izpitu.		Laboratory practical completion is required to attend written exams.
Kolokvij iz vaj		. Laboratory practical written exam
Seminarska naloga		Seminar work
Pisni izpit		Written exam

Reference nosilca/Lecturer's references:

- 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. *deljeno prvo avtorstvo
- MIHELIČ, Marko, DOBERŠEK, Andreja, **GUNČAR, Gregor**, TURK, Dušan. Inhibitory fragment from the p41 form of invariant chain can regulate activity of cysteine cathepsins in antigen presentation. J Biol Chem, 2008, vol. 283, no. 21, str. 14453-14460.
- **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 j., 1999, vol. 18, str. 793-803.

DIPLOMSKO DELO

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Diplomsko delo
Course title:	Diploma work
Članica nosilka/UL Member:	UL FKKT

Študijski programi in stopnja	Študijska smer	Letnik	Semestri	Izbirnost
Biokemija, prva stopnja, univerzitetni	Ni členitve (študijski program)	3. letnik	2. semester	obvezni

Univerzitetna koda predmeta/University course code:	0072083
Koda učne enote na članici/UL Member course code:	D1BI

Predavanja /Lectures	Seminar /Seminar	Vaje /Tutorials	Klinične vaje /Clinical tutorials	Druge oblike študija /Other forms of study	Samostojno delo /Individual student work	ECTS
				225	225	15

Nosilec predmeta/Lecturer:	
Vrsta predmeta/Course type:	obvezni/mandatory

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

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	**Prerequisites:**
Odobrena tema diplomskega dela.	Approved topic.

Vsebina:	**Content (Syllabus outline):**
Diplomsko delo se opravlja iz področja biokemije. Vsebina in naslov se določata v soglasju z izbranim mentorjem. Mentor je lahko učitelj na UL FKKT [t.j. zaposleni na fakulteti na učiteljskem delovnem mestu ali zaposleni na fakulteti na delovnem mestu asistenta, ki ima učiteljski naziv (docent, izredni ali redni profesor) ali nosilec predmeta na študijskem programu 1. ali 2. stopnje UL FKKT, ki ni zaposlen na fakulteti]. Mentor je praviloma učitelj na programu, ki ga je študent vpisal.	The diploma thesis is performed in the field of biochemistry. The topic and title of the thesis are chosen in agreement with the chosen mentor. The mentor is an UL FCCT teacher (i.e. employee at the faculty occupying a teaching position or occupying a teaching assistant position and holding a teaching degree [assistant professor, associate professor, full professor] or any lecturer who lectures a course as part of a 1st or 2nd cycle study programme of the UL FCCT and is not an employee of the faculty). As a rule, the mentor is a teacher in the programme of the student's enrolment.

Temeljna literatura in viri/Readings:

Knjige in članki, ki so povezani z vsebino diplomskega dela. Books and paper, associated with the topic of the thesis.

Cilji in kompetence:	Objectives and competences:
Dokončno oblikovanje pričakovanega lika diplomanta. Študent bodo ob izdelavi diplomske naloge pokazal sposobnosti iskanja in zaznavanja problemov in znal poiskati rešitev za tak problem. Pri delu bodo pokazal, da je pridobil večino kompetenc navedenih v programu študija.	Final shaping of the expected characteristics of the diploma student. Students will demonstrate the skills to search for and detect problems as well as found the solutions for the problems. They will demonstrate the majority of the competences described in the study programme.

Predvideni študijski rezultati:	Intended learning outcomes:
Znanje in razumevanje Pri izdelavi diplomskega dela bo slušatelj pridobil naslednje kompetence: • sposobnost samostojne izvedbe biokemijskih analiz na osnovi ustnih ali pisnih navodil; • razumevanje meja zanesljivosti svojih eksperimentalnih podatkov; • sposobnost izvedbe manjšega projekta, za katerega ni nujno, da njegov rezultat zadošča kriterijem za objavo; • sposobnost v posredovanja informacij, idej, problemov in rešitev dobro informirani publiki; • sposobnost prilagajanja novim situacijam in sprejemanja odločitev; • sposobnost načrtovanja in upravljanja s časom; razvita profesionalna etična in okoljska odgovornost. Uporaba Znanje in pridobljene veščine bo diplomant lahko uporabil pri opravljanju poklica. Refleksija Povezovanje vseh pridobljenih teoretičnih znanj z reševanjem problemov na področju biokemije ter kritični pogled na uporabnost teh znanj. Prenosljive spretnosti Pri delu bo diplomant pridobil znanja o metodah reševanja problemov, o načinu prezentacije teh znanj v pisani in govorjeni obliki povezani z ostalimi metodami posredovanja raziskav ugotovitev itd.	Knowledge and Comprehension During the preparation of the diploma thesis, the student will gain the following competences: - The ability to independently perform biochemical analyses based on written and oral instructions, - Understanding the margins of confidence of experimental data, - Ability to perform a minor project, which does not necessarily produce publishable results, - Ability to transmit information, ideas, problems and solutions to a well-informed audience - Ability to adapt to novel situations and make decisions, - Ability to plan and manage time. - Developed professional ethical and environmental responsibility. Application Students will use the acquired knowledge and skills in their profession. Analysis Integrations of theoretical knowledge with biochemical problem solving and a critical perspective on the usefulness of this knowledge. Skill-transference Ability Students will acquire knowledge on the methods of problem solving, presentation of knowledge in written and oral form in connection with other methods, etc.

Metode poučevanja in učenja:	Learning and teaching methods:
Študijsko in raziskovalno delo pod vodstvom mentorja, po možnosti tudi delo v laboratoriju.	Study and research work under the supervision of the mentor, if possible also laboratory work.

Načini ocenjevanja:	Delež/Weight	Assessment:
Ocenjuje se diplomsko delo in zagovor diplomskega 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.		Evaluation includes the thesis and the oral presentation in front of a commission, consisting of the chair, the mentor and one member.

Reference nosilca/Lecturer's references:

ENCIMATIKA

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Encimatika
Course title:	Enzymatics
Članica nosilka/UL Member:	UL FKKT

Študijski programi in stopnja	Študijska smer	Letnik	Semestri	Izbirnost
Biokemija, prva stopnja, univerzitetni	Ni členitve (študijski program)	3. letnik	1. semester	obvezni

Univerzitetna koda predmeta/University course code:	0072084
Koda učne enote na članici/UL Member course code:	BK132

Predavanja /Lectures	Seminar /Seminar	Vaje /Tutorials	Klinične vaje /Clinical tutorials	Druge oblike študija /Other forms of study	Samostojno delo /Individual student work	ECTS
30	15	30 LV			75	5

Nosilec predmeta/Lecturer:	prof. dr. Marko Novinec
Vrsta predmeta/Course type:	obvezni/mandatory

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

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

Vsebina:	Content (Syllabus outline):
Nomenklatura in klasifikacija encimov: razredi encimov, reakcije, izoencimi, ribocimi, abcimi. Encimska kataliza: teorija prehodnega stanja, različne oblike kataliz, eksperimentalni pristopi za določanje mehanizma reakcije, primeri. Osnove encimske kinetike: pridobivanje in obdelava kinetičnih podatkov, encimske enote, simboli, kinetika enosubstratnih in dvosubstratnih reakcij, kinetika predravnotežnega stanja. Regulacija encimske aktivnosti: inhibitorji, razpoložljivost substrata, ireverzibilne in reverzibilne kovalentne modifikacije, inhibicija s končnim produktom, kontrola aktivnosti preko vezave liganda (alosterični in kooperativni efekt), primeri. Encimi v organiziranih sistemih: klasifikacija multiencimskih sistemov, primeri.	Nomenclature and classification of enzymes: classes of enzymes, types of reactions, isoenzymes, ribozymes, abzymes. Enzyme catalysis: transition state theory, different forms of catalysis, experimental approaches to the determination of enzyme mechanisms, examples. An introduction to enzyme kinetics: obtaining and analysing the kinetic data, enzyme units, symbols, kinetics of one-substrate and two-substrate reactions, pre-steady state kinetics. The control of enzyme activity: inhibitors, substrate availability, irreversible and reversible covalent modifications, end-product inhibition, control of activity by ligand-induced conformational changes (allosteric and cooperative effects), examples.

Razgradnja proteinov: lizosomska in nelizosomska pot (ubikvitinacija, proteasom).	Enzymes in organized systems: classification of multienzyme systems, examples. Protein degradation: lysosomal and non-lysosomal pathways (ubiquitination, proteasome).

Temeljna literatura in viri/Readings:

- Fundamentals of Enzymology, Price N.C. & Stevens L., 3rd ed, Oxford University Press, 1999. 478 strani (60 %)

Cilji in kompetence:	**Objectives and competences:**
Študentje spoznajo lastnosti in delovanje encimov. Na izbranih primerih se na strukturnem nivoju spoznajo z različnimi mehanizmi encimske katalize in tudi z različnimi strategijami kontrole njihove aktivnosti. Študent bo sposoben samostojno izvesti encimske teste s pomočjo pripravljenih protokolov in kritično ovrednotiti rezultate.	Objectives: Learning the functional properties of enzymes. Familiarizing students with the structural basis of the mechanisms of enzyme catalysis and regulation in selected examples. Competences: Ability to independently perform enzyme reaction experiments according to prepared protocols and to critically evaluate the obtained results.

Predvideni študijski rezultati:	**Intended learning outcomes:**
Znanje in razumevanje Pridobljeno znanje omogoča razumevanje encimsko kataliziranih reakcij in njihove regulacije na nivoju strukturno-funkcijskih lastnosti encimov. Uporaba Poznavanje delovanja encimov ima široko uporabnost v vseh panogah, kjer so vključeni encimi (znanost, medicina, industrija). Refleksija Študent poveže pridobljeno znanje s strategijami uporabnosti encimov. Prenosljive spretnosti Sposobnost uporabe domače in tuje literature, kritično branje raziskovalnih člankov, sposobnost ustnega in pisnega poročanja.	Knowledge and Comprehension Acquired knowledge enables the understanding of enzyme-catalysed reactions and their regulation at the structural and functional levels. Application Knowledge of enzyme function is widely applicable in various fields, such as research, medicine and industry. Analysis Students are able to link the acquired knowledge with the strategies of the use of enzymes. Skill-transference Ability Ability to use Slovenian and foreign literature, critical reading of scientific papers, ability of oral and written reporting.

Metode poučevanja in učenja:	**Learning and teaching methods:**
Predavanja, raziskovalni seminar, laboratorijske vaje	Lectures, research seminar, laboratory courses

Načini ocenjevanja:	**Delež/Weight**	**Assessment:**
Opravljene vaje so pogoj za pristop k izpitu. Seminarska naloga Pisni izpit Ocene: 6-10 (pozitivno), 1-5 (negativno)		Completed laboratory course is prerequisite for the exam. Seminar work Written exam Grades: 6-10 (positive), 1-5 (negative)

Reference nosilca/Lecturer's references:

ULČAKAR, Liza, **NOVINEC, Marko**. Inhibition of human cathepsins B and L by caffeic acid and its derivatives. Biomolecules. Jan. 2021, vol. 11, iss. 1, str. 1-9. GORIČAN, Tjaša, CIBER, Luka, PETEK, Nejc, SVETE, Jurij, **NOVINEC, Marko**. Synthesis and kinetic characterization of hyperbolic inhibitors of human cathepsins K and S based on a succinimide scaffold. Bioorganic chemistry. Oct. 2021, vol. 115, str. 1-13.

REBERNIK, Mateja, SNOJ, Tina, KLEMENČIČ, Marina, **NOVINEC, Marko**. Interplay between tetrameric structure, enzymatic activity and allosteric regulation of human dipeptidyl-peptidase I. Archives of biochemistry and biophysics. 30 Oct. 2019, vol. 675, str. 1-11.

FIZIKA

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Fizika
Course title:	Physics
Članica nosilka/UL Member:	UL FKKT

Študijski programi in stopnja	Študijska smer	Letnik	Semestri	Izbirnost
Biokemija, prva stopnja, univerzitetni	Ni členitve (študijski program)	1. letnik	1. in 2. semester	obvezni

Univerzitetna koda predmeta/University course code:	0072060
Koda učne enote na članici/UL Member course code:	BK102S

Predavanja /Lectures	Seminar /Seminar	Vaje /Tutorials	Klinične vaje /Clinical tutorials	Druge oblike študija /Other forms of study	Samostojno delo /Individual student work	ECTS
90		60 SV			150	10

Nosilec predmeta/Lecturer:	prof. dr. Igor Muševič, prof. dr. Janez Bonča, prof. dr. Svjetlana Fajfer
Vrsta predmeta/Course type:	obvezni/mandatory

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

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

Vsebina:	Content (Syllabus outline):
Kinematika: premo enakomerno in pospešeno gibanje točkastega telesa, gibanje v prostoru. Dinamika: sila in masa. Newtonovi zakoni, izrek o gibanju težišča, izrek o gibalni količini, sila curka, izrek o kinetični energiji, delo, potencialna energija, prožnost, prožnostna energija, vrtenje togega telesa okoli nepremične osi, navor, Newtonov zakon pri vrtenju, izrek o vrtilni količini. Mehanika tekočin: hidrostatika, hidrostatični tlak, vzgon, hidrodinamika, opis toka tekočin, Bernoullijeva enačba. Nihanje in valovanje: amplituda, frekvenca in nihajni čas, sinusno nihanje, nihanja molekul, vsiljeno nihanje, sklopljeno nihanje, spekter nihanja, longitudinalno in transferzalno	Kinematics: uniform and accelerated motion of a particle, motion in space Dynamics: Force and mass; Chord force; Newton's laws; the theorem on the system of particles and velocity of the centre of mass; kinetic energy theorem; work; potential energy; elasticity; rotation of a rigid body around a fixed axis; torque; Newton's law on rotation; theorem on conservation of angular momentum. Fluid mechanics: hydrostatics, hydrostatic pressure; buoyancy; hydrodynamics; description of fluid flow; Bernoulli's equation. Oscillation and wave motions: amplitude, frequency and oscillation intervals; harmonic oscillation; oscillation of molecules, forced oscillation; oscillation of coupled oscillators; oscillation spectrum;

valovanje, energijski tok, gostota energijskega toka, valovna dolžina, hitrost valovanja, interferenca, stoječe valovanje, spekter valovanja, lastna nihanja, osnove akustike. Električno polje in električni tok: Coulombov zakon, statično električno polje, električno polje točkastega naboja, električno polje v okolici električnega dipola, električni potencial, napetost, Gaussov zakon, Poissonova enačba, kondenzator, kapaciteta kondenzatorja, dielektrik v elektricnem polju, izoliran prevodnik v električnem polju, influenca, Ohmov zakon, enosmerni in izmenični tok, izmenični tok skozi ohmski upor in kondenzator, merjenje električnega toka in napetosti, električno delo in moč. Magnetno polje: statično magnetno polje, gostota magnetnega polja, sila na vodnik v magnetnem polju, magnetni navor na tokovno zanko, magnetni moment, bio-magnetna orientacija (preko kristalov magnetita), Amperov zakon, magnetno polje v okolici ravnega vodnika, v tuljavi, induktivnost tuljave, izmenični tok skozi tuljavo, indukcija, električni nihajni krog, dušeno nihanje. Svetloba: nastanek elektromagnetnega valovanja, hitrost elektromagnetnega valovanja, odboj, lorn in interferenca svetlobe, svetlobni energijski tok, absorpcija svetlobe, fotometrija, spekter svetlobe, elektromagnetno sevanje segretih teles (Wiennov in Stefanov zakon). Geometrijska optika: zrcala in leče enačba zrcal in leč, oko, napake očes, optične naprave: povečevalno steklo in mikroskop. Izbrana poglavja iz moderne fizike: fotoefekt, uklonska slika curka elektronov, de Broglijeva valovna dolžina, Bohrov model atoma	longitudinal and transversal waves, radiant flux, radiant flux density, wave length; the speed of a travelling wave, interference, standing waves; motion spectrum; fundamentals of acoustics. Electric field and electric current: Coulomb's law, static electric field; electric field of a point charge, electric field of an electric dipole, electric potential, voltage, Gauss's law, Poisson's equation, capacitor, capacitance, dielectric in electric field, insulated conductor in electric field, influence, Ohm's law, direct and alternating current, alternating current through Ohm's resistor and capacitor, measuring electric current and voltage, electrical work and power. Magnetic field: static magnetic field, density of magnetic field, magnetic force on a current-carrying conductor, magnetic torque on a current loop, magnetic moment, bio-magnetic orientation (via magnetite crystals), Amper's law, magnetic field in the vicinity of a long straight wire, in the coil, inductivity of a coil, alternating current through a coil, induction, alternating current in an undamped and damped electric circuit. Light: formation of electromagnetic radiation, speed of electromagnetic radiation, reflection, refraction and interference, radiant energy, absorption of light, photometry, light spectrum, electromagnetic radiation of black bodies (Wienn's and Stefan's law). Geometrical optics: reflectors and lenses, equation of mirrors and lenses, eye, vision corrections, optical devices, magnifying glass and microscope. Selected topics in modern physics: photo effect, electron beam diffraction, de Broglie's wave length, Bohr's model of atom.

Temeljna literatura in viri/Readings:

Osnovna/Basic:
- J.Strnad: Fizika II, DZS, Ljubljana, 1977. pp. 288, (50%)
- R.Kladnik: Visokošolska fizika II, DZS, Ljubljana, 1989. pp. 335 (30%)

Dodatna/Additional:
- D. Halliday, R. Resnick, J. Walker: Fundamentals of Physics (Extended), John Wiley, New York, 1993.
- R. A. Serway in J. S. Faughn, College Physics, Saunders College Publishing, 1999.

Cilji in kompetence:	**Objectives and competences:**
Predmet je podlaga za pridobitev kompetenc s področja priprave materiala za preiskave in izvajanje nadzora kakovosti kar vključuje umerjanje analizatorjev, izvajanje kontrole kvalitete dela in sodelovanje pri kontroli kvalitete rezultatov.	The course represents the basis to reach competences in the area of material preparation for research and quality control that is composed of instrument calibration, work quality control and cooperation in controlling the reliability of results.

Predvideni študijski rezultati:	**Intended learning outcomes:**
Znanje in razumevanje Pri predmetu Fizika študenti pridobijo razumevanje	**Knowledge and Comprehension** During the physics course students obtain the

osnovnih fizikalnih pojmov in fizikalnih količin, spoznajo osnovne zakone narave ter se ob reševanju problemov navadijo osnov analitičnega mišljenja. **Uporaba** Dobro poznavanje osnovnih fizikalnih zakonitosti olajša študentu delo s sodobno laboratorijsko opremo, mu omogoča poglobljeno razumevanje njenega delovanja in tako poveča učinkovitost njene uporabe pri vsakdanjem delu. Fizikalno znanje je tudi nujno potrebno pri izvajanju, obdelavi in kritičnem ovrednotenju dobljenih meritev, kar predstavlja osnovo laboratorijskega dela. Predmet Fizika se neposredno navezuje na predmete: Fizikalna kemija. **Refleksija** Pridobljeno znanje fizikalnih osnov bo študentu omogočilo kritično ovrednotiti rezultate laboratorijskih meritev in poglobljeno razumevanje predpisanih postopkov pri izvajanju meritev. **Prenosljive spretnosti** Sposobnost samostojnega spremljanja novih spoznanj in literature s področja laboratorijske tehnike. Razumevanje fizikalnih meritev in sposobnost njihovega ovrednotenja. Kritičen odnos do standardov kakovosti.	understanding of basic physical concepts and quantities, they obtain the understanding of the basic laws of nature and through problem solving acquire the basics principles of analytical thinking. **Application** In depth understanding of basic physics laws empowers the student to operate modern laboratory equipment and enables better understanding the quality of measurements. This in turn increases the efficiency of operating the equipment. Physical knowledge is as well crucial in critical analysis of results that represent the basis of laboratory work. Physics connects to the following classes: Physical chemistry **Analysis** The acquired knowledge of physics will enable the student to critically evaluate the outcomes of laboratory measurements and rigorous understanding of prescribed measurement procedures. **Skill-transference Ability** The ability to autonomously follow the latest advances in the field of modern laboratory techniques. Understanding of physical measurements and the ability of critical evaluation of quality standards and procedures.

Metode poučevanja in učenja:	**Learning and teaching methods:**
Predavanja s prikazom fizikalnih eksperimentov. Računske vaje.	Lectures with demonstration of physical experiments. Problem solving.

Načini ocenjevanja:	**Delež/Weight**	**Assessment:**
Pisni izpit iz računskih vaj. Končna ocean je sestavljena iz		Written exam problem solving. Final score:
-izpita iz teorije	50,00 %	- theory
-izpita iz vaj Ocene 6-10 pozitivno.	50,00 %	- problem solving Grades 6-10 positive results.

Reference nosilca/Lecturer's references:

Prof. dr. Svjetlana Fajfer / Dr. Svjetlana Fajfer, Full Professor

1. Svjetlana Fajfer, Jernej F. Kamenik, Ivan Nisandzic, Jure Zupan "Implications of Lepton Flavor Universality Violations in B Decays", Phys.Rev.Lett. 109 (2012) 161801.

2. Ilja Doršner, **Svjetlana Fajfer**, Nejc Košnik, Ivan Nišandžić "Minimally flavored colored scalar in bar B ->D (*) tau bar nu and the mass matrices constraints", JHEP 1311 (2013) 084.

3. Ilja Dorsner, **Svjetlana Fajfer**, Admir Greljo, Jernej F. Kamenik "Higgs Uncovering Light Scalar Remnants of High Scale Matter Unification", JHEP 1211 (2012) 130.

4. Jure Drobnak, **Svjetlana Fajfer**, Jernej F. Kamenik "Probing anomalous tWb interactions with rare B decays", Nucl.Phys. B855 (2012) 82-99.

5. Ilja Dorsner, **Svjetlana Fajfer**, Jernej F. Kamenik, Nejc Kosnik "Light colored scalars from grand unification and the forward-backward asymmetry in t t-bar production", Phys.Rev. D81 (2010) 055009.

Prof. dr. Janez Bonča / Dr. Janez Bonča, Full Professor

1. VIDMAR, Lev, **BONCA, Janez**, TOHYAMA, Takami, and MAEKAWA, Sadamichi, Quantum Dynamics of a Driven Correlated System Coupled to Phonons, Phys. Rev. Lett. 107, 246404-1- 246404-4 (2011).

2. MIERZEJEWSKI, Marcin, **BONČA, Janez**, PRELOVŠEK, Peter. Integrable Mott insulators driven by a finite electric field. Phys. Rev. Lett., 107, 126601-1-126601-4, (2011).

3. MIERZEJEWSKI, Marcin, VIDMAR, Lev, **BONČA, Janez**, PRELOVŠEK, Peter. Nonequilibrium quantum dynamics of a charge carrier doped into a Mott insulator. Phys. Rev. Lett. 106, 196401-1-196401-4 (2011).
4. VIDMAR, Lev, **BONČA, Ja**nez, MIERZEJEWSKI, Marcin, PRELOVŠEK, Peter, TRUGMAN, Stuart A. Nonequilibrium dynamics of the Holstein polaron driven by an external electric field. Phys. Rev., B 83, 134301-1-134301-7 (2011).
5. VIDMAR, Lev, **BONČA, Janez**, MAEKAWA, Sadamichi, TOHYAMA, Takami. Bipolaron in the t-J model coupled to longitudinal and transverse quantum lattice vibrations. *Phys. Rev. Lett.* 103, 186401 (2009).
6. BONČA, Janez, MAEKAWA, Sadamichi, TOHYAMA, T. Numerical approach to the low-doping regime of the t-J model. *Phys. Rev. B* 76, 035121 (2007).

Prof. dr. Igor Muševič / Dr. Igor Muševič, Full Professor

1. I. Muševič, Izpitna vprašanja iz fizike za kemike, (Zbirka izbranih poglavij iz fizike, 36). Ljubljana: DMFA - založništvo, 2002. 9 str. ISBN 961-212-126-5.
2. M. Vilfan, **I. Muševič**, Tekoči kristali, (Knjižnica Sigma, 74). Ljubljana: DMFA - založništvo, 2002. 117 str., ilustr. ISBN 961-212-136-2.
3. I. Muševič, M. Škarabot, U. Tkalec, M. Ravnik, S. Žumer, Two-dimensional nematic colloidal crystals self-assembled by topological defects. *Science* 313, 954-958 (2006).
4. U. Tkalec, M. Ravnik, S. Čopar, S. Žumer, **I. Muševič**, Reconfigurable knots and links in chiral nematic colloids. *Science* 333, 62 (2011).
5. I. Muševič, S. Žumer, Maximizing memory. *Nature Materials* 10, 1 (2011).

FIZIKALNA KEMIJA

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Fizikalna kemija
Course title:	Physical Chemistry
Članica nosilka/UL Member:	UL FKKT

Študijski programi in stopnja	Študijska smer	Letnik	Semestri	Izbirnost
Biokemija, prva stopnja, univerzitetni	Ni členitve (študijski program)	2. letnik	1. semester, 2. semester	obvezni

Univerzitetna koda predmeta/University course code:	0072071
Koda učne enote na članici/UL Member course code:	BK113S

Predavanja /Lectures	Seminar /Seminar	Vaje /Tutorials	Klinične vaje /Clinical tutorials	Druge oblike študija /Other forms of study	Samostojno delo /Individual student work	ECTS
80	25	45 LV			150	5

Nosilec predmeta/Lecturer:	prof. dr. Ksenija Kogej
Vrsta predmeta/Course type:	obvezni/mandatory
Jeziki/Languages:	Predavanja/Lectures: Slovenščina Vaje/Tutorial: Slovenščina

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

Vsebina:	Content (Syllabus outline):
Plini. Uvod. Lastnosti plinov. Enačbe stanja, idealni in realni plini. Kritični pojavi, utekočinjanje plinov. **Prvi zakon termodinamike.** Delo in toplota. Prvi termodinamični zakon. Notranja energija, entalpija. Toplotne kapacitete. Kalorimetrija. Diferenčna dinamična kalorimetrija. Termokemija. Odvisnost entalpije od temperature. **Drugi zakon termodinamike.** Obrnljivi in neobrnljivi procesi. Entropija. Računanje entropijskih sprememb pri reverzibilnih in ireverzibilnih procesih. Tretji termodinamični zakon. Gibbsova in Helmholtzova prosta energija. Odprti sistemi. Kemijski potencial in kriterij za snovno ravnotežje. Fazno pravilo. Fazna ravnotežja. Clausius-Clapeyronova enačba. Fazni diagrami.	**Gasses**. Properties of gasses. Equations of state, ideal and real gasses. Critical phenomena, condensation of gasses. **The first law of thermodynamics.** Work and heat. The internal energy and enthalpy. Heat capacities. Calorimetry. Differential scanning calorimetry. Thermochemistry. Dependence of enthalpy on temperature. **The second law of thermodynamics.** Reversible and irreversible processes. Entropy. Calculation of entropy changes in reversible and irreversible processes. The third law of thermodynamics. Gibbs and Helmholtz free energy. Open systems. Chemical potential and the criterion for equilibrium. The phase rule. Phase equilibria. The Clausius-Clapeyron equation.

Raztopine. Parcialne molske količine. Idealne in neidealne raztopine. Termodinamika mešanja. Raoultov in Henryjev zakon. Koligativne lastnosti. Raztopine elektrolitov. Ionske aktivnosti. Debye-Hückelov zakon. Vsoljevanje in izsoljevanje. Koligativne lastnosti raztopin elektrolitov. Donnanov efekt. Biološke membrane. **Kemijsko ravnotežje.** Termodinamična konstanta kemijskega ravnotežja. Ravnotežje v plinastem stanju. Heterogeno ravnotežje. Vpliv temperature in tlaka na ravnotežje. Vezanje ligandov na makromolekule. Disociacijska ravnotežja. **Elektrokemija.** Elektrokemijski členi. Napetost galvanskega člena. Termodinamika galvanskega člena. Biološka oksidacija. Membranski potencial. **Kemijska kinetika.** Hitrostni zakon, red reakcije in konstanta reakcijske hitrosti. Mehanizem reakcije. Razpolovni čas. Vzporedne, postopne in obojesmerne reakcije. Vpliv temperature na hitrost reakcije. Kataliza. Aktivacijska energija. Encimska kinetika in inhibicija. **Laboratorijske vaje:** Kalorimetrija. Parni tlak in izparilna entalpija. Krioskopija. Heterogeno ravnotežje. Napetost in notranja upornost galvanskih členov, merjenje pH. Termodinamika galvanskega člena. Prevodnost šibkih in močnih elektrolitov. Protolitsko ravnotežje. Kemijska kinetika.	Phase diagrams. **Solutions.** Partial molar quantities. Ideal and non-ideal solutions. Thermodynamics of mixing. Raoult's and Henry's law. Colligative properties. Electrolyte solutions. Ionic activities. Debye-Hückel theory. Salting-in and salting-out. Colligative properties of electrolytes. The Donnan effect. Biological membranes. **Chemical equilibrium.** Thermodynamic equilibrium constant. Equilibrium in gaseous systems. Heterogeneous equilibrium. Effect of temperature and pressure on equilibrium. Binding of ligands to macromolecules. Bioenergetics. Dissociation equilibria. **Electrochemistry**. Electrochemical cells. Electromotive force (EMF) of galvanic cell. Thermodynamics of galvanic cells. Biological oxidation. Membrane potential. **Chemical kinetics.** Reaction rates, reaction order and the rate constant. Reaction mechanism. The half-life. Reversible, consecutive and chain reactions. The effect of temperature on reaction rate. Catalysis. Activation energy. Enzyme kinetics and inhibition. **Laboratory practice:** Calorimetry. Vapour pressure and heat of vaporization. Cryoscopy. Heterogeneous equilibrium. EMF and internal resistance of galvanic cells, measurement of pH. Thermodynamics of galvanic cells. Conductivity of weak and strong electrolytes. Protolytic equilibrium. Chemical kinetics.

Temeljna literatura in viri/Readings:

Temeljna literatura:

Raymond Chang: Physical Chemistry for the Biosciences, University Science Books, Sausalito, California, 2005; 190 strani (50 %).

P. W. Atkins: Physical Chemistry, 7th Edition, Oxford University Press, Oxford, 2002, 400 strani (38 %).

Matjaž Bončina, Janez Cerar, Andrej Godec, Barbara Hribar Lee, Andrej Jamnik, Jurij Lah, Andrej Lajovic, Miha Lukšič, Črtomir Podlipnik, Iztok Prislan, Jurij Reščič, Bojan Šarac, Matija Tomšič in Gorazd Vesnaver: FIZIKALNA KEMIJA – PRAKTIKUM, interno študijsko gradivo, Ljubljana, 2011, 260 strani (40 %).

Dopolnilna literatura:

P. Atkins and J. de Paula: Physical Chemistry for the Life Sciences, Oxford University Press, Oxford, UK, 2006.

W. J. Moore: Physical Chemistry, 5th Edition, Harlow: Longman, 1996; 950 strani.

Cilji in kompetence:	**Objectives and competences:**
Fizikalna kemija je osnovni naravoslovni predmet, pri katerem študenti spoznajo temeljne fizikalno-kemijske zakonitosti in njihovo uporabo pri reševanju zelo različnih problemov iz naravoslovja. Predmet usmerja študenta k samostojnemu delu ter k abstraktnemu in kritičnemu razmišljanju o svojih opažanjih. Osvojeno znanje mu pomaga razumeti in interpretirati pojave v naravi ter jih povezovati z drugimi naravoslovnimi vedami, še posebej s temami iz biokemije. Eden od pomembnih cilje je, da študenti preverijo razumevanje pridobljenega teoretičnega	Physical chemistry is a fundamental natural science course where students learn about basic physical-chemical principles and their application in solving various problems in chemistry and nature. The aim is to direct student to independent work and to critical and abstract thinking about their observations. The acquired knowledge helps students to understand and interpret phenomena in nature and to relate them with other natural sciences, in particular with subjects related to biochemistry. One of important objectives is that students verify their understanding of theoretical knowledge of physical-chemical principles

znanja v laboratoriju, kjer se spoznajo z meritvami pomembnih fizikalnih zakonitosti in lastnosti snovi.	in laboratory by measuring various physical properties of matter.

Predvideni študijski rezultati:	**Intended learning outcomes:**
Znanje in razumevanje Študent se pri predmetu spozna z osnovnimi naravnimi zakonitosti sistemov in fizikalno kemijskih količin. Osvoji osnovne termodinamske zakone, pojme obrnljivi in neobrnljivi procesi ter spozna kriterije za spontanost procesov in za ravnotežje. Spozna razliko med termodinamiko in kinetiko ter osvoji pristope za obravnavo preprostih in bolj zapletenih reakcijskih mehanizmov, npr. encimske kinetike. Nauči se razmišljati v okviru različnih enostavnih modelov. Osnovne termodinamične zakonitosti se nauči uporabljati na primerih iz biokemijskega področja. Pri študiju predmeta študent razvije kritičen in analitičen način razmišljanja, ki je nujen za razumevanje kompleksnih pojavov na področju biokemije. Velik poudarek predmeta je tudi na laboratorijskih vajah, katerih cilj je pridobivanje spretnosti za izvajanje meritev termodinamičnih in kinetičnih količin. Študent se nauči pravilnega in kvalitetnega izvajanja meritev in ustreznega podajanja rezultatov, ki jih interpretira v skladu s teoretičnim znanjem, ki ga je osvojil pri predavanjih. Uporaba Študij predmeta Fizikalna kemija je nujna podlaga za to, da bo študent razumel principe raziskovalnih metod, ki jih bo uporabljal na različnih strokovnih področjih, saj moderne eksperimentalne tehnike v veliki meri temeljijo na fizikalno-kemijskih procesih. Pridobljeno znanje mu bo pomagalo pri interpretaciji dobljenih rezultatov in pri razumevanju pojavov na biokemijskem in drugih področjih. Študent bo osvojil tudi veščine, ki so potrebne za kvalitetno izvajanje meritev fizikalno-kemijskih količin. Spretnosti in izkušnje, ki jih bo pridobil pri delu v laboratoriju, mu bodo koristile pri nadaljnjem strokovnem razvoju in pri vključevanje v delo v večjih interdisciplinarnih raziskovalnih skupinah in v industrijskih družbah. S tem se bo naučil posredovati znanje in rezultate drugim. Refleksija Študent pridobi občutek za fizikalno-kemijski način razmišljanja, razvije zmožnost abstraktne predstave o fizikalno-kemijskih količinah in se naučil povezovanja znanja. To mu omogoča interpretacijo pojavov v naravi, reševanje praktičnih problemov na raznih področjih in odločanje o smiselnosti uporabe spoznanih teorij v praksi. Prenosljive spretnosti Študent se nauči uporabljati domačo in tujo literaturo, privadi se varnega dela v laboratoriju, dela z raznimi aparaturami ter zbiranja, obdelovanja in interpretiranja rezultatov. Nauči se uporabljati računalnik tako za obdelavo kot za prikaz rezultatov in podajati pregledna in eksaktna poročila o	Knowledge and Comprehension Students learn to understand basic natural principles for various systems and physical and chemical quantities. They are acquainted with basic thermodynamic laws, with concepts reversible and irreversible processes, with criteria for spontaneity and equilibrium. Students learn to understand the difference between thermodynamics and kinetics and acquire the principles for treating simple and more complex reaction mechanisms, e.g. enzyme kinetics. They acquire critical thinking in the framework of simple models and learn to apply basic thermodynamic principles to solving problems in biochemistry. They develop a critical and analytical way of thinking necessary for understanding complex phenomena in the field of biochemistry. Emphasis of the course is also on laboratory practice where students learn about how to measure thermodynamic and kinetic quantities. They are taught how to correctly and precisely perform measurements and report their results. They interpret the results in frames of theories which they learned in courses. Application The course in Physical Chemistry is the necessary basis for understanding fundamentals of research methods that are used in various fields, because modern experimental techniques are based on physical and chemical processes treated within this subject. The knowledge of physical chemistry helps students to interpret phenomena in biochemistry and in other fields. Students will gain skills necessary to correctly perform measurements of physical-chemical properties. The skills and experience they acquire in team work in laboratory will be useful in their future professional work, in particular in larger interdisciplinary research groups or in teams in companies. In this way they learn how to transfer knowledge among group members. Refleksija Študent pridobi občutek za fizikalno-kemijski način razmišljanja, razvije zmožnost abstraktne predstave o fizikalno-kemijskih količinah in se naučil povezovanja znanja. To mu omogoča interpretacijo pojavov v naravi, reševanje praktičnih problemov na raznih področjih in odločanje o smiselnosti uporabe spoznanih teorij v praksi. Prenosljive spretnosti Študent se nauči uporabljati domačo in tujo literaturo, privadi se varnega dela v laboratoriju, dela z raznimi aparaturami ter zbiranja, obdelovanja in interpretiranja rezultatov. Nauči se uporabljati računalnik tako za obdelavo kot za prikaz rezultatov in podajati pregledna in eksaktna poročila o

opravljenem delu. Predmet študenta navaja tako na timsko kot tudi na samostojno delo.	opravljenem delu. Predmet študenta navaja tako na timsko kot tudi na samostojno delo.

Metode poučevanja in učenja:	**Learning and teaching methods:**
Predavanja, seminarji, laboratorijske vaje.	Lectures, seminars, practical course.

Načini ocenjevanja:	**Delež/Weight**	**Assessment:**
Pisni izpit, ki ga lahko nadomestijo trije pozitivno ocenjeni pistni testi med letom.	70,00 %	Written examination. The written part can be passed by 3 written tests during the year.
Pozitivno ocenjen kolokvij pri vajah.	30,00 %	Written exam from laboratory practice with a positive grade.
Ocene: pozitivno 6-10; negativno 1-5.		Grades: positive 6-10; negative 1-5.

Reference nosilca/Lecturer's references:

-PRELESNIK, Simona, ASEYEV, Vladimir, **KOGEJ, Ksenija**. Differences in association behavior of isotactic and atactic poly(methacrylic acid). Polymer, ISSN 0032-3861. [Print ed.], 2014, vol. 55, no. 3, str. 848-854, [COBISS.SI-ID 1675823]

-ANKO, Maja, MAJHENC, Janja, **KOGEJ, Ksenija**, SILLARD, Rannard, LANGEL, Ülo, ANDERLUH, Gregor, ZORKO, Matjaž. Influence of stearyl and trifluoromethylquinoline modifications of the cell penetrating peptide TP10 on its interaction with a lipid membrane. Biochimica et biophysica acta, Biomembranes, ISSN 0005-2736. [Print ed.], 2012, vol. 1818, iss. 3, str. 915-924, ilustr. [COBISS.SI-ID 4881434]

-**KOGEJ, Ksenija**. Association and structure formation in oppositely charged polyelectrolyte-surfactant mixtures. Advances in colloid and interface science, ISSN 0001-8686. [Print ed.], 2010, vol. 158, no. 1/2, str. 68-83, [COBISS.SI-ID 34100741]

FUNKCIJSKA GENOMIKA

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Funkcijska genomika
Course title:	Functional Genomics
Članica nosilka/UL Member:	UL FKKT

Študijski programi in stopnja	Študijska smer	Letnik	Semestri	Izbirnost
Biokemija, prva stopnja, univerzitetni	Ni členitve (študijski program)	3. letnik		izbirni

Univerzitetna koda predmeta/University course code:	0088103
Koda učne enote na članici/UL Member course code:	BKSI7

Predavanja /Lectures	Seminar /Seminar	Vaje /Tutorials	Klinične vaje /Clinical tutorials	Druge oblike študija /Other forms of study	Samostojno delo /Individual student work	ECTS
30	15	30 LV			75	5

Nosilec predmeta/Lecturer:	prof. dr. Uroš Petrovič
Vrsta predmeta/Course type:	izbirni strokovni/Elective Professional
Jeziki/Languages:	Predavanja/Lectures: Angleščina, Slovenščina Vaje/Tutorial: Angleščina, Slovenščina

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

Vsebina:	Content (Syllabus outline):
Genom: *Projekt Človeški genom* - zgodovinski pregled, kloniranje in kartiranje; drugi genomi. *Metode preiskave vloge posameznega gena* - tehnologija izničenja genov, utišanje genov z siRNA in protismiselno tehnologijo. *Celostne genomske analize z mikromrežami* - genotipiziranje in SNP čipi, re-sekvenciranje, CGH mikromreže, mutacijska analiza, iskanje promotorskih zaporedij. *Genomika* - primerjalna in evolucijska genomika, metagenomika. *Transkriptom:* Načini izražanja genov, tehnike za merjenje transkriptoma. *Proteom:* Interakcije protein-protein in protein-DNA; visoko zmogljivostne tehnike za karakterizacijo proteinov in njihovih interakcij.	*Genome:* Human Genome Project – historical overview, cloning and mapping; other genomes. Methods of analysing the role of genes – production of knockouts, siRNA silencing and antisense technology. Comprehensive genome analyses using microarrays - genotypisation and SNP chips, resequencing, CGH microarrays, mutation analysis, promoter sequencing. Genomics – comparative and evolutionary genomics, metagenomics. *Transcriptome:* ways of genomic expression, transcriptome measuring techniques. *Proteome:* protein-protein and protein-DNA interactions; high performance techniques for protein characterisation and their interactions.

Metabolom: sistemske študije kemičnih prstnih odtisov metaboličnih procesov v celici (metabolično profiliranje), separacijske in identifikacijske metode. *Fenom:* metode za določitev različnih vrst fenotipov na genomski ravni modelnih mikroorganizmov. *Osnove sistemske biologije:* teorija sistemov v biologiji, uporaba načela mrež (teorije grafov) v sistemski biologiji, osnove modeliranja bioloških mrež, orodja bioinformatike v funkcijski genomiki in sistemski biologiji. *Modelni organizmi v sistemski biologiji in funkcijski genomiki*: zgodovinski okvir razvoja sistemske biologije, kvasovka *S. cerevisiae*, nematoda *C. elegans*. *Funkcijska genomika in družba* - varstvo podatkov, pravni in etični vidiki, patentiranje. *Urejanje genoma* – uporaba novih metod za urejanje genoma (npr. CRISPR-Cas9) v funkcijski genomiki.	*Metabolome*: system studies of chemical fingerprints of metabolic processes in a cell (metabolic profiling), separation and identification methods. *Phenome*: methods for determining different phenotypes at the genome level of model microorganisms. *Fundamentals of systems biology*: theory of systems in biology, graph theory in systems biology, fundamentals of modelling biological networks, bioinformatics tools used in functional genomics and systems biology. *Model organisms in systems biology and functional genomics*: historical background of systems biology, S. cerevisiae yeast, C. elegans nematode. *Functional genomics and the society* – data protection, legal and ethical aspects, patenting. *Genome editing* – use of new methods for genome editing (e.g. CRISPR-Cas9) in functional genomics.

Temeljna literatura in viri/Readings:

Izbrana poglavja iz:

- Prevsner J. 2015 Bioinformatics And Functional Genomics, 3rd edition. Wiley Blackwell, 1160 strani (~15%)
- Klipp, E., Herwig, R., Kowald, A., Wierling, C., Lehrach, H. 2005 Systems Biology in Practice: Concepts, Implementation and Application. John Wiley & Sons.; 496 strani (~30%)
- Stagljar I. (Ed.) 2015 Yeast Functional Genomics and Proteomics. Humana Press, 304 strani (~25%).
- 3) Palsson B.O. 2015 Systems Biology: Constraint-based Reconstruction and Analysis. Cambridge University Press, 531 strani (~20 %)

Dodatna literatura:

- Debeljak, N., Horvat, S., Juvan, P., Košir, R., Kunej, T., Petrovič, U., Režen, T., Rozman, D., Ačimovič, J. 2016 Funkcijska genomika – praktikum. 2. izdaja
- Članki iz tekoče periodike.

Cilji in kompetence:	**Objectives and competences:**
Cilji predmeta: pridobivanje osnovnih znanj o genomiki in študijah funkcije genov; spoznavanje (teoretično in praktično) eksperimentalnih in računskih tehnik, ki se uporabljajo v funkcijski genomiki; seznanjanje z modelnimi organizmi in njihovo uporabnostjo; pridobivanje osnovnih znanj o funkcijski genomiki in sistemski biologiji pri sesalcih in modelnih organizmih. **Predmetno specifične kompetence**: sposobnost načrtovanja eksperimentov s področja funkcijske genomike; sposobnost uporabe eksperimentalnih in bioinformatskih orodij, sposobnost razumevanja in interpretacije podatkov, sposobnost načrtovanja in izvedbe eksperimentov s področij transkriptomike, proteomike z interaktomiko, fenomike in eksperimentov z uporabo metod sekvenciranja nove generacije (NGS).	**Learning outcomes**: Acquiring basic knowledge on genomics and studies on gene functions; Acquiring (theoretical and practical) knowledge on experimental and computational techniques used in functional genomics; Learning about model organisms and their application; Acquiring basic knowledge on functional genomics and systems biology in mammals and model organisms. **Competences**: subject specific competencies: planning experiments in functional genomics, use of experimental bioinformatics tools, understanding and interpreting data, ability to design and perform experiments in the fields of transcriptomics, proteomics with interactomics, phenomics, and experiments using next generation sequencing (NGS) methods.

Predvideni študijski rezultati:	**Intended learning outcomes:**
Znanje in razumevanje - Poznavanje zgradbe in vloge človeškega genoma. - Poznavanje in razumevanja osnov transkriptomke, proteomike, metabolomike ion fenomike.	**Knowledge and Comprehension** - Know the structure and function of human genome - Know and understand the basics of transcriptomics, proteomics, metabolomics and phenomics

- Poznavanje in razumevanja mrež in modelov bioloških sistemov. - Poznavanje modelnih organizmov v funkcijski genomiki in njihovih specifičnosti. - Poznavanje osnovnih načel modeliranja bioloških sistemov. - Poznavanje in razumevanje problematike pravnih in etičnih vidikov pogenomskega obdobja. **Uporaba** - Sposobnost uporabe specifičnih eksperimentalnih metod funkcijske genomike. - Sposobnost uporabe specifičnih bioinformatskih orodij. **Refleksija** Študentje bodo razvili sposobnost kompleksnega vpogleda v biološke sisteme. Pridobili bodo sposobnost akstraktnejšega dojemanja organizacije in delovanje genoma ter celic in organizmov. **Prenosljive spretnosti** - Sposobnost intepretacije eksperimentalnih podatkov.	- Know and understand the concept of biological networks and systems - Know model organisms in functional genomics and their specificities - Know the basics of modelling in biology - Know and understand the issues and importance of legal and ethical aspects of the post-genome era **Application** - Ability to use specific experimental methods of functional genomics - Ability to use specific bioinformatics tools **Analysis** Students will be capable of a complex insight into biological systems. They will also obtain the capacity of abstract understanding of genome and cell/organism organization and functioning. **Skill-transference Ability** - Ability to interpret experimental data

Metode poučevanja in učenja:	**Learning and teaching methods:**
Predavanja, seminarji, laboratorijsko delo.	Lecture, seminars, laboratory-based practical work

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

Reference nosilca/Lecturer's references:

- Mattiazzi Ušaj M, Kaferle P, Toplak A, Trebše P, **Petrovič U.** (2013) Determination of toxicity of neonicotinoids on the genome level using chemogenomics in yeast. Chemosphere. (v tisku; doi: 10.1016/j.chemosphere.2013.10.063)
- Mattiazzi M, Sun Y, Wolinski H, Bavdek A, Petan T, Anderluh G, Kohlwein SD, Drubin DG, Križaj I, **Petrovič U.** (2012) A neurotoxic phospholipase A2 impairs yeast amphiphysin activity and reduces endocytosis. PLoS One. 7(7):e40931
- Mattiazzi M, Curk T, Križaj I, Zupan B, **Petrovič U.** (2010) Inference of the molecular mechanism of action from genetic interaction and gene expression data. OMICS. 14(4):357-367

- Polymorphisms of CYP51A1 from Cholesterol Synthesis: Associations with Birth Weight and Maternal Lipid Levels and Impact on CYP51 Protein Structure. Lewińska M, Zelenko U, Merzel F, Golic Grdadolnik S, Murray JC, **Rozman D**. PLoS One. 2013 Dec 17;8(12):e82554. doi: 10.1371/journal.pone.0082554. eCollection 2013., PMID:24358204
- Inducible cAMP early repressor regulates the Period 1 gene of the hepatic and adrenal clocks. Zmrzljak UP, Korenčič A, Košir R, Goličnik M, Sassone-Corsi P, **Rozman D**. J Biol Chem. 2013 Apr 12;288(15):10318-27. doi: 10.1074/jbc.M112.445692. Epub 2013 Feb 25., PMID: 23443664
- Novel insights into the downstream pathways and targets controlled by transcription factors CREM in the testis. Kosir R, Juvan P, Perse M, Budefeld T, Majdic G, Fink M, Sassone-Corsi P, **Rozman D**. PLoS One. 2012;7(2):e31798. doi: 10.1371/journal.pone.0031798. Epub 2012 Feb 22., PMID:22384077

INSTRUMENTALNE METODE ANALIZE

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Instrumentalne metode analize
Course title:	Instrumental analytical methods
Članica nosilka/UL Member:	UL FKKT

Študijski programi in stopnja	Študijska smer	Letnik	Semestri	Izbirnost
Biokemija, prva stopnja, univerzitetni	Ni členitve (študijski program)	2. letnik	1. semester	obvezni

Univerzitetna koda predmeta/University course code:	0072072
Koda učne enote na članici/UL Member course code:	BK117

Predavanja /Lectures	Seminar /Seminar	Vaje /Tutorials	Klinične vaje /Clinical tutorials	Druge oblike študija /Other forms of study	Samostojno delo /Individual student work	ECTS
45		30 LV			75	5

Nosilec predmeta/Lecturer:	prof. dr. Mitja Kolar
Vrsta predmeta/Course type:	obvezni/mandatory

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

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

Vsebina:	Content (Syllabus outline):
Pregled pomembnih kemijskih ravnotežij v analizni kemiji, pufrske raztopine. Klasične analizne metode; njihove značilnosti in omejitve. Instrumentalne analizne metode: delitev, osnovni principi metod, kvantitativno vrednotenje meritev (umeritvena krivulja, standardni dodatek). **Pregled spektroskopskih analiznih metod:** Molekularna absorpcijska spektrometrij (UV in VIS) osnove metode (Beer-Lambertov zakon) in instrumentacije, primeri uporabe v biokemijski analitiki. Molekulska fluorescenčna spektroskopija; osnove metode, instrumentacija karakteristike; primeri uporabe v analitiki biološko aktivnih spojin.	Survey of chemical equilibria important in analytical chemistry. Classical analytical techniques; their properties and limitations. Instrumental methods: classification, principles, quantitative evaluation of results (calibration curve, standard addition approach). **Spectroscopic methods:** UV-VIS molecular absorption spectrometry; theoretical basis (Beer-Lambert law), instrumentation and practical examples of its application. Molecular fluorescence spectrometry; theoretical basis, instrumentation and application in biochemical analysis. Atomic absorption spectroscopy: flame and electrothermal atomization, hydride generation.

Atomska absorpcijska spektrometrija načini atomizacije (plamen, elektrotermična atomizacija, hidridne tehnike). Atomska emisijska spektrometrija (vzbujanje v plamenu in induktivno sklopljeni plazmi), uporaba metod atomske spektrometrije v analitiki bioloških vzorcev. Masna spektrometrija osnovni načini ionizacije, masni spektrometri, interpretacija enostavnih masnih spektrov: Elementna masna spektrometrija (ICP-MS); osnovni principi in pomen v analitiki sledov. **Pregled elektrokemijskih analiznih metod:** Osnove potenciometrije (ionoselektivne elektrode) in voltametrije, elektrokemijski senzorji. **Separacijske metode v analizni kemiji:** Osnovni principi kromatografske separacije, parametri kromatografskih separacij (retencijski čas, število teoretskih podov, ločljivost, načini kvantifikacije), plinska kromatografija, tekočinska kromatografija visoke ločljivosti (izbira mobilne in stacionarne faze, gradientno in izokratsko eluiranje), kapilarna elektroforeza. Sklopljene metode v biokemijski analitiki. **Statistično vrednotenje analiznih rezultatov:** napake, statistični testi, regresija in korelacija. **Laboratorijske vaje:** Molekularna absorpcijska spektrometrija (merjenje spektrov v UV-VIS področju, uporaba spektrofotometrije za kvantitativno določevanje organskih in anorganskih zvrsti). Molekularna fluorescenca; določevanje biološko aktivnih substanc. Atomska emisijska spektrometrija. Plamenska in elektrotermična atomska absorpcijska spektrometrija (določevanje težkih kovin v bioloških materialih) Uporaba potenciometrije v analitiki (ionoselektrivne elektrode, potenciometrične titracije). Plinska (GC) in tekočinska kromatografija visoke ločljivosti (HPLC).	Atomic emission spectroscopy; excitation in flame and inductively coupled plasma. Application of atomic spectroscopy in biochemical analysis. Mass spectrometry: modes of ionization, analysis and detection of ions, identification of compounds, instrumentation. Elemental mass spectrometry (ICP-MS), basic principles and its importance in trace analysis. **Electroanalytical techniques:** principles, instrumentation and application of potentiometry, voltammetry and electrochemical sensors. **Separation methods in analytical chemistry**: Fundamental parameters in chromatography; retention time, number of theoretical plates, resolution, quantification), gas chromatography (GC), high-performance liquid chromatography (HPLC), selection of mobile and stationary phase, isocratic and gradient elution, capillary electrophoresis (CE). Hyphenated techniques in biochemical analysis. **Statistical evaluation of analytical results** (errors, statistical tests, regression, correlation). **Laboratory exercises:** Molecular absorption spectrometry (measurement of UV-VIS spectra, quantitative determination of organic and inorganic species). Molecular fluorescence (quantitative determination of biologically active compounds). Flame emission spectrometry Flame and electrothermal atomic absorption. spectrometry (determination of metals in biological samples). Potentiometry (Ionoselective electrodes, potentiometric titrations). The application of chromatography in analysis (GC and HPLC).

Temeljna literatura in viri/Readings:

OSNOVNI UČBENIK:

- D.A. Skoog, D.M. West, Holler, Fundamentals of Analytical Chemistry, Holt-Saunders Int. Ed. New York (izbrana poglavja / selected chapters, v obsegu 175 strani / 175 pages)
- D.C.Harris, Quantitative Chemical analysis, W.H.Freeman N.Y (1008 str. / pages 15%)

DODATNA LITERATURA / ADDITIONAL LITERATURE:

- Navodila za vaje / Instructions for laboratory exercises
- M. Veber: Študijski materiali (prosojnice, izpitne naloge in vprašanja) – dostop na spletu / M. Veber: Notes to lectures (available on internet)

Cilji in kompetence:	**Objectives and competences:**
Pri predmetu Instrumentalne metode analize bodo študentje biokemije spoznali osnovne koncepte sodobne analizne kemije, principe pomembnejših	**Objectives**: To understand basic concepts in modern analytical chemistry and fundamental principles of important instrumental analytical techniques; To get

instrumentalnih analiznih metod ter se seznanili z nekaterimi pristopi v analitiki bioloških materialov. Metode bodo znali uporabiti pri reševanju analiznih problemov ter kritično vrednotiti in interpretirati rezultate meritev.	knowledge on some approaches used for the analysis of biological materials. **Competences**: Students will acquire practical skills and experiences for the use of some instrumental techniques in analytical chemistry and will be able to evaluate and present analytical results.

Predvideni študijski rezultati:	**Intended learning outcomes:**
Znanje in razumevanje Študentje bodo pridobili osnovna teoretska in praktična znanja, ki so potrebna za razumevanje pomembnejših analiznih postopkov, ki jih biokemik potrebuje pri vsakodnevnih odločitvah (kontrola kakovosti!) in so temelj za izvedbo praktičnih analiz. Prav tako bodo sposobni kritično presoditi zmogljivosti nekaterih analiznih metod, primerjati klasične in instrumentalne pristope v analitiki ter ustrezno obravnavati rezultate kemijskih analiz. Razen teoretskih temeljev bodo pridobili tudi praktične laboratorijske spretnosti. Uporaba Poleg fizikalno-kemijskih osnov, ki so osnova razumevanje analiznih postopkov, bodo pridobili tudi praktična znanja, ki so potrebna pri zasnovi in izvedbi analiz ter kritični interpretaciji podatkov in dobljenih rezultatov. Refleksija Teoretska in praktična znanja bo lahko študent uporabil pri reševanju praktičnih in teoretskih problemov (v času študija in praksi). Poznavanja zmogljivosti in omejitev analiznih metod v praksi so lahko osnova za mnoge pomembne strokovne odločitve. Prenosljive spretnosti Pri predmetu bo študent pridobil laboratorijske spretnosti, naučil se bo dela z instrumenti v laboratoriju ter izvedbe pomembnih kemijskih meritev znal bo uporabljati ustrezno literaturo, eksperimentalne podatke bo znal ustrezno obdelati ter primerno interpretirati.	Knowledge and Comprehension Students will get fundamental theoretical and practical knowledge which is important for understanding of analytical procedures. They will be able to compare analytical methods and critically evaluate analytical results. Besides theoretical knowledge the will get practical skills for the work in the analytical laboratory. Application Besides theoretical physical and chemical knowledge, which is the basis for the understanding of analytical procedures, they will get also practical knowledge which is important for planning and performing of analysis and interpretation of analytical data. Analysis Students will be able to use knowledge on analytical chemistry to solve some practical and theoretical problems during later study and practice. The knowledge of abilities and limitations of instrumental analytical methods play an important role in many professional decisions. Skill-transference Ability Students will gain practical skills, they will be able to perform basic instrumental measurements, they will be able to find and use the relevant literature and to evaluate data obtained by measurements using analytical instrumentation.

Metode poučevanja in učenja:	**Learning and teaching methods:**
Eksperimentalna predavanja in laboratorijske vaje.	Lectures and laboratory exercises

Načini ocenjevanja:	**Delež/Weight**	**Assessment:**
Pogoj za izpit so uspešno opravljene vaje s pisnim testom. 25 %	25,00 %	Completed laboratory course with written test is prerequisite for the exam.
Pisni in ustni izpit 75 %	75,00 %	Written and oral examination
Ocene: 6-10 pozitivno		Marks: 6-10 positive

Reference nosilca/Lecturer's references:

- IVANOVIĆ, Milena, PETEK, Anja, ISLAMČEVIĆ RAZBORŠEK, Maša, KOLAR, Mitja. Chemometric characterization of Slovenian red wines. *Acta chimica slovenica*, 2017, 64, 537-542.
- BEVC, Sebastjan, MOHORKO, Eva, KOLAR, Mitja, BRGLEZ, Polonca, HOLOBAR, Andrej, KNIEPEISS, Daniela, PODBREGAR, Matej, PIKO, Nejc, HOJS, Nina, KNEHTL, Maša, EKART, Robert,

HOJS, Radovan. Measurement of breath ammonia for detection of patients with chronic kidney disease. *Clinical nephrology*, 2017, 88, suppl. 1, S14-S17.
- STAVBAR, Severina, KNEZ HRNČIČ, Maša, PREMZL, Katarina, KOLAR, Mitja, ŠOSTAR-TURK, Sonja. Sub- and super-critical water oxidation of wastewater containing amoxicillin and ciprofloxacin. *The Journal of supercritical fluids*, 2017, 128, 73-78.

KEMIJSKI PRAKTIKUM

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Kemijski praktikum
Course title:	Practical course in chemistry
Članica nosilka/UL Member:	UL FKKT

Študijski programi in stopnja	Študijska smer	Letnik	Semestri	Izbirnost
Biokemija, prva stopnja, univerzitetni	Ni členitve (študijski program)	1. letnik	1. semester	obvezni

Univerzitetna koda predmeta/University course code:	0072061
Koda učne enote na članici/UL Member course code:	BK104

Predavanja /Lectures	Seminar /Seminar	Vaje /Tutorials	Klinične vaje /Clinical tutorials	Druge oblike študija /Other forms of study	Samostojno delo /Individual student work	ECTS
	30	45 LV			75	5

Nosilec predmeta/Lecturer:	prof. dr. Romana Cerc Korošec
Vrsta predmeta/Course type:	obvezni/mandatory
Jeziki/Languages:	Predavanja/Lectures: Slovenščina Vaje/Tutorial: Slovenščina

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

Vsebina:	Content (Syllabus outline):
Študentje se najprej seznanijo z varnostnimi pravili dela v laboratoriju. Nato samostojno izvedejo 11 praktičnih vaj, ob katerih se naučijo osnovne veščine praktičnega laboratorijskega dela kot so npr: izparevanje, filtracija, sušenje, sinteza preprostih spojin, merjenje prostornine plinov in tekočin, priprava raztopin, merjenj gostote tekočin, titracija, itd ter na podlagi opazovanj pri kvalitativnih poskusih znajo povezati praktične izkušnje z osnovnimi kemijskimi zakonitostmi. **Vsebine praktičnih vaj:** Formule kemijskih spojin; Kemijska reakcija, presežek reaktantov, izkoristek kemijske reakcije; Plini, kemijske enačbe; Priprava raztopin iz trdnih topljencev, Reakcije med raztopinami kislin in baz; Destilacija in retitracija; Kemijsko ravnotežje; Ravnotežna konstanta kemijske	Safety rules for work in a laboratory; Practical work in a laboratory: by independently performing 11 laboratory practiced students acquire practical laboratory procedures and operations, e.g. evaporation, filtration, drying, synthesis of simple compounds, measuring the volume of gases and liquids, preparation of solutions, measuring the density of liquids, titration, etc. They are able to link practical experience, obtained during observation of qualitative experiments, with basical chemical principles. **Practical exercises - contents:** Formulae of chemical compounds; Chemical reaction, limiting reactant, yield of chemical reaction; Gases, Chemical equations; Preparation of solutions, starting from solid solutes; Reactions between acids and bases;

reakcije; Topnost; Ionske reakcije, topnostni produkt; Protolitska ravnotežja v vodnih raztopinah; Pufrske raztopine; Redoks reakcije; Koordinacijske spojine Ob posameznih vajah se vsebina osnovnega kemijskega računanja smiselno nadgrajuje: osnovni kemijski zakoni, množina snovi, molska masa snovi, formule spojin, računanje povezano s kemijsko reakcijo, parcialni tlaki, množinski deleži (molski ulomki), prostorninski deleži, povprečne molske mase, koncentracije raztopin; računanje pri titraciji, topnosti snovi, kemijskem ravnotežju, protolitskih ravnotežjih in redoks reakcijah.	Distillation and retitration; Chemical equilibrium; Equilibrium constant, Solubility; Ionic reactions, solubility product; Ionization equilibria in aqueous solutions; Buffer solutions; Redox reactions; Coordination compounds. The content of basic chemical calculations is built upon: basic chemical principles, mole concept, molar mass, chemical formula, calculations connected with chemical reaction, partial pressure, mole fraction, volume fraction, average molar mass, solution concentration and titration calculation, solubiliy of substances, chemical equilibrium, ionization and redox reactions.

Temeljna literatura in viri/Readings:

- N. Bukovec, R. Cerc Korošec, E. Tratar Pirc: Praktikum iz splošne in anorganske kemije, Založba UL FKKT, Ljubljana, 2010 (druga dopolnjena izdaja), 113 str.
- N. Bukovec, R. Cerc Korošec, A. Golobič, N. Lah in E. Tratar Pirc: Osnove kemijskega računanja, zbirka nalog, Založba UL FKKT, Ljubljana, 2011, 191 str.

Cilji in kompetence:	**Objectives and competences:**
Cilji: Spoznati principe varnega dela v laboratoriju, različne metode dela, oziroma pristope pri praktičnem delu v laboratoriju. z uporabo osnovnega kemijskega računanja, oziroma osnovnih kemijskih zakonitosti. **Kompetence:** Zna varno ravnati z kemikalijami, pozna varnostne zahteve in ukrepe v laboratoriju; spozna in obvlada različne osnovne metode laboratorijskega dela; zna samostojno izvajati posamezne eksperimente; je sposoben kritično ovrednotiti določene meritve in/ ali dobljene rezultate pri osnovnem kemijskem računanju.	**Objectives:** Knowledge of the basic principles of safety work. Knowledge of different methods of work in laboratory. Knowledge of basic chemical calculations in solving practical problems. **Competences:** Ability to work safely and autonomously in laboratory. Ability to use different methods of basic laboratory work. Ability to apply knowledge of basic chemical calculations in solving practical problems in laboratory. Ability to critically evaluate measurements and the results obtained in chemical calculations.

Predvideni študijski rezultati:	**Intended learning outcomes:**
Znanje in razumevanje Študent usvoji osnovne principe varnega dela v kemijskem laboratoriju ter zna osnove kemijskega računanja uporabiti pri kvantitativnem vrednotenju določenih eksperimentov. **Uporaba** Pridobljene znanje oziroma spretnosti pri laboratorijskem delu in znanje osnovnega kemijskega računanja so temelji predmetom pri nadaljnjem študiju. **Refleksija** Študent je sposoben kritično ovrednotiti izvedene meritve in oceniti dobljene rezultate pri tem pa razvija sposobnosti za samostojno laboratorijsko delo. **Prenosljive spretnosti** Študent pridobi praktične laboratorijske spretnosti in izkušnje, znanje osnovnega kemijskega računanja ter, zna uporabljati strokovni jezik (pisno in ustno)	**Knowledge and Comprehension** Knowledge of the basic principles of safety at work and different methods of work in a laboratory. Application of basic chemical calculations in solving practical problems. **Application** Knowledge and skills gained through laboratory practice, and the knowledge of basic chemical provide a foundation for further studies. **Analysis** The student can critically evaluate measurements and results while developing the skills required for independent laboratory work. **Skill-transference Ability** The student gains practical laboratory skills and experience, a knowledge of chemical calculation, and can use correct terminology in both written and spoken form.

Metode poučevanja in učenja:	**Learning and teaching methods:**

Laboratorijske vaje, zasnovane na individualnem delu študenta ter delno s timskim delom. Pisanje laboratorijskega dnevnika. Sodelovalno učenje/ poučevanje ter problemsko delo na seminarjih. Sprotno preverjanje znanja s pisnimi preglednimi vajami.	Laboratory practice based on the students' individual work and group work. Laboratory journal. Collaborative learning/teaching and problem solving at seminars. Short written evaluation of the students' knowledge.

Načini ocenjevanja:	**Delež/Weight**	**Assessment:**
Opravljene vaje so pogoj za pristop k izpitu. Pisni izpit (nadomestita ga lahko dva pozitivno ocenjena kolokvija). Ocene: pozitivno 6-10; negativno 1-5		Completed laboratory practice is prerequisite for the examination. Written examination (can be replaced by two positively evaluated midterm exams) Grades: 6-10 pass, 1-5 fail.

Reference nosilca/Lecturer's references:

- N. Bukovec, **R. Cerc Korošec**, E. Tratar Pirc: Praktikum iz splošne in anorganske kemije, Založba UL FKKT, Ljubljana, 2010 (druga dopolnjena izdaja), 113 str.
- N. Bukovec**, R. Cerc Korošec**, A. Golobič, N. Lah in E. Tratar Pirc: Osnove kemijskega računanja, zbirka nalog, Založba UL FKKT, Ljubljana, 2011, 191 str.
- B. Genorio, K. Pirnat, **R. Cerc Korošec**, R. Dominko, M. Gaberšček: Electroactive organic molecules immobilized onto solid nanoparticels as a cathode material for lithium-ion batteries. – Angewandte Chemie, 2010, 49, 7222-7224.

MATEMATIKA

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Matematika
Course title:	Mathematics
Članica nosilka/UL Member:	UL FKKT

Študijski programi in stopnja	Študijska smer	Letnik	Semestri	Izbirnost
Biokemija, prva stopnja, univerzitetni	Ni členitve (študijski program)	1. letnik	1. in 2. semester	obvezni

Univerzitetna koda predmeta/University course code:	0072062
Koda učne enote na članici/UL Member course code:	BK101S

Predavanja /Lectures	Seminar /Seminar	Vaje /Tutorials	Klinične vaje /Clinical tutorials	Druge oblike študija /Other forms of study	Samostojno delo /Individual student work	ECTS
90		60 SV			150	10

Nosilec predmeta/Lecturer:	Jaka Smrekar, Petar Pavešić
Vrsta predmeta/Course type:	obvezni/mandatory

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

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

Vsebina:	Content (Syllabus outline):
Limite funkcij: računske operacije s funkcijami (vsota, produkt, kompozitum, inverzna funkcija), zveznost, asimptote, lastnosti zveznih funkcij. **Odvod in njegova uporaba:** geometrijski pomen, pravila za odvajanje, odvodi elementarnih funkcij, diferencial in njegova uporaba, višji odvodi, Rollejev in Lagrangeov izrek, L' Hospitalovo pravilo, ekstremi, konveksnost, konkavnost in prevoji, uporaba odvoda pri grafih (ciklometrične, hiperbolične in area funkcije), parametrično podane krivulje. **Taylorjeva vrsta**: konvergenca zaporedja, pojem konvergence številske vrste, Taylorjeva formula, Taylorjeva vrsta za funkcije e^x, sin x, cos x, ln(1+x), (1+x)^n. **Nedoločeni integral**: osnovne lastnosti, integriranje po delih, vpeljava nove spremenljivke, integrali	**Limits of functions:** computation with functions (sum, product, composition, inverse), continuity, asimptotes, properties of continuous functions. **The derivative and its application:** the geometric meaning, rules for differentiation, the derivatives of elementary functions, the differential and its applications, higher derivatives, Rolle's and Lagrange's theorems, L'Hospitale rule, minima and maxima, convexity and concavity, application of the derivative to study the behavior of functions (cyclometric, hyperbolic and inverse hyperbolic functions), parametric curves. **Taylor's series:** convergence of sequences and series, Taylor's formula, Taylor's series for functions e^x, sin x, cos x, log(1+x), (1+x)^n.

osnovnih elementarnih funkcij (nekaterih racionalnih, trigonometrijskih in algebraičnih). **Določeni integral**: geometrijski pomen in osnovne lastnosti, zveza z nedoločenim integralom, izlimitirani integrali. **Uporaba integrala:** ploščina, ločna dolžina, prostornina in površina vrtenine, težišče, vztrajnostni moment. **Diferencialne enačbe:** enačbe prvega reda z ločljivima spremenljivkama, homogene, linearne, znižanje reda v nekaterih enačbah drugega reda, linearne diferencialne enačbe drugega reda s konstantnimi koeficienti, sistemi linearnih diferencialnih enačb prvega reda s konstantnimi koeficienti, uporaba v kemiji in drugod. **Vektorji v R^n in C^n:** ponovitev osnovnih operacij z vektorji v R^3, koordinatni sistem v prostoru, linearna neodvisnost, podprostori, baze, skalarni produkt, vektorski in mešani produkt, determinante reda 2 in 3. **Matrike:** osnovne računske operacije , matrike kot linearne preslikave, zasuki in zrcaljenja, sistemi linearnih enačb (Gaussova metoda reševanja), determinante, inverzna matrika, Cramerjeve formule , lastne vrednosti in lastni vektorji, diagonalizacija simetrične matrike. **Funkcije več spremenljivk:** funkcija dveh spremenljivk in njen graf, zveznost, parcialni odvodi, posredno odvajanje, implicitne funkcije, totalni diferencial, gradient, Taylorjeva vrsta, ekstremi, vezani ekstremi. **Osnove verjetnosti in statistike**: poskusi, relativna frekvenca, verjetnost, porazdelitve, predstavitev podatkov, opisne statistike, populacija, vzorčenje, normalna porazdelitev, linearna regresija.	**The indefinite integral**: basic properties, integration per partes, change of variables, integration of elementary functions (rational, some trigonometric and algebraic). **The definite integral**: the geometric meaning and basic properties, the fundamental theorem of calculus, improper integrals. **Application of integration:** calculations of areas, arc lenghts, volumes and surfaces of revolution, centers of mass, moments of inertia. **Differential equations**: equations of order 1, separation of variables, homogeneous and linear equations, examples of reduction of order, second-order linear differential equations with constant coefficients, systems of linear differential equations, applications to chemistry and elsewhere. **Vectors in R^n and C^n**: basic operations for vectors in R^3, coordinate systems, inner product, vector product, multiple products, determinants of order 2 and 3, R^n and C^n as vector spaces, linear independence, subspaces, basis. **Matrices**: basic operations, matrices as linear transformations, rotations and reflections, systems of linear equations (Gauss elimination method), determinants, invertible matrices, Cramer's formulas, eigenvalues and eigenvectors, diagonalization of symmetric matrices. **Functions of several variables**: functions of two variables and their graphs, continuity, partial derivatives, total differential, gradient, the chain rule, implicit functions, Taylor's series, extrema, constrained extrema. **The basics of probability and statistics:** experiments, relative frequency, probability, distributions, data presentation, descriptive statistics, population, sampling, normal distribution, linear regression.

Temeljna literatura in viri/Readings:

- R. Jamnik, Matematika, DMFA Slovenije, Ljubljana, 1994.
- P. Šemrl, Osnove višje matematike, DMFA Slovenije, Ljubljana, 2009.
- P. Moravec, Rešene naloge iz matematike, FKKT UL, Ljubljana 2009.

Dopolnilna literatura:

- A. Turnšek, Tehniška matematika, FS, Ljubljana, 2007, 306 str.
- P. Mizori – Oblak, Matematika za študente tehnike in naravoslovja, 1. del, FS, UL Ljubljana, 2001.
- P. Mizori – Oblak, Matematika za študente tehnike in naravoslovja, 2. del, FS UL, Ljubljana, 1997.
- I. Vidav, Višja matematika I, DMFA Slovenije, Ljubljana, 1994, 477 str.
- G. Doggett, B. T. Sutcliffe, Mathematics for Chemistry, Longman, 1995, 286 str.
- G. S. Gill, The Calculus Bible, 366 str., http://www.math.byu.edu/Math/CalculusBible/
- B. Magajna, Izpitne naloge, http://www.fmf.uni-lj.si/~magajna/Matematika1KEM/osnovna.htm

Cilji in kompetence:	**Objectives and competences:**
Cilj predmeta: Seznaniti študente z osnovnimi metodami matematične analize in linearne algebre, potrebnimi pri nadaljnem študiju, ki spadajo v temeljno izobrazbo naravoslovca ali tehnika. Tak	To familiarize students with calculus and basic linear algebra necessary for further study. This is a usual part of curriculum for students of science and technology. This enables students to better understnad some other areas of their study. It gives

predmet je zato obvezni del programa na vsaki naravoslovni ali tehnični fakulteti. **Predmetno specifične kompetence:** Pridobljeno znanje bo študentu omogočilo boljše razumevanje drugih strokovnih predmetov. Imel bo možnost pridobiti nekaj temeljnih matematičnih pojmov in spretnosti, ki so potrebne za razumevanje strokovne literature in tudi za uspešno opravljanje dela. (Za naravoslovca ali tehnika so skoraj tako neobhodni kot poštevanka v vsakdanjem življenju.)	them an oportunity to acquire basic mathematical skills needed to follow the literature in their own speciality.

Predvideni študijski rezultati:	**Intended learning outcomes:**
Znanje in razumevanje Razumevanje pojmov funkcijske odvisnosti, limite, odvoda in integrala, poznavanje metod reševanja nekaterih elementarnih tipov diferencialnih enačb in njihove uporabe v kemiji (in drugod), osnovni prijemi linearne algebre. osnovna analiza funkcij več spremenljivk. **Uporaba** Uporaba zgoraj omenjenih pojmov pri reševanju konkretnih nalog iz matematike, fizike in kemije. **Refleksija** Gre za poglobitev in bistveno razširitev v srednji šoli pridobljenega znanja matematike, ki je nujno za razumevanje naravoslovnih znanosti in je zato o obvezni del študijskih programov povsod po svetu. **Prenosljive spretnosti** Predmet daje tudi osnovo za razumevanje nekaterih računalniških postopkov in metod, ki jih bodo spoznali kasneje pri drugih predmetih in ob delu.	**Knowledge and Comprehension** Students should understand the concepts of functional dependence, limits, differentiation and integration, and acquire the skill of solving certain types of differential equations and their application to chemistry (and elsewhere), basic approaches of linear algebra and analysis of functions of several variables. **Application** Students should be able to apply calculus and linear algebra to problems from physics and chemistry. **Analysis** The course gives a considerable extension of the mathematical knowledge that the students acquired in high school, which is essential for the understanding of any natural science and chemistry in particular. **Skill-transference Ability** The knowledge of calculus is necessary for effective use of computer modeling in science, which the students will meet later in the course of their study.

Metode poučevanja in učenja:	**Learning and teaching methods:**
Predavanja, vaje, sodelovalno učenje / poučevanje.	Lectures, exercises, homework, consultations.

Načini ocenjevanja:	**Delež/Weight**	**Assessment:**
Pisni izpit (ali štirje kolokviji), teoretični (ustni) izpit. Od 6-10 (pozitivno) oz. 1-5 (negativno) oz. opravil/ ni opravil; ob upoštevanju Statuta UL in fakultetnih pravil		Written exam (or four midterm exams), oral exam.

Reference nosilca/Lecturer's references:

Izr. prof. dr. Jaka Smrekar / Dr. Jaka Smrekar, Associate Professor

1. J. Smrekar: Homotopy type of mapping spaces and existence of geometric exponents. Forum Math. letnik 22 (2010), št. 3, 433–456.

2. J. Smrekar, A. Yamashita: Function spaces of CW homotopy type are Hilbert manifolds. Proc. Amer. Math. Soc. letnik 137 (2009), št. 2, 751–759.

3. J. Smrekar: Periodic homotopy and conjugacy idempotents. Proc. Amer. Math. Soc. letnik 135 (2007), št. 12, 4045–4055.

Prof. dr. Petar Pavešić / Dr. Petar Pavešić, Full Professor

1. PAVEŠIĆ, Petar, PICCININI, Renzo A.. *Fibrations and their classification*, (Research and exposition in mathematics, vol. 33). Lemgo: Heldermann, cop. 2013. XIII, 158 str., ilustr. ISBN 978-3-88538-233-1. [COBISS.SI-ID 16616793]

2. PAVEŠIĆ, Petar. Reducibility of self-homotopy equivalences. *Proceedings. Section A, Mathematics*, ISSN 0308-2105, 2007, vol. 137, iss 2, str. 389-413. [COBISS.SI-ID 14371929]

3. FRANETIČ, Damir, **PAVEŠIĆ, Petar**. H-spaces, semiperfect rings and self-homotopy equivalences. *Proceedings. Section A, Mathematics*, ISSN 0308-2105, 2011, vol. 141, iss. 6, str. 1263-1277. [COBISS.SI-ID 16077401]
4. PAVEŠIĆ, Petar. Induced liftings, exchange rings and semi-perfect algebras. *Journal of Pure and Applied Algebra*, ISSN 0022-4049. [Print ed.], 2010, vol. 214, iss 11, str. 1901-1906. [COBISS.SI-ID 15627865]
5. PAVEŠIĆ, Petar. Kaj naj študente naučimo o funkcijah?. *Obzornik za matematiko in fiziko*, ISSN 0473-7466, 2007, letn. 54, št. 5, str. 166-172. [COBISS.SI-ID 14461273]

MIKROBIOLOGIJA

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Mikrobiologija
Course title:	Microbiology
Članica nosilka/UL Member:	UL FKKT

Študijski programi in stopnja	Študijska smer	Letnik	Semestri	Izbirnost
Biokemija, prva stopnja, univerzitetni	Ni členitve (študijski program)	2. letnik	2. semester	obvezni

Univerzitetna koda predmeta/University course code:	0072087
Koda učne enote na članici/UL Member course code:	BK120

Predavanja /Lectures	Seminar /Seminar	Vaje /Tutorials	Klinične vaje /Clinical tutorials	Druge oblike študija /Other forms of study	Samostojno delo /Individual student work	ECTS
45		30 LV			75	5

Nosilec predmeta/Lecturer:	prof. dr. Nina Gunde Cimerman
Vrsta predmeta/Course type:	obvezni/mandatory
Jeziki/Languages:	Predavanja/Lectures: Slovenščina Vaje/Tutorial: Slovenščina

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

Vsebina:	Content (Syllabus outline):
Pri predmetu se bodo seznanili s kratko zgodovino mikrobiologije, s poimenovanjem in uvrščanjem mikroorganizmov, s prikazom biotske raznovrstnosti mikroorganzmov, z njihovim biotehnološkim pomenom in potencialom kot tudi s patogenimi interakcijami mikroorganizmov. Proučevanje mikroorganizmov bo potekalo s pomočjo različnih mikroskopskih, biokemijskih in molekularno-bioloških tehnik. Predmet je organiziran v več sklopih: - prokariontska celica: velikost, oblika in organizacija bakterijske celice, strukture na zunanji strani celične stene, celična stena, specifične znotrajcelične strukture, razlike med funkcionalno anatomijo prokariontske in evkariontske celice,	Students will be acquainted with short history of microbiology, nomenclature and classification of microorganisms, presentation of microbial biodiversity, biotechnological value and potential of microorganisms, as well as microbial pathogenic interactions. Study of microorganisms will be performed using different microscopic, biochemical and molecular techniques. The course covers several topics: - prokaryotic cell: size, shape and organization, cell surface structures, cell wall, specific cell inclusions, and differences between the functional anatomy of prokaryotic and eukaryotic cell, - viruses; size, shape, structure, viral replication, viral diversity (overview of bacterial, animal and plant viruses)

- virusi: velikost, oblika, struktura, razmnoževanje, predstavitev izbranih skupin bakteriofagov, različnih živalskih in rastlinskih virusov, - mikrobna rast: rastne zahteve (fizikalne, kemijske), gojišča (kemijsko definirana, kompleksna, diferencialna), metode gojenja, rast mikroorganizmov, vpliv fizikalnih in kemijskih dejavnikov na rast, - mikrobna ekologija: vloga mikroorganizmov v naravi, ekstremofili, negojljivi mikroorganizmi, osnovne ekološke metode v mikrobiologiji, - osnove klasifikacije mikroorganizmov in mikrobne taksonomije, ki temeljijo na morfologiji, fiziologiji in molekularnih značilnostih, - glive kot evkariontski mikroorganizmi: opis, značilnosti vegetativne in reproduktive rasti, saprofitna vloga.	- microbial growth; physicochemical growth requirements, media (chemically defined, complex, differential), methods of cultivation, growth of microorganisms, influence of physical and chemical parameters on the microbial growth, genetically stable preservation of microorganisms, - microbial ecology: role of microorganisms in nature, extremophiles, uncultivable microrganisms, basic ecological methods in microbiology, molecular biological and biochemical methods for the detection of microorganisms in the environment, - classification of microorganisms: phylogenetic relations, taxonomical hierarchy, criteria for the classification and identification of microorganisms based on morphology, physiology, and molecular characteristics, presentation of the main groups of archaea, bacteria, fungi and viruses, - Fungi as eukaryotic microorganisms: general description, characteristics of their vegetative and reproductive growth, saprophytic role of fungi.

Temeljna literatura in viri/Readings:

Temeljna literatura:

- Madigan M.T., Martinko J.M., Stahl D.A., Clark D.P., Brock Biology of Microorganisms. 1105 pages, Prentice Hall, 13th edition (2012), ISBN: 978-0-321-73551-5

Dodatna literatura:

- Tortora G.J., Funke B.R.,Case C.L. Microbiology: An introduction. 944 pages, Benjamin Cummings, 8th edition (2003), ISBN: 0805376143.
- Bauman R. W. , Machunis-Masuoka E., Tizar I. R., Bauman R., Bauman Microbiology,. 896 pages, Benjamin-Cummings Publishing Company; Bk&CD-Rom edition (2003), ISBN: 0805376526.

Spletne strani:

http://www.personal.psu.edu/faculty/j/e/jel5/micro/
http://www.microbeworld.org/
http://www.textbookofbacteriology.net/
http://www.microbiological-garden.net.
http:/www.mycolog.com/fifthtoc.html
Dodatna /seminarska ipd. literatura bo dosegljiva preko nosilke predmeta.

Cilji in kompetence:	**Objectives and competences:**
Mikrobiologija je eden od naravoslovnih predmetov, pri katerem se študenti spoznajo z osnovami celične strukture prokariontske celice v primerjavi z evkariontsko; s parametri in kontrolo mikrobne rasti;z metabolnimi značilnostmi posameznih skupin mikroorganizmov (bakterij, arhebakterij, gliv in virusov); z osnovami mikrobne ekologije, evolucije, sistematike in taksonomije mikroorganizmov.	Students will be acquainted with the basics of microbiology; prokaryotic cell structure in comparison with the eukaryotic cell; parameters and control of microbial growth; metabolic characteristics of different groups of microorganisms (bacteria, archaea, fungi, viruses). Students will also become familiar with the basics of microbial ecology, evolution, systematics and taxonomy of microorganisms.

Predvideni študijski rezultati:	**Intended learning outcomes:**
Znanje in razumevanje Znanje in razumevanje osnovnih mikrobioloških pojmov in zakonitosti, mikrobnih struktur in procesov. Uporaba	Knowledge and Comprehension Knowledge and understanding of basic microbiological terms, laws, microbial structures and processes. Application

Razlikovanje različnih tipov mikrobnih celic in gojenje mikroorganizmov v laboratoriju, poznavanje metod dela v mikrobiologiji, zmožnost razlage principov oz. zakonitosti na posameznih primerih in iskanje povezav s prakso. Refleksija Študent pridobi občutek za mikrobiološke dimenzije in posebnosti živega mikrobnega sveta. Prenosljive spretnosti Teoretična in praktična podlaga potrebna za aseptično delo v mikrobiološkem laboratoriju, pri gojenju mikroorganizmov, uporaba domače in tuje literature ter drugih virov pri zbiranju in interpretiranju podatkov, poznavanje strokovnih izrazov, poročanje (ustno in pisno).	The ability to differentiate between various microbial cells and the knowledge of the microbial cultivation in the laboratory , proficiency in microbiological techniques/methods, the ability to explain principles or laws in individual cases and to apply this knowledge in real-life context. Acquisition of laboratory skills. Analysis To develop an understanding of the ubiquity, importance and peculiarity of microbes in the environment. Skill-transference Ability Theoretical and practical background needed for sterile technique, culture techniques, growth assessment, microscopy. Search and critical assessment of research literature and other sources; team working; collection and interpretation of the data; correct usage of the expert terminology; written and oral communication skills.

Metode poučevanja in učenja:	**Learning and teaching methods:**
Predavanja in laboratorijske vaje. Študent s pridobljenim praktičnim in teoretičnim znanjem iz vaj, predavanj in ustreznih učbenikov ter po uspešno opravljenem izpitu razume osnovne mikrobiološke zakonitosti.	Lectures, group seminar work and laboratory exercises. With the acquired theoretical and practical knowledge based on the lectures, laboratory exercises and appropriate textbooks after the exam was successfully passed, the student will be able to understand the basic microbiological principles.

Načini ocenjevanja:	**Delež/Weight**	**Assessment:**
Opravljene vaje so pogoj za pristop k izpitu.		Successful performance of practical courses is the precondition for the theoretical exam.
Pisni izpit.		Written exam.
Ocene: 6-10 (pozitivno), 1-5 (negativno).		Marks: 6-10 (positive), 1-5 (negative).

Reference nosilca/Lecturer's references:

- **GUNDE-CIMERMAN, Nina**, OREN Aharon., PLEMENITAŠ Ana (Editors): Adaptation to Life at High Salt Concentrations in Archaea, Bacteria, and Eukarya (Cellular Origin, Life in Extreme Habitats and Astrobiology) (Hardcover), 577 pages, Publisher: Springer; 1 edition (November 14, 2005) ISBN: 1402036329
- GOSTINČAR, Cene, GRUBE, Martin, DE HOOG, Sybren, ZALAR, Polona, **GUNDE-CIMERMAN, Nina**. Extremotolerance in fungi : evolution on the edge. FEMS microbiology, ecology, 2010, vol. 71, str. 2-11. [COBISS.SI-ID 2166607]
- LENASSI, Metka, GOSTINČAR, Cene, JACKMAN, Shaun, TURK, Martina, SADOWSKI, Ivan, NISLOW, Corey, **GUNDE-CIMERMAN, Nina**, PLEMENITAŠ, Ana, et al. Whole genome duplication and enrichment of metal cation transporters revealed by De Novo genome sequencing of extremely halotolerant black yeast Hortaea werneckii. PloS one, ISSN 1932-6203, Aug. 2013, vol. 8, iss. 8., [COBISS.SI-ID 30761177]

MOLEKULARNA BIOLOGIJA

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Molekularna biologija
Course title:	Molecular biology
Članica nosilka/UL Member:	UL FKKT

Študijski programi in stopnja	Študijska smer	Letnik	Semestri	Izbirnost
Biokemija, prva stopnja, univerzitetni	Ni členitve (študijski program)	2. letnik	2. semester	obvezni

Univerzitetna koda predmeta/University course code:	0072074
Koda učne enote na članici/UL Member course code:	BK119

Predavanja /Lectures	Seminar /Seminar	Vaje /Tutorials	Klinične vaje /Clinical tutorials	Druge oblike študija /Other forms of study	Samostojno delo /Individual student work	ECTS
45	20	10 LV			75	5

Nosilec predmeta/Lecturer:	prof. dr. Marko Dolinar
Vrsta predmeta/Course type:	obvezni/mandatory
Jeziki/Languages:	Predavanja/Lectures: Slovenščina Vaje/Tutorial: Slovenščina

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

Vsebina:	Content (Syllabus outline):
1. Mehanizem podvojevanja DNA 2. Mutacije in popravljanje okvar na DNA 3. Homologna rekombinacija 4. Transkripcija in posttranskripcijski procesi 5. Genetski kod in tRNA 6. Biosinteza proteinov 7. Struktura kromosomov in organizacija genoma 8. Kontrola izražanja pri prokariontih 9. Kontrola izražanja pri evkariontih 10. Usmerjanje proteinov in posttranslacijske modifikacije 11. Transpozicijski elementi 12. Virusi Laboratorijske vaje: 1. Plazmidi in transformacija bakterijskih celic 2. Laktozni operon in alfa komplementacija	1. Mechanism of DNA replication 2. Mutations and DNA damage repair 3. Homologous recombination 4. Transcription and posttranscriptional processes 5. Genetic code and tRNA 6. Protein biosynthesis 7. Chromosome structure and genome organization 8. Regulation of expression in prokaryotes 9. Regulation of expression in eukaryotes 10. Protein targeting and posttranslational modifications 11. Transposition elements 12. Viruses Laboratory practicals: 1. Plasmids and transformation of bacterial cells 2. Lactose operon and alpha complementation

3. Utišanje genov s protismerno RNA	3. Gene silencing with antisense RNA

Temeljna literatura in viri/Readings:

- B.E. Tropp: Principles of Molecular Biology. Jones & Bartlett Learning, 2014

pomožni vir:

- J.E. Krebs, E.S. Goldstein, S.T. Kilpatrick: Lewin's Essential Genes, 3rd edition, Jones & Bartlett Learning, 2013

Cilji in kompetence:	**Objectives and competences:**
Študenti bodo razumeli mehanizme prenosa genetske informacije in zorenja proteinov. Spoznali bodo raznolikost načinov delovanja molekul RNA in vedeli, kako je organiziran kromatin. S primeri bodo znali razložiti, kako sta povezani zgradba in funkcija proteinov.	Students will understand the mechanisms of genetic information flow and posttranslational processes. They will know the versatility of RNA molecules and the organisation of the chromatin. Based on examples, students will be able to demonstrate structure – function relationship in proteins.

Predvideni študijski rezultati:	**Intended learning outcomes:**
Znanje in razumevanje Znanje: Delovanje polimeraz in pomožnih proteinov pri ohranjanju in prenosu genetske informacije. Adapterska hipoteza in način povezovanja tRNA in aminokislin. Zgradba ribosomov in potek sinteze beljakovin. Zgradba genoma in načini uravnavanja izražanja genov. Lastnosti proteinov, ki določajo njihovo mesto v celici ali zunaj nje in mehanizmi usmerjanja proteinov. Mehanizmi znotrajcelične razgradnje beljakovin in njihova razgradnja v prebavilih. Zgradba virusov. Razumevanje: Različne vrste zapisa informacij v bioloških sistemih. Strukturna fleksibilnost nukleinskih kislin in pomen za uravnavanje prenosa genetske informacije. Mehanizmi zagotavljanja natančnosti prenosa zapisov z DNA na RNA in proteine. Pomen zorenja proteinov za njihovo delovanje in usmerjanje v celici. Pomen razgrajevanja proteinov za delovanje celice in za pridobivanje aminokislin za biosintezne reakcije. Interakcije med nukleinskimi kislinami in proteini v celicah in virusih. Uporaba Sposobnost razlikovanja stopenj kompleksnosti organizmov (prokarionti, evkarionti) na osnovi poznavanja biokemijskih procesov. Delo z bakterijami in virusi: varnostni in praktični vidiki. Refleksija Do katere mere so prokarionti lahko modelni organizmi za biokemijske procese? Molekule prenašajo informacije v zaporedjih dušikovih baz na podoben način kot zaporedja bitov v računalništvu. Zaporedja nukleotidov so digitaliziran zapis življenja. Za evolucijo je potrebno ohranjanje, pa tudi spreminjanje genetske informacije. Protein ni funkcionalen brez nativne tridimenzionalne zgradbe. Okužba z virusi ni samo stvar izpostavljenosti	Knowledge and Comprehension Knowledge: Mechanisms of polymerases and accessory proteins in maintaining genetic information. Adapter hypothesis and mode of amino acid biding to tRNA. Ribosome structure and protein synthesis process. Genome organization and modes of regulating gene expression. Properties of proteins that determine their cellular localization and mechanisms of protein sorting. Mechanisms of intracellular protein degradation and protein digestion in the intestine. Viral structures. Comprehension: Various information formats in biological systems. Structural flexibility of nucleic acids and its role for regulation of genetic information flow. Mechanisms determining a faithful flow of information from DNA to RNA and proteins. Importance of protein maturation for its activity and cellular sorting. Importance of protein degradation for cell functions and acquiring amino acids for biosynthetic reactions. Interactions between nucleic acids and proteins in cells and viruses. Application Differentiation between complexity levels of organisms (prokaryotes, eukaryotes) based on knowledge of biochemical processes. Practical considerations for work with bacteria and viruses. Analysis In how far prokaryotes can serve as model organisms for biochemical processes? Molecules transfer information as sequences of nitrogen bases similarly to byte sequences in computers. Nucleotide sequences are digitalized life code. Evolution requires both maintaining and modifying genetic information. Proteins are not functional before they reach their native three dimensional structures. Viral infection is not only a matter of exposure; it crucially depends on

virusom, pač pa je odvisna od površinskih struktur virusnega delca in celic, ki so za okužbo dovzetne. Prenosljive spretnosti Pristopi k reševanju problemov v biokemiji (ob primerih klasičnih eksperimentov v molekularni biologiji). Interpretacija laboratorijskih testov, ki temeljijo na pretvorbi kromogenih substratov; kvantitativnost in kvalitativnost. Delo z DNA in bakterijami. Pripravljanje in predstavljanje strokovnih vsebin, napisanih v angleškem jeziku – uporaba terminološkega slovarja.	surface structures on both viruses and susceptible cells. Skill-transference Ability Approaches to solving problems in biochemistry (gained from classical experiments in molecular biology). Interpretation of laboratory tests based on conversion of chromogenic substrates. Quantitative vs. qualitative tests. Working with DNA and bacteria. Preparing and presenting professional content based on English sources – use of the terminology dictionary.

Metode poučevanja in učenja:	**Learning and teaching methods:**
Predavanja, laboratorijske vaje, individualno in skupinsko delo pri pripravi seminarjev.	Lectures, laboratory practical courses, individual and group work for preparing seminars.

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

Reference nosilca/Lecturer's references:

- LAH, Jurij, DROBNAK, Igor, **DOLINAR, Marko**, VESNAVER, Gorazd. What drives the binding of minor groove-directed ligands to DNA hairpins?. Nucleic acids research, ISSN 0305-1048, 2008, vol. 36, no. 3, str. 897-904. [COBISS.SI-ID 29269765]
- VASILJEVA, Olga, **DOLINAR, Marko**, TURK, Vito, TURK, Boris. Recombinant human cathepsin H lacking the mini chain is an endopeptidase. Biochemistry, ISSN 0006-2960. [Print ed.], 2003, vol. 42, str. 13522-13528. [COBISS.SI-ID 17899303]
- **DOLINAR, Marko**, MEHLE, Andreja, MOZETIČ-FRANCKY, Bojana, SCHWEIGER, Ana, TURK, Vito. Endoproteolytic pattern observed during refolding of a human exopeptidase proenzyme, procathepsin H, produced in Escherichia coli. Food technology and biotechnology, ISSN 1330-9862, 2000, vol. 38, str. 5-9. [COBISS.SI-ID 14910247]

MOLEKULARNA EVOLUCIJA IN RAZVOJ

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Molekularna evolucija in razvoj
Course title:	Molecular evolution and development
Članica nosilka/UL Member:	UL FKKT

Študijski programi in stopnja	Študijska smer	Letnik	Semestri	Izbirnost
Biokemija, prva stopnja, univerzitetni	Ni členitve (študijski program)	3. letnik		izbirni

Univerzitetna koda predmeta/University course code: 0640061

Predavanja /Lectures	Seminar /Seminar	Vaje /Tutorials	Klinične vaje /Clinical tutorials	Druge oblike študija /Other forms of study	Samostojno delo /Individual student work	ECTS
30	15	30 LV			75	5

Nosilec predmeta/Lecturer: doc. dr. Vera Župunski

Vrsta predmeta/Course type: izbirni strokovni/Elective Professional

Jeziki/Languages:

Predavanja/Lectures:	Angleščina, Slovenščina
Vaje/Tutorial:	Angleščina, Slovenščina

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

Vsebina:	Content (Syllabus outline):
Spremembe v DNA, RNA in proteinih, ki povzročijo evolucijo: mutacije, sinonimne, nesinonimne, genetski zdrs, selekcija. Analiza hitrosti evolucijskih sprememb: evolucija vpliva na celotna zaporedja ali le na določenih mestih, poteka različno hitro skozi čas, molekularna ura, razlika na ravni organizma, zaporedij. Evolucijska divergenca: kako nastanejo spremembe na nivoju populacije; vplivi, kot so izolacija, fitnes. Evolucijske sile: selekcija in nevtralna evolucija. Primeri konvergentne in divergentne evolucije, iskanje predniških zaporedij. Opis evolucijskih modelov: metode razdalj, ML, MP, Bayes. Evolucija človeka: razvoj organizma in vrste. Molekularne osnove razvoja človeškega embrija: od spolnih celic do mehanizmov oploditve in razvoja	Changes in DNA, RNA, and proteins that drive evolution: Mutations, synonymous, non-synonymous, genetic drift, selection. Estimating mutation rates: in whole sequences or site-specific, molecular clock, differences in analysis of sequences or organisms. Evolutionary divergence: implications in population, effects of isolation, fitness. Driving forces of evolution: selection, neutral evolution. Examples of convergent and divergent evolution, ancestral sequences. Evolutionary models: distance methods, Maximum Likelihood, Maximum Parsimony, Bayes. Human evolution and development. Molecular basis of human embryo development: from gametes to mechanisms of fertilisation and embryonic

embrija. Molekularne osnove razvoja organov (organogeneza iz ektoderma, mezoderma in endoderma). Molekularni procesi regeneracije organov in staranja.	development. Molecular basis of organogenesis (ectoderm, endoderm, mesoderm). Molecular processes of regeneration and ageing.

Temeljna literatura in viri/Readings:

- Lindell Bromham: An Introduction to Molecular Evolution and Phylogenetics, Oxford University Press, 2016 (glavni vir)
- Masatosh Nei and Sudhir Kumar: Molecular Evolution and Phylogenetics, Oxford University Press, 2000 (izbrana poglavja)
- Michael J.F. Barresi and Scott F. Gilbert: Developmental Biology, OUP USA, 2020 (izbrana poglavja)
- Nico van Straalen, Dick Roelofs: Human Evolution and Development, Textbook for Life Sciences, Amsterdam University Press, 2019 (izbrana poglavja)

Cilji in kompetence:	**Objectives and competences:**
Pri predmetu bodo študenti pridobili osnovna znanja o molekularni evoluciji in molekularnih mehanizmih razvoja organizma. Po opravljenih obveznostih bodo študenti sposoben razumeti molekularne procese, ki vodijo v razvoj, in uporabljati osnovne metode molekularne evolucije.	The objectives of the course is to provide students with a basic knowledge of molecular evolution and development. Upon completion of the course, students will be able to understand molecular mechanisms of development and apply basic methods of molecular evolution.

Predvideni študijski rezultati:	**Intended learning outcomes:**
Znanje in razumevanje Študenti se pri predmetu seznanijo s pomembnimi pojmi in metodami molekularne evolucije, kot so spremembe, ki vodijo evolucijo, pomen molekularne ure, vrste evolucije. Na osnovi primerov se znanje poglobi in pridobi razumevanje molekularnih mehanizmov, ki vodijo v razvoj organizmov. **Uporaba** Pridobljeno znanje predstavlja razširitev osnovnega biokemijskega znanja in spodbuja študenta k povezovanju znanja in reševanju problemov. Predmet je podlaga za razumevanje bolj kompleksnih procesov na ravni genoma in organizma. **Refleksija** Poleg znanj o molekularni evoluciji in razvoju bo študent razvil sposobnost razmišljanja o molekularnih mehanizmih in posledicah na nivoju organizma. **Prenosljive spretnosti** Samostojno in skupinsko delo pri vajah in pripravi seminarjev. Analiza in ovrednotenje rezultatov, pisanje poročil. Sposobnost uporabe strokovne literature.	**Knowledge and Comprehension** Knowledge of principles and methods of molecular evolution such as molecular clock, distance determination, driving forces for evolution. Using the examples, students deepen their knowledge and improve their understanding of molecular mechanisms of development. **Application** The course broadens essential biochemical knowledge and encourages students to integrate this knowledge and solve problems. The course topics provide the indispensable foundation for understanding more complex processes at the level of genomes and organisms. **Analysis** Students acquire knowledge in course topics and develop the ability of thinking from molecular mechanisms to the level of an organism. **Skill-transference Ability** Individual and group work in practicals and preparation of seminars. Analysis and evaluation of results, report writing. The ability to use scientific literature.

Metode poučevanja in učenja:	**Learning and teaching methods:**
Predavanja, laboratorijske vaje, individualni in skupinski seminarji.	Lectures, practicals, and individual and group seminars.

Načini ocenjevanja:	**Delež/Weight**	**Assessment:**
Seminarska naloga	25,00 %	Seminar work

Pisni izpit Pogoj za pristop k izpitu: opravljene laboratorijske vaje in seminarska naloga.	75,00 %	Written exam Requirements for exam admission: completed laboratory practicals and seminar work.

Reference nosilca/Lecturer's references:

ŽUPUNSKI, Vera, GUBENŠEK, Franc, KORDIŠ, Dušan. Evolutionary dynamics and evolutionary history in the RTE clade of non-LTR retrotransposons. Molecular biology and evolution. 2001, vol. 18, str. 1849-1863. ISSN 0737-4038. [COBISS.SI-ID 16218919]
ŽUPUNSKI, Vera, KORDIŠ, Dušan, GUBENŠEK, Franc. Adaptive evolution in the snake venom Kunitz/BPTI protein family. FEBS letters. [Print ed.]. 2003, vol. 547, str. 131-136. ISSN 0014-5793. [COBISS.SI-ID 17648423],
ŽUPUNSKI, Vera, KORDIŠ, Dušan. Strong and widespread action of site-specific positive selection in the snake venom Kunitz/BPTI protein family. Scientific reports. 2016, vol. 6, str. 37054-1-37054-12. ISSN 2045-2322. DOI: 10.1038/srep37054. [COBISS.SI-ID 29935911],

MOLEKULSKO KLONIRANJE

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Molekulsko kloniranje
Course title:	Molecular Cloning
Članica nosilka/UL Member:	UL FKKT

Študijski programi in stopnja	Študijska smer	Letnik	Semestri	Izbirnost
Biokemija, prva stopnja, univerzitetni	Ni členitve (študijski program)	3. letnik	1. semester	obvezni

Univerzitetna koda predmeta/University course code:	0072088
Koda učne enote na članici/UL Member course code:	BK131-1

Predavanja /Lectures	Seminar /Seminar	Vaje /Tutorials	Klinične vaje /Clinical tutorials	Druge oblike študija /Other forms of study	Samostojno delo /Individual student work	ECTS
30	5	40 LV			75	5

Nosilec predmeta/Lecturer:	prof. dr. Marko Dolinar
Vrsta predmeta/Course type:	obvezni/mandatory

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

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

Vsebina:	Content (Syllabus outline):
1. Raziskovanje DNA in molekularna biotehnologija: zgodovina in prihodnost. 2. Laboratorijski organizmi v DNA-tehnologiji. 3. Encimi pri delu z DNA. 4. Elektroforezne metode. 5. Vektorske molekule. Reporterski geni. 6. Sinteza DNA *in vitro*. Sinteza cDNA. Priprava DNA-knjižnic. Transformiranje celic. 7. PCR in izvedene tehnike. 8. Hibridizacija, sonde, načini označevanja DNA. Presejanje knjižnic. 9. Določanje nukleotidnega zaporedja DNA. 10. Ekspresijski sistemi. Transkripcija/translacija *in vitro*.	1. Exploring DNA and molecular biotechnology – past and future. 2. Laboratory organisms in DNA technology. 3. DNA-modifying enzymes. 4. Electrophoretic methods. 5. Vectors and reporters. 6. DNA synthesis in vitro. cDNA synthesis. Preparation of DNA libraries. Cell transformation. 7. PCR and deducted techniques. 8. Hybridization, probes and approaches for DNA labelling. Screening of DNA libraries. 9. DNA sequencing. 10. Expression systems. In vitro transcription / translation.

11. Izražanje v prokariontih: vektorji, fuzije, optimizacija proizvodnje. Usmerjena lokalizacija, topnost, stabilnost, renaturacija. 12. Izražanje v kvasovkah, insektnih in sesalskih celicah. 13. Laboratorijska varnost pri delu z GSO. Praktični del: 1. Načrtovanje začetnih oligonukleotidov, konstruiranje rekombinantnih molekul (računalniška vaja). 2. Preparativno rezanje plazmidne DNA z restriktazami. 3. Izolacija DNA iz gela in ocena koncentracije. 4. Priprava kompetentnih celic. 5. Ligacija fragmentov DNA in transformacija bakterij. 6. Izolacija plazmidne DNA iz transformant v malem merilu. 7. Restrikcijska analiza rekombinantnih vektorskih molekul. 8. Indukcija izražanja rekombinantne DNA. 9. Analiza topnosti rekombinantnega proteina. Lokalizacija rekombinantnega proteina in test biološke aktivnosti. Seminar: Ocena tveganja za delo z gensko spremenjenimi organizmi v zaprtem sistemu.	11. Expression in prokaryotes: vectors, fusions, optimization of production. Targeted localization, solubility, stability and renaturation. 12. Expression in yeast, insect and mammalian cells. 13. Laboratory safety issues in work with genetically modified organisms Practical course: 14. Primer design and construction of recombinant molecules (computer work). 15. Preparative restriction enzyme cleavage of plasmid DNA. 16. DNA isolation from agarose gels and estimation of DNA concentration. 17. Preparation of competent cells. 18. DNA fragment ligation and bacterial transformation. 19. Small-scale plasmid DNA isolation from transformants. 20. Restriction analysis of recombinant vector molecules. 21. Induction of recombinant DNA expression. 22. Solubility assay, localization screening and biological activity test. Seminar: 23. Risk assessment for work with GMOs in a contained system.

Temeljna literatura in viri/Readings:

- Twyman & Primrose: Principles of Gene Manipulation and Genomics. Oxford: Blackwell Publishing, 2006.
- Dolinar: Molekulsko kloniranje, Navodila za vaje. Ljubljana: Fakulteta za kemijo in kemijsko tehnologijo UL, 2016. Dostopno na spletu: http://www.fkkt.uni-lj.si/fileadmin/datoteke/1-O_fakulteti/7-Zalo%C5%BEba/Skripta_MK_201617.pdf

Cilji in kompetence:	**Objectives and competences:**
Vsak študent mora biti po opravljenem kolokviju in izpitu sposoben ob ustreznem vodstvu sam izvesti osnovne analize DNA, pripraviti rekombinantno molekulo DNA in razumeti osnovne postopke dela pri pripravi rekombinantnih proteinov v različnih tipih gostiteljskih organizmov. Poznati bo moral tudi načela varnosti dela z gensko spremenjenimi organizmi.	Under guidance, students will be able to perform basic DNA analyses and construct a recombinant DNA molecule. Students will understand fundamental procedures in recombinant protein preparation in different types of host organisms and will be aware of safe laboratory work with genetically modified organisms.

Predvideni študijski rezultati:	**Intended learning outcomes:**
Znanje in razumevanje Znanje: poznavanje encimov, ki jih uporabljamo pri delu z DNA in pri pripravi rekombinantnih proteinov, osnove metod za označevanje in analizo nukleinskih kislin, lastnosti vektorskih molekul in metode vnosa DNA v gostiteljsko celico. Zakonska urejenost dela z GSO. Razumevanje	Knowledge and Comprehension Knowledge: Knowing enzymes used for DNA modifications and preparation of recombinant proteins, basic methods for nucleic acids labelling and analysis, properties of vector molecules and methods for incorporation of foreign DNA into host cells. Knowing legal framework for working with GMOs. Comprehension

Postopek PCR, postopek določanja nukleotidnega zaporedja, postopki priprave DNA-knjižnic, načini pridobivanja rekombinantnih proteinov. Uporaba Razlikovanje med vektorskimi molekulami, občutek za velikosti molekul DNA (bazni pari, masa) in količine (femtomolarno do mikromolarno območje). Izolacija vektorskih DNA iz celic. Rezanje DNA z restriktazami. Ligacija DNA. Transformiranje bakterijskih celic. Biosinteza rekombinantnih proteinov in analiza njegovih lastnosti. Refleksija Povezovanje posameznih metod v celoten eksperiment – primer priprave rekombinantnega proteina. Povezovanje dela z DNA z analizo proteinov. Prenosljive spretnosti Laboratorijsko delo v skupini s kolegom. Pisanje poročil o laboratorijskem delu. Načela varnosti pri laboratorijskem delu z DNA in genetsko spremenjenimi mikroorganizmi. Način priprave ocene tveganja.	PCR technique, DNA sequencing, preparation of DNA libraries, approaches to recombinant protein preparation. Application Distinguishing between various types of vector molecules, feeling for sizes of biological macromolecules (base pairs vs. molecular mass) and quantities (femtomolar to micromolar range). Isolation of vector molecules from cells. DNA digestion with restriction enzymes. DNA ligation. Bacterial transformation. Biosynthesis of recombinant proteins and their analysis. Analysis Combining separate methods into an experiment – case experiments for preparation of a recombinant protein. Work with DNA continues at the protein level. Skill-transference Ability Laboratory work in a group with a colleague student. Writing laboratory work reports. Principles of laboratory safety when working with DNA and GM microorganisms. Writing a risk assessment.

Metode poučevanja in učenja:	**Learning and teaching methods:**
Predavanja, laboratorijske vaje, individualno delo pri pripravi seminarjev. Spletna gradiva za določena poglavja.	Lectures, laboratory practical courses, individual work for preparing seminars. Web sources for some topics.

Načini ocenjevanja:	**Delež/Weight**	**Assessment:**
Pisni izpit, seminarska naloga ter ustni kolokvij z vaj. Opravljene vaje so pogoj za pristop k izpitu.		Written examination, seminary presentation and oral practicals defence. Access to examination only with completed laboratory practicals.

Reference nosilca/Lecturer's references:

- 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]
- 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 letters, ISSN 0014-5793. [Print ed.], 2005, vol. 579, str. 1285-1290. [COBISS.SI-ID 18842407]
- PUNGERČIČ, Galina, DOLENC, Iztok, **DOLINAR, Marko**, BEVEC, Tadeja, KOKALJ-JENKO, Saša, KOLARIČ, Saša, TURK, Vito. Individual recombinant thyroglobulin type-1 domains are substrates for lysosomal cysteine proteinases. Biological chemistry, ISSN 1431-6730, 2002, vol. 383, str. 1809-1812. [COBISS.SI-ID 17215527]

ORGANSKA KEMIJA I

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Organska kemija I
Course title:	Organic chemistry I
Članica nosilka/UL Member:	UL FKKT

Študijski programi in stopnja	Študijska smer	Letnik	Semestri	Izbirnost
Biokemija, prva stopnja, univerzitetni	Ni členitve (študijski program)	1. letnik	2. semester	obvezni

Univerzitetna koda predmeta/University course code:	0072063
Koda učne enote na članici/UL Member course code:	BK109

Predavanja /Lectures	Seminar /Seminar	Vaje /Tutorials	Klinične vaje /Clinical tutorials	Druge oblike študija /Other forms of study	Samostojno delo /Individual student work	ECTS
60	15				75	5

Nosilec predmeta/Lecturer:	prof. dr. Janez Košmrlj
Vrsta predmeta/Course type:	obvezni/mandatory

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

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

Vsebina:	Content (Syllabus outline):
Osnove strukture organskih molekul (kovalentna vez, hibridizacija ogljikovega atoma, energija vezi, dolžina in valenčni koti); nomenklatura organskih spojin (nasičeni, nenasičeni in aromatski ogljikovodiki, alkil in aril halogenidi, alkoholi, fenoli, etri in amini, karbonilne spojine: aldehidi in ketoni, karboksilne kisline in njihovi derivati). Splošne lastnosti organskih spojin (elektronska delokalizacija, resonance, resonačna energija, tavtomerija, dipolni moment); kislost in bazičnost organskih spojin (vpliv topila, induktivni, resonačni in sterični efekt ter vpliv hibridizacije); izomerija (konstitucijska izomerija in stereoizomerija, rotacija okrog C-C vezi v acikličnih spojinah, konformacije cikloalkanov, geometrijska izomerija, optična izomerija, relativna in absolutna konfiguracija,	Structure and bonding in organic molecules (ionic and covalent bonds, hybridization of the carbon atoms). Nomenclature of organic compounds (saturated, unsaturated and aromatic hydrocarbons, alkyl and aryl halides, alcohols, phenols, ethers and amines, carbonyl compounds: aldehydes, ketones, carboxylic acids and derivatives). Properties of organic compounds connected to the resonance (electron delocalization, resonance structures, resonance energy), tautomerism (keto-enol, nitro-acinitro, nitroso-oxime, imine-enamine and other tautomerisms), and dipole moment. Organic acids and bases: the influence of the solvent, inductive, resonance and steric effect, the role of hybridization. Isomers in organic chemistry: rotamers, conformers, cis and trans isomerism, optical

racemati). Reakcijski mehanizmi (vrste organskih reakcij, načini cepitve vezi, elektrofilni in nukleofilni reagenti, ogljikovi intermediati, prehodno stanje in aktivacijski kompleksi, kinetični in termodinamski produkti, kataliza, pozitivni katalizatorji in inhibitorji. Nukleofilne substitucije in eliminacije na nasičenih ogljikih (substitucije SN1 in SN2, stereokemija substitucij, substitucijam konkurenčne reakcije, reakcije alkil halogenidov in alkoholov, eliminacije E1 in E2, sin in anti eliminacije); adicije na alkene in alkine (elektrofilne adicije, cikloadicije, radikalske adicije); aromatske substitucije (aromatičnost, mehanizmi elektrofilnih substitucij, tipični primeri, vrste nukleofilnih aromatskih substitucij).	isomerism (enatiomers, diastereoisomers, optical activity, relative and absolute configuration, racemates). Types of organic reactions (radical and ionic cleavage, electrophilic and nucleophilic reagents, carbon intermediates, activation complex, free energy of activation, reaction rate, catalysis and catalysts). Nucleophilic substitutions on sp3 carbons (SN1, SN2 and their stereochemistry, competition reactions, applications in organic synthesis). Elimination reactions (E1 and E2 reactions, examples of sin and anti-eliminations). Additions involving alkenes and alkynes. Electrophilic and nucleophilic aromatic substitutions.

Temeljna literatura in viri/Readings:

- Organic chemistry with Biological Applications, John E. McMurry, 3rd edition, Cengage Learning, 2015.
- Organska kemija, Darko Dolenc, UL FKKT, 2019.

Cilji in kompetence:	**Objectives and competences:**
Študent na primerih enostavnih modelnih spojin spozna osnovne principe in zakonitosti, po katerih potekajo kemijske pretvorbe organskih spojin ter povezavo med reaktivnostjo in lastnostmi spojine s strukturo molekule. Pridobljeno znanje študentu omogoča prepoznavanje reaktivnosti in lastnosti določenih kompleksnejših molekul.	Knowledge of the basic principles required to understand fundamental reactions of organic compounds. Understanding the connection between the structure and the properties of organic molecules. The students will be able to follow more advanced organic courses. Ability to use the IUPAC as well as the trivial nomenclature on various types of organic compounds. Ability to discuss general properties of organic substrates in connection with resonance, tautomerism, dipole moment etc. Interpretation of three-dimensional structures of various molecules. Ability to plan simple transformations of aliphatic and aromatic substrates employing nucleophilic substitutions and eliminations as well as electrophilic additions and aromatic substitutions.

Predvideni študijski rezultati:	**Intended learning outcomes:**
Znanje in razumevanje Študent spozna nekatere osnovne zakonitosti, ki veljajo v organski kemiji. Poleg znanj o reaktivnosti in lastnostih obravnavanih organskih spojin je sposoben načrtovati možnosti za njihovo interkonverzijo. Uporaba Študent se seznani s posameznimi vrstami organskih spojin, z njihovo strukturo, reaktivnostjo in z možnostmi njihove interkonverzije. Skupaj s predmetom Organska kemija 2 dobi nekatere osnove za razumevanje biokemijskih procesov. Predmet pripravlja študenta za eksperimentalno delo v organskem laboratoriju. Refleksija Študent pridobi občutek za določene transformacije organskih spojin, ki jih je mogoče izvesti v laboratoriju. Prenosljive spretnosti	Knowledge and Comprehension Understanding the fundamentals of organic chemistry. Knowledge on structural features of organic compounds, structure-reactivity relationship, and typical organic transformations. Application Student acquires knowledge about the types of organic compounds, their structure, reactivity and possible interconversions. In combination with the Organic Chemistry II course, the student acquires some basics to understand biochemical processes. Student gets prepared for experimental work in an organic chemistry laboratory. Analysis Student learns basics for some transformation of organic compounds that can be conducted in laboratory. Skill-transference Ability

Izkušnje pri reševanju problemov, delo v skupinah, zbiranje in interpretacija rezultatov ter njihovo kritično vrednotenje.	Experiences in solving problems, team work, collection and interpretation of results and their critical evaluation.

Metode poučevanja in učenja:	**Learning and teaching methods:**
Predavanja, seminarji.	Lectures, seminars.

Načini ocenjevanja:	**Delež/Weight**	**Assessment:**
2 testa za sprotno preverjanje znanja in pisni izpit. Če študent na vsakem od obeh testov zbere najmanj 50% točk je lahko oproščen opravljanja izpita. Ocene: 6-10 (pozitivno), 1-5 (negativno)		2 tests and written exam. If a student gets 50% in both of the tests, he/she can be exempted from taking the exam. Ratings: 6-10 (positive), 1-5 (negative)

Reference nosilca/Lecturer's references:

- A. Demšar, **J. Košmrlj**, S. Petriček: Variable-temperature nuclear magnetic resonance spectroscopy allows direct observation of carboxylate shift in zinc carboxylate complexes. J. Am. Chem. Soc. 2002, 124, 3951–3958.
- D. Urankar, **J. Košmrlj**: Concise and Diversity-Oriented Synthesis of Ligand Arm-Functionalized Azoamides. J. Comb. Chem. 2008, 10, 981–985.
- Z. Časar, M. Steinbücher, **J. Košmrlj**: Lactone Pathway to Statins Utilizing the Wittig Reaction. The Synthesis of Rosuvastatin. J. Org. Chem. 2010, 75, 6681–6684.
- B. Pinter, D. Urankar, A. Pevec, F. De Proft, **J. Košmrlj**: Platinum mediated dinitrogen liberation from 2-picolylazide through a putative Pt=N double bond containing intermediate. Inorg. Chem. 2013, 4528–4533.
- A. Bolje, **J. Košmrlj**: A Selective Approach to Pyridine Appended 1,2,3-Triazolium Salts. Org. Lett. 2013, 15, 5084–5087.
- D. Cappoen, V. Majce, C. Uythethofken, D. Urankar, V. Mathys, M. Kočevar, L. Verschaeve, S. Polanc, K. Huygen, **J. Košmrlj**, Eur. J. Med. Chem. 2014, 74, 85–94.

ORGANSKA KEMIJA II

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Organska kemija II
Course title:	Organic chemistry II
Članica nosilka/UL Member:	UL FKKT

Študijski programi in stopnja	Študijska smer	Letnik	Semestri	Izbirnost
Biokemija, prva stopnja, univerzitetni	Ni členitve (študijski program)	2. letnik	1. semester	obvezni

Univerzitetna koda predmeta/University course code:	0072075
Koda učne enote na članici/UL Member course code:	BK112

Predavanja /Lectures	Seminar /Seminar	Vaje /Tutorials	Klinične vaje /Clinical tutorials	Druge oblike študija /Other forms of study	Samostojno delo /Individual student work	ECTS
30	15	30 LV			75	5

Nosilec predmeta/Lecturer:	prof. dr. Janez Košmrlj
Vrsta predmeta/Course type:	obvezni/mandatory

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

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

Vsebina:	Content (Syllabus outline):
Karbonilne spojine (vrste transformacij karbonilnih spojin, adicija vode, alkoholov, karboanionov in dušikovih nulkeofilov na aldehide in ketone, aldolna kondenzacija in sorodne reakcije, adicije na kumulirane sisteme, pretvorbe karboksilnih kislin in njihovih derivatov). Heterociklične spojine (sintezni principi, reakcije nekaterih heterociklov, porfirinska barvila, protoporfirin IX, hem, klorofil, derivati korina, žolčna barvila, piridin, NAD, piridoksin, piridoksal, piridoksamin, pirimidini in purini, nukleozidi in nukleotidi). Ogljikovi hidrati (struktura monosaharidov, mutarotacija, reakcije monosaharidov, disaharidi, načini tvorbe glikozidne vezi, maltoza, celobioza, laktoza, saharoza, homopolisaharidi, škrob, glikogen, celuloza, hitin); maščobe (sestava in lastnosti, trigliceridi in njihova	Carbonyl compounds (typical transformations of aldehydes and ketones: addition of water, alcohols, hydride ion, cyanide ion, carbanions, and nitrogen nucleophiles; condensations; transformations of carboxylic acids and their derivatives). Heteroaromatic compounds (general synthetic approaches; typical reactions of electron-reach heterocycles: pyrroles, furans, tiophenes; porphyrins: protoporphyrin IX, hem, haemoglobin, chlorophylls; vitamin B12; indole and derivatives; pyridines: properties, synthesis, reactions, nicotinic acid, NAD, vitamin B6; pyrimidines: synthesis and reactions, hydroxypyrimidines; purines, nucleosides and nucleotides. Carbohydrates (classification, names and the structures of carbohydrates, Fischer projections,

hidroliza, fosfolipidi; terpeni in steroidi (izoprenska enota v terpenih, neciklični in ciklični monoterpeni, osnovne karakteristike steroidov), amino kisline (struktura in lastnosti amino kislin, izoelektrična točka, značilne reakcije amino kislin). Vaje iz organske kemije: varnost pri delu v laboratoriju in ukrepi v primeru nesreče, laboratorijska oprema, osnove protonske in IR spektroskopije, sinteza, izolacija in čiščenje spojin.	conformations of cyclic forms, anomeric sugars, mutarotation, reactions of monosaccharides: oxidations and reductions, formation of glycosides, ethers and esters, important disaccharides: maltose and isomaltose, cellobiose, lactose, sucrose, polysaccharides: amylose, amilopectin, glycogen, cellulose, chitin). Fats: fatty acids, triglycerides, phospholipids, glycolipids. Terpenes and steroids. α-Amino acids: structure and properties, isoelectric point, typical reactions of α-amino acids. **Experimental work**: safety in the lab, an introduction to the IR and NMR spectroscopy, lab equipment, experiments involving the synthesis, isolation, purification and identification of simple organic compounds.

Temeljna literatura in viri/Readings:

- Organic chemistry with Biological Applications, John E. McMurry, 3rd edition, Cengage Learning, 2015.
- Organska kemija, Darko Dolenc, UL FKKT, 2019.

Cilji in kompetence:	**Objectives and competences:**
Študent nadgradi znanje iz Organske kemije 1 o enostavnih modelnih spojinah in zakonitostih, po katerih potekajo kemijske pretvorbe organskih spojin. Pridobljeno znanje študentu omogoča prepoznavanje reaktivnosti in lastnosti kompleksnejših molekul in razumevanje že opisanih procesov v živih organizmih na molekularnem nivoju.	Upgrading the knowledge from Organic Chemistry I course on simple model compounds and principles of organic transformations. Student gets prepared to recognize reactivity and properties of more complex molecules and processes on leaving organisms at the molecular level.

Predvideni študijski rezultati:	**Intended learning outcomes:**
Znanje in razumevanje Študent spozna osnovne zakonitosti, ki veljajo v organski kemiji. Poleg znanj o reaktivnosti in lastnostih mnogih organskih spojin je sposoben načrtovati nekatere možnosti za njihovo interkonverzijo. Spozna tudi pomembne naravne spojine, ki jih srečuje pri nadaljnjem študiju. Uporaba Študent se seznani s posameznimi vrstami organskih spojin, z njihovo strukturo, reaktivnostjo in z možnostmi njihove interkonverzije. Dobi nekatere osnove za razumevanje biokemijskih procesov. Predmet usposablja študenta za samostojno eksperimentalno delo. Refleksija Študent pridobi občutek za različne transformacije organskih spojin, ki jih je mogoče izvesti v laboratoriju ter za primerjavo le-teh s procesi v naravi. Prenosljive spretnosti Izkušnje pri reševanju problemov, delo v skupinah, zbiranje in interpretacija rezultatov ter njihovo kritično vrednotenje.	Knowledge and Comprehension Student acquires basic principles of organic chemistry, knowledge about the reactivity and properties of organic compounds. Student learns about the most important natural occurring compounds that are the subject in continuation of the study. Application Student learns about different classes of organic compounds, their structure, reactivity and interconversion. Student learns basic principles to understand biochemical processes. Student gets trained for an independent laboratory experimental work. Analysis Student acquires feeling for different transformations that can be performed in laboratory and for their comparison with the processes in nature. Skill-transference Ability Experiences in solving problems, team work, collection and interpretation of results and their critical evaluation.

Metode poučevanja in učenja:	**Learning and teaching methods:**
Predavanja, seminarji, laboratorijske vaje.	Lectures, seminars, practical courses.

Načini ocenjevanja:	Delež/Weight	Assessment:
2 testa za sprotno preverjanje znanja in pisni izpit. Če študent na vsakem od obeh testov zbere najmanj 50% točk je lahko oproščen opravljanja izpita. Ocene: 6-10 (pozitivno), 1-5 (negativno)		2 tests and written exam. If a student gets 50% in both of the tests, he/she can be exempted from taking the exam. Ratings: 6-10 (positive), 1-5 (negative)

Reference nosilca/Lecturer's references:

- A. Demšar, **J. Košmrlj**, S. Petriček: Variable-temperature nuclear magnetic resonance spectroscopy allows direct observation of carboxylate shift in zinc carboxylate complexes. J. Am. Chem. Soc. 2002, 124, 3951–3958.
- D. Urankar, **J. Košmrlj**: Concise and Diversity-Oriented Synthesis of Ligand Arm-Functionalized Azoamides. J. Comb. Chem. 2008, 10, 981–985.
- Z. Časar, M. Steinbücher, **J. Košmrlj**: Lactone Pathway to Statins Utilizing the Wittig Reaction. The Synthesis of Rosuvastatin. J. Org. Chem. 2010, 75, 6681–6684.
- B. Pinter, D. Urankar, A. Pevec, F. De Proft, **J. Košmrlj**: Platinum mediated dinitrogen liberation from 2-picolylazide through a putative Pt=N double bond containing intermediate. Inorg. Chem. 2013, 4528–4533.
- Bolje**, J. Košmrlj**: A Selective Approach to Pyridine Appended 1,2,3-Triazolium Salts. Org. Lett. 2013, 15, 5084–5087.
- D. Cappoen, V. Majce, C. Uythethofken, D. Urankar, V. Mathys, M. Kočevar, L. Verschaeve, S. Polanc, K. Huygen, **J. Košmrlj**, Eur. J. Med. Chem. 2014, 74, 85–94.

OSNOVE BIOKEMIJSKEGA INŽENIRSTVA

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Osnove biokemijskega inženirstva
Course title:	FUNDAMENTALS OF BIOCHEMICAL ENGINEERING
Članica nosilka/UL Member:	UL FKKT

Študijski programi in stopnja	Študijska smer	Letnik	Semestri	Izbirnost
Biokemija, prva stopnja, univerzitetni (od študijskega leta 2023/2024 dalje)	Ni členitve (študijski program)	3. letnik		izbirni

Univerzitetna koda predmeta/University course code:	0088097
Koda učne enote na članici/UL Member course code:	BKSI1

Predavanja /Lectures	Seminar /Seminar	Vaje /Tutorials	Klinične vaje /Clinical tutorials	Druge oblike študija /Other forms of study	Samostojno delo /Individual student work	ECTS
30	15	30 LV			75	5

Nosilec predmeta/Lecturer:	prof. dr. Polona Žnidaršič Plazl
Vrsta predmeta/Course type:	izbirni strokovni/elective professional

Jeziki/Languages:	Predavanja/Lectures:	Angleščina, Slovenščina
	Vaje/Tutorial:	Angleščina, Slovenščina

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

Vsebina:	Content (Syllabus outline):
Uvod: biotehnologija - interakcija disciplin. Osnove kemijsko procesnega računanja: Stacionarne in nestacionarne snovne in energijske bilance. Osnove kemijske reakcijske kinetike: določanje kinetične enačbe, diferencialna in integralna metoda. Idealna mešalni in cevni reaktor. Šaržno in kontinuirno obratujoči reaktorji. Homogene reakcije. Heterogene reakcije. Osnove bioreaktorskega inženirstva: transportni procesi v bioreaktorjih: tok tekočin ter mešanje in zračenje. Reologija bioprocesnih brozg. Prenos toplote in snovi: toplotni in snovni tok, toplotna in snovna prehodnost in prestopnost, potencialna razlika. Vrste bioreaktorjev. Izbira in načrtovanje bioreaktorja. Merjenje in kontrola procesnih parametrov v	Introduction: Biotechnology- interaction of disciplines. Fundamentals of chemical Engineering calculations: mass and energy balances. Fundamentals of chemical reaction Kinetics: estimation of reaction kinetics equation: differential and integral method. Mixed flow and plug flow reactors. Batch and continuous operation of reactors. Homogenous and heterogeneous reactions. Fundamentals of bioreactor engineering: heat and mass transfer in bioreactors. Rheology of fermentation broths. Basic types of bioreactors. Introduction to bioreactor design. Measurement and control of bioprocess parameters. Transfer of bioprocess from laboratory to industrial scale. Upstream processes: inoculum and substrate preparation, sterilization.

bioreaktorju. Načini kontrole bioprocesov: šaržno, kontinuirno in polšaržno. Osnove prenosa postopka v industrijsko proizvodnjo. Pripravljalni procesi: izbira in priprava gojišča in vcepka. Sterilizacija zraka, gojišča in opreme. Izolacijski procesi: ločevanje in obdelava biomase ter izolacija produktov. Ravnanje z odpadki in zaščita okolja. Biotehnološki postopki: pregled izvedb tipičnih biotehnoloških postopkov proizvodnje biomase, primarnih in sekundarnih metabolitov ter biotransformacij. Vsa poglavja so obogatena s številnimi praktičnimi računskimi primeri. Posamezne skupine študentov pripravijo seminarje iz izbrane tematike. Laboratorijske vaje: Mešanje. Prenos kisika. Gojenje v mikrobov v bioreaktorju. Ultrafiltracija. Seminar: izbrani primeri osnovnih operacij, bioprocesov oziroma biotehnoloških postopkov.	Downstream processes: biomass separation and product isolation. Waste management and environment protection. Bioprocess technology: description of selected bioprocess technologies.

Temeljna literatura in viri/Readings:

- Doran, P.M. Bioprocess Engineering Principles, 2nd Ed., Elsevier, Amsterdam [etc.], 2013, 919 p. (30 %)
- Raspor, P. (ur.) Biotehnologija. Bia, d.o.o., Ljubljana. 1996. 815 p. (20 %)
- Žnidaršič Plazl, P., Pavko, A. Praktikum iz biokemijskega inženirstva. Fakulteta za kemijo in kemijsko tehnologijo, Ljubljana. 2005. 89 p. (90 %)

Cilji in kompetence:	**Objectives and competences:**
Cilj predmeta je spoznanje in razumevanje osnovnih inženirskih principov in vloge kemijskega inženirstva oziroima tehnike v biotehnologiji, ki je po definiciji interdisciplinarna veda in se ukvarja z nastajanjem produkta od laboratorija do proizvodnje za trg. Študent si pri predmetu pridobi naslednje specifične kompetence: -sposobnost razumevanja in povezovanja inženirskih znanj z znanji mikrobiologije, in biokemije, - spoznavanje tehnološkega postopka od laboratorijskih raziskav do industrijskega postopka, - uporaba inženirskih znanj v industrijskih procesih, - spoznavanje različnosti tehnoloških procesov z ozirom na uporabljeni mikroorganizem, - sposobnost pridobivati potrebne podatke za izračune v biokemijskem inženirstvu, - sposobnost analizirati dejavnike, ki so pomembni za načrtovanje, delovanje, obnašanje in spremljanje bioprocesov, - osvajanje nekaterih izbranih laboratorijskih tehnik za analizo in vodenje bioprocesa v laboratorijskem merilu.	Understanding the basic principles of chemical engineering; Knowing the role of chemical engineering in the field of biotechnology, knowing how to integrate chemical engineering, microbiological and biochemical principles to obtain the biotechnological product on commercial scale. Competences: Ability to define the basic steps in biotechnological process from raw material to a biotechnological product. Knowledge of basic principles of transfer from laboratory to industrial scale. Ability to define and analyse the parameters which are important for the process design and control.

Predvideni študijski rezultati:	**Intended learning outcomes:**
Znanje in razumevanje Študent se pri predmetu seznani z osnovnimi zakonitostmi in principi kemijskega inženirstva in vlogo te vede v biotehnologiji. Nauči se tehničnega razmišljanja in integralnega pristopa pri aplikaciji	Knowledge and Comprehension Understanding basic principles of chemical engineering and the role of engineering in biotechnology. Knowing how to integrate chemical engineering, microbiological and biochemical

naravoslovnih in tehničnih znanj pri analizi, načrtovanju in vodenju biotehnoloških procesov. Uporaba Pridobljeno znanje bo študent uporabil pri analizi posameznih faz biotehnoloških postopkov oziroma pri prenosu postopkov v večje merilo ter pri analizi in vodenju biotehnoloških proizvodnih procesov od surovine do produkta v vseh merilih. Refleksija Študent pridobi občutek za tehnični način razmišljanja in predstavo o sestavljanju posameznih faz postopka v celoto. Prenosljive spretnosti Izkušnje pri reševanju biotehnoloških problemov. Zbiranje podatkov, računanje in načrtovanje ter kritično vrednotenje rezultatov. Uporaba domače in tuje literature. Podajanje poročil o opravljenem delu.	principles in development, operation, performance and monitoring of biotechnological processes. Application Student will develop the ability to participate in the development, control and analysis of biotechnological processes. Analysis Student will interpret and analyse the knowledge on selected biocatalytic processes. Skill-transference Ability Experiences with solving biotechnological problems. Experimental data collection, analysis and critical evaluation of results. The use of scientific literature, writing and presentation of reports.

Metode poučevanja in učenja:	**Learning and teaching methods:**
- Predavanja, - laboratorijske vaje, - seminarji.	Lectures, seminars, practical training.

Načini ocenjevanja:	**Delež/Weight**	**Assessment:**
Kolokvij iz laboratorijskih vaj	40,00 %	Laboratory practical exam
Seminar	20,00 %	Seminar
Pisni in ustni izpit	40,00 %	Written and oral exam
Ocene: 6-10 (pozitivno), 1-5 (negativno).		Grades: 6-10 (positive), 1-5 (negative)

Reference nosilca/Lecturer's references:

- NOVAK, Uroš, POHAR, Andrej, PLAZL, Igor, ŽNIDARŠIČ PLAZL, Polona. Ionic liquid-based aqueous two-phase extraction within a microchannel system. Separation and Purification Technology, 2012, 97, 172-178
- ŽNIDARŠIČ PLAZL, Polona, PLAZL, Igor. Microbioreactors. In: MOO-YOUNG, Murray (Ed.). Comprehensive Biotechnology, 2nd Edition. Amsterdam [etc.]: Elsevier, 2011, 289-301.
- POHAR, Andrej, ŽNIDARŠIČ PLAZL, Polona, PLAZL, Igor. Integrated system of a microbioreactor and a miniaturized continuous separator for enzyme catalyzed reactions. Chem. Eng. J., 2012, vol. 189/190, no. 1, 376-382.

OSNOVE FARMAKOLOGIJE

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Osnove farmakologije
Course title:	Fundamentals of Pharmacology
Članica nosilka/UL Member:	UL FKKT

Študijski programi in stopnja	Študijska smer	Letnik	Semestri	Izbirnost
Biokemija, prva stopnja, univerzitetni	Ni členitve (študijski program)	3. letnik		izbirni

Univerzitetna koda predmeta/University course code:	0088096
Koda učne enote na članici/UL Member course code:	BKSI2

Predavanja /Lectures	Seminar /Seminar	Vaje /Tutorials	Klinične vaje /Clinical tutorials	Druge oblike študija /Other forms of study	Samostojno delo /Individual student work	ECTS
30	30	15 LV			75	5

Nosilec predmeta/Lecturer:	izr. prof. dr. Katarina Černe
Vrsta predmeta/Course type:	izbirni strokovni/elective professional

Jeziki/Languages:	Predavanja/Lectures:	Angleščina, Slovenščina
	Vaje/Tutorial:	Angleščina, Slovenščina

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

Vsebina:	Content (Syllabus outline):
Opredelitev farmakologije in njenih področij. 1. Osnovni principi delovanja zdravil (tarče in mehanizmi delovanja). 2. Osnove farmakokinetike – kako zdravila pridejo v organizem, kako prehajajo v različne predelke organizma in na kakšen način se jih organizem znebi. 3. Kako pride do neželenih učinkov zdravil. 4. Osnove toksikologije. Pregled izbranih farmakodinamskih skupin zdravil.	Definition of pharmacology and its fields: 1. Basic principles of drug action (targets and mechanisms of action).. 2. Basics of pharmacokinetics - how the drug comes into the body, how to pass through the different compartments of the organism and the main routs of excretion. 3. How comes to adverse drug reactions. 4. Basics of toxicology. Overview of selected pharmacodynamic drug groups.

Temeljna literatura in viri/Readings:

- Rang HP, Dale MM, Ritter JM, Flower RJ, Henderson G: Rang and Dale's Pharmacology,, Churchill Livingstone Elsevier. Zadnja izdaja.

- Černe K, Ferjan I, Kržan M, Lipnik-Štangelj M, Osredkar D, Rajtar-Osredkar S, Stanovnik L. Izbrana poglavja iz farmakologije. Navodila za vaje s protokoli. Elektronska oblika dostopna na spletni strani Inštituta za farmakologijo in eksperimentalno toksikologijo. Zadnja verzija.

Cilji in kompetence:	**Objectives and competences:**
Cilji: Študent spozna, kako zdravila delujejo na organizem in kako organizem vpliva na zdravila; na kakšen način zdravila spremenijo potek bolezenskih procesov in kako lahko povzročijo neželene učinke. Spoznal bo, kako se preskušajo potencialna nova zdravila. Seznanil se bo tudi z glavnimi skupinami zdravil. Kompetence: Sposobnost pokazati znanje in povezovanje bistvenih dejstev in načel pri razvoju in delovanju zdravil. Sposobnost razumevanja farmakokinetike zdravila in njenega pomena na učinek zdravila. Zmožnost razmišljanja in povezovanja interdisciplinarnih znanj. Sposobnost povezovanja temeljnega znanja različnih področij, kemije, biokemije ter elementov fiziologije.	Objectives: Students learn about how drugs act on the body and how the body affects the drug; how medicines alter the course of disease processes and how they can cause adverse effects. They will learn how to test potential new drugs. Students will become acquainted with major categories of drugs. Competencies: Ability to demonstrate knowledge and integration of the essential facts and principles in the development and mechanisms of actions of medicines. The ability to understand the pharmacokinetics and its relevance to the effect of the drug. The ability of thinking and integration of interdisciplinary knowledge. Ability to connect basic knowledge of different areas of chemistry, biochemistry and elements of physiology.

Predvideni študijski rezultati:	**Intended learning outcomes:**
Znanje in razumevanje Študent osvoji osnove delovanja zdravil: mehanizme delovanja, učinke in farmakokinetične lastnosti predstavnikov posameznih farmakodinamičnih skupin zdravil. Pozna indikacijska področja in kontraindikacije za jemanje posameznih zdravil. Predvideti zna možnost nastanka neželenih učinkov zdravil ter pozna ukrepe pri zastrupitvah z zdravili. Uporaba Študij tega predmeta je podlaga za to, da bo študent razumel dejavnike, ki vplivajo na učinke zdravil in mu bo pomagalo pri povezavi s praktičnimi primeri uporabe zdravil ter pri raziskovanju učinkov zdravila. Razumel bo principe raziskav, ki jih bo uporabljal na različnih strokovnih področjih v povezavi z zdravili /ksenobiotiki Pridobljeno znanje mu bo pomagalo pri interpretaciji in evalvaciji dobljenih rezultatov. Refleksija Štident:pridobi občutek za povezovanje teorije in izkušenj v praksi pri procesu nastajanja zdravil ali pri preučevanju mehanizmov delovanja in učinkov zdravil/ksenobiotikov. Pridobi tudi občutek za kritično vrednotenje med teoretičnimi principi in praktičnim eksperimentalnim delom. Pridobi tudi osnovo za boljše razumevanje vpliva režima doziranja zdravil pri posamezni medikamentozni terapiji. Prenosljive spretnosti Izkušnje pri reševanju problemov. Zbiranje in interpretiranje rezultatov ter njihovo kritično vrednotenje. Uporaba domače in tuje literature. Podajanje poročil o opravljenem delu. Izkušnje s predstavitvijo svojega dela in z uporabo pripomočkov pri tem.	Knowledge and Comprehension Students acquire the basics of drug action: mechanism of action, effects and pharmacokinetic properties of representatives of individual pharmacodynamic drug groups. He knows the areas of indication and contraindications for taking certain medicines. Can foresee the possibility of the occurrence of adverse drug reactions and knows measures in poisoning with drugs. Application Study of this object is the basis for that student will understand the factors that influence the effects of medicines and will help him in connection with practical examples of the use of drugs and study the effects of the medicine. Understand the principles of research, which will be used in various professional fields in conjunction with drugs / xenobiotics acquired knowledge, will help him in the interpretation and evaluation of the results obtained. Analysis Students will acquire a feel for the integration of theory and experience in practice in the process of the emergence of medication or when examining mechanisms of action and effects of drugs / xenobiotics. Get a feel for the critical evaluation of the theoretical principles and practical experimental work. Obtain a basis for better understanding the impact of dosage regimen of medicines in individual drug therapy. Skill-transference Ability Experience in problem solving. Collection and interpretation of results and their critical evaluation. The use of domestic and foreign literature. Expression of reports on the work done. Experience

	with the presentation of their work and the use of the devices in this.

Metode poučevanja in učenja:	**Learning and teaching methods:**
Predavanja, vaje, seminarji, problemsko naravnan študij.	Lectures, seminars, practical training, problem-based study.

Načini ocenjevanja:	**Delež/Weight**	**Assessment:**
Pisni in ustni izpit.		Written and oral examination.
Ocene od 6-10 (pozitivno) oz. 1-5 (negativno).		Grades 6-10 (positive) and. 1-5 (negative).

Reference nosilca/Lecturer's references:

- JAKIMOVSKA, Marina, **ČERNE, Katarina**, VERDENIK, Ivan, KOBAL, Borut. Circulating serum sVCAM-1 concentration in advanced ovarian cancer patients: correlation with concentration in ascites. Radiology and oncology, ISSN 1318-2099, 2013, vol. , no. , str. 9-15, ilustr., doi: 10.2478/raon-2013-0066. [COBISS.SI-ID 30924505]
- **ČERNE, Katarina**, ERMAN, Andreja, VERANIČ, Peter. Analysis of cytotoxicity of melittin on adherent culture of human endothelial cells reveals advantage of fluorescence microscopy over flow cytometry and haemocytometer assay. Protoplasma, 2013, vol. , iss. , str., ilustr., doi: 10.1007/s
- **ČERNE, Katarina**, KOBAL, Borut. Implications of microvesicle and cell surface protein shedding for biomarker studies, cancerogenesis, and therapeutic target discovery in ovarian cancer. V: IGLIČ, Aleš (ur.). Advances in planar lipid bilayers and liposomes. Vol. 16. Oxford [etc.]: Elsevier: Academic Press, 2012, str. 239-274, ilustr., graf. prikazi, doi: 10.1016/B978-0-12-396534-9.00008-8. [COBISS.SI-ID 30079961] 00709-013-0489-8.

OSNOVE GENETIKE

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Osnove genetike
Course title:	Fundamentals of Genetics
Članica nosilka/UL Member:	UL FKKT

Študijski programi in stopnja	Študijska smer	Letnik	Semestri	Izbirnost
Biokemija, prva stopnja, univerzitetni	Ni členitve (študijski program)	3. letnik	1. semester	obvezni

Univerzitetna koda predmeta/University course code:	0072090
Koda učne enote na članici/UL Member course code:	BK134

Predavanja /Lectures	Seminar /Seminar	Vaje /Tutorials	Klinične vaje /Clinical tutorials	Druge oblike študija /Other forms of study	Samostojno delo /Individual student work	ECTS
30		25 SV + 20 LV			75	5

Nosilec predmeta/Lecturer:	doc. dr. Jernej Ogorevc
Vrsta predmeta/Course type:	obvezni/mandatory

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

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

Vsebina:	Content (Syllabus outline):
PREDAVANJA 1. Uvod- zgodovina, evgenika, genetika danes 2. Osnovna in razširjena Mendelska genetika 3. Kromosomska teorija, citogenetika 4. Genetska rekombinacija, vezano dedovanje in kartiranje 5. Genske interakcije, komplementacija, penetranca, ekspresivnost 6. Osnove genomike – GWAS - študija primera 7. Epigenetika – dedovanje, učinki na izražanje genov, staranje 8. Uravnavanje genskega izražanja pri evkariontih in analitske metode za njegovo spremljanje 9. Dinamika in struktura evkariontskih genomov 10. Razvojna genetika 11. Celična diferenciacija in reprogramiranje genoma	LECTURES 1. Introduction – history of genetics, eugenics 2. Mendelian genetics, other inheritance patterns 3. Chromosomal theory, citogenetics 4. Genetic recombination, linkage, gene mapping 5. Gene interactions, complementation, penetrance, expresivity 6. Basics of genomics – GWAS – Case study 7. Epigenetics – inheritance, effects on gene expression and ageing 8. Gene regulation in eukaryotes and analytical methods for monitoring gene expression 9. Dynamics and structure of eukaryotic genomes 10. Developmental genetics 11. Cell differentiation and genome reprogramming 12. Population and conservation genetics

12. Populacijska in konzervacijska genetika 13. Genetika kvantitativnih lastnosti 14. Evolucijska genetika SEMINARSKE VAJE 1. Osnovni principi dedovanja I, II 2. Spolno vezano in organelno dedovanje 3. Alelne interakcije 4. Genske interakcije 5. Vezani geni 6. Analiza genetske vezave in epigenetskega dedovanja 7. Populacijska genetika I, II 8. Kvantitativna genetika LABORATORIJSKE VAJE 1. Analiza DNA sesalcev del – izolacija, kvantifikacija, genetski označevalci 2. Analiza DNA sesalcev del – analiza genetske variabilnosti; laboratorijske živali – ogled Centra 3. Analiza RNA sesalcev 1. del – izolacija, reverzna transkripcija, cDNA sinteza, analitika kvalitete RNA (RIN) 4. Analiza RNA 2. del – qPCR RT-PCR, izračuni_analiza diferencialnega izražanja Karakterizacija matičnih celic / CRISPR/Cas – validacija sgRNA	13. Quantitative genetics 14. Evolutionary genetics CABINET TUTORIAL 1. Basic principles of heredity I, II 2. Sex-linked and organelle inheritance 3. Allele interactions 4. Gene interactions 5. Genetic linkage 6. Linkage analysis and epigenetic inheritance 7. Population genetics I, II 8. Quantitative genetics LABORATORY PRACTICAL 1. Mammalian DNA analysis Part 1 - isolation, quantification, genetic markers 2. Mammalian DNA analysis Part 2 - genetic variability analysis; Laboratory animals - tour of the Center 3. Mammalian RNA analysis Part 1 - isolation, reverse transcription, cDNA synthesis, RNA quality analysis (RIN) 4. RNA analysis Part 2 - qPCR, calculations_analysis of differential expression Stem-cell characterization / CRISPR/Cas based validation of sgRNA

Temeljna literatura in viri/Readings:

- Anthony Griffiths; John Doebley; Catherine Peichel; David A. Wassarman: Introduction to Genetic Analysis, 12th Edition, 2020
- znanstveni članki

Cilji in kompetence:	**Objectives and competences:**
Študenti bodo razumeli, kako se kvalitativne in kvantitativne lastnosti prenašajo med generacijami, ob tem pa bodo znali analizirati različna križanja oziroma rodovnike in razumeti koncepte umetne selekcije različnih učinkov genov (dominantnost, recesivnost, nad-dominanca, aditivnost), interakcije med aleli in geni, ter mehanizem genetske rekombinacije. Obvladali bodo osnovna statistična orodja v genetiki in pristope h genskemu kartiranju. Hkrati bodo znali na primerih razložiti uporabnost genskih markerjev in njihove lastnosti. Razumeli bodo, kakšne so možnosti analize genoma na ravni celice in organizma ter kako genetsko opišemo populacije. Vedeli bodo, zakaj je pomembno ohranjanje genskih virov in kako je to mogoče doseči. Študentje bodo kompetentni pri izbiri optimalnega genetskega modela za določeno znanstveno vprašanje.	Understanding how qualitative and quantitative traits are transmitted through generations, getting to know how experimental genetic crosses and pedigrees are analysed; and knowing the basic concepts of artificial selection, gene actions, gene interactions, mechanisms of meiotic recombination, and current genomics approaches. Students will become competent in applying basic statistical methods in evaluating genetic problems and understand the main characteristics of genetic and biochemical markers and their suitability for various applications. They should develop a genome-wide understanding of underlying biochemical processes at a cell, tissue, organismal or population level. Students should be able to identify and select the most appropriate genetic model for a particular scientific question under study.

Predvideni študijski rezultati:	**Intended learning outcomes:**
Znanje in razumevanje Študentje bodo pridobili znanje različnih genetskih konceptov in razumevanja elementov determinacije	Knowledge and Comprehension Students should be able to acquire knowledge of a wide spectrum of genetic concepts in determination

fenotipa, načinov dedovanja, kvalitativne in kvantitativne genetike in se naučili analizirati genetska križanja in rodovnike. Pridobili bodo kompetence za samostojno uporabo sodobnih bioinformacijskih orodij za analizo dednih dejavnikov v bioloških sistemih. Osvojili bodo "genetski" način razmišljanja pri obravnavanju fenotipa in dednih bolezni ter možnosti uporabe pri svojih projektih iz ožjega področja biokemije. Uporaba Uporabnost statističnih metod in modelov v biologiji. Računanje alelnih frekvenc in drugih genetskih lastnosti populacije. Analiza poskusnih križanj ali obstoječih rodovnikov za posamezne dedno prenosljive lastnosti. Integriranje klasične mendelske genetike z molekularnimi mehanizmi. Refleksija Tudi biološki procesi (dedovanje) so podvrženi matematičnim zakonitostim. Populacije imajo svoje skupne genetske lastnosti. Dedne bolezni se dedujejo predvidljivo. Za ohranjanje genetskih lastnosti ni dovolj ohranjanje biotopa. Genetske lastnosti dinamične populacije so odvisne tudi od njene velikosti. Naravna in umetna selekcija imata enako genetsko osnovo a različne cilje. Razvijanje "genetskega" načina razmišljanja pri obravnavanju fenotipa ter kritično vrednotenje genetskih konceptov. Prenosljive spretnosti Statistična analiza populacij in dedovanja. Predstavitve strokovnih vsebin na osnovi angleškega izvirnika; uporaba terminološkega slovarja. Razumevanje etičnih vidikov povezanih s sodobno genetiko je lahko koristno pri evalvaciji širših bioetičnih problemov v bioznanostih.	of phenotype, modes of inheritance of qualitative and quantitative traits, and learn how to analyse genetic crosses and pedigrees. Competences gained cover a comprehensive understanding of genetic concepts and development of genetic approach to thinking about the biochemical and biological questions, phenotype and inherited diseases. Application Ability to use state of the art statistical tools will enable students to analyse genetic mapping problems, use of genetic markers and how to characterise populations with genetic means. Students should be able to integrate classical genetic knowledge with modern biochemistry and molecular biology. Analysis Students should be able to reflect how inheritance is linked to biochemical and biological processes and mathematical/statistical concepts – what constitutes common genetic architecture of a population and why can we predict inheritance patterns of next generations. How natural and artificial selection have common genetic basis but different aims. Ability to reflect common grounds of biochemistry and genetics. Skill-transference Ability Use of genetic and statistical analyses in problem solving. Use of foreign contemporary literature and genetic terminology to enhance understanding in other fields of life sciences. Students will also gain insight into ethical, legal and social issues surrounding modern genetics.

Metode poučevanja in učenja:	**Learning and teaching methods:**
Predavanja, laboratorijske in seminarske vaje; vmesna kratka preverjanja znanja (kvizi); individualno reševanje problemov doma	Lectures, laboratory and seminar practicum; short quizzes; take-home individual problem solving exercises.

Načini ocenjevanja:	**Delež/Weight**	**Assessment:**
Dva kolokvija ali končni pisni izpit		Two partial written exams or on final written exam

Reference nosilca/Lecturer's references:

- **OGOREVC, Jernej**, SIMČIČ, Mojca, ZORC, Minja, ŠKRJANC, Monika, DOVČ, Peter. TLR2 polymorphism (rs650082970) is associated with somatic cell count in goat milk. *PeerJ*, ISSN 2167-8359, 31. jul. 2019, vol. 7, str. 1-9, e-7340, ilustr. https://peerj.com/articles/7340.pdf, doi: 10.7717/peerj.7340. [COBISS.SI-ID 4274568].
- FORSTNERIČ, Vida, OVEN, Irena, **OGOREVC, Jernej**, LAINŠČEK, Duško, PRAZNIK, Arne, LEBAR, Tina, JERALA, Roman, HORVAT, Simon. CRISPRa-mediated FOXP3 gene upregulation in mammalian cells. *Cell & bioscience*, ISSN 2045-3701, 21. Nov. 2019, vol. 9, art. 93, str. 1-12, ilustr. https://cellandbioscience.biomedcentral.com/articles/10.1186/s13578-019-0357-0, doi: 10.1186/s13578-019-0357-0. [COBISS.SI-ID 4332936].

- **OGOREVC, Jernej**, DOVČ, Peter. Expression of estrogen receptor 1 and progesterone receptor in primary goat mammary epithelial cells. *Animal science journal*, ISSN 1740-0929, 2016, vol. 87, no. 12, str. 1464-1471. http://onlinelibrary.wiley.com/doi/10.1111/asj.12553/abstract;jsessionid=88B56CB81EBED8B3D29F8D35AB4186E1.f03t02, doi: 10.1111/asj.12553. [COBISS.SI-ID 3713928]

OSNOVE PROGRAMIRANJA

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Osnove programiranja
Course title:	Introduction to programming
Članica nosilka/UL Member:	UL FKKT

Študijski programi in stopnja	Študijska smer	Letnik	Semestri	Izbirnost
Biokemija, prva stopnja, univerzitetni	Ni členitve (študijski program)	2. letnik	1. semester	obvezni
Kemija, prva stopnja, univerzitetni	Ni členitve (študijski program)	2. letnik	1. semester	obvezni
Kemijsko inženirstvo, prva stopnja, univerzitetni	Ni členitve (študijski program)	1. letnik	1. semester	obvezni

Univerzitetna koda predmeta/University course code:	0071971
Koda učne enote na članici/UL Member course code:	OSNPR

Predavanja /Lectures	Seminar /Seminar	Vaje /Tutorials	Klinične vaje /Clinical tutorials	Druge oblike študija /Other forms of study	Samostojno delo /Individual student work	ECTS
45		30 LV			75	5

Nosilec predmeta/Lecturer:	izr. prof. dr. Miha Moškon
Vrsta predmeta/Course type:	obvezni/mandatory

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

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

Vsebina:	Content (Syllabus outline):

Študenti bodo v okviru predmeta spoznali:
1. Uvod v računalništvo
  1. Programska oprema
  2. Algoritem
2. Programiranje v Pythonu
  1. Osnove programiranja
  2. Spremenljivke
  3. Osnovni podatkovni tipi
  4. Stavki (priredilni, pogojni, zanke)
  5. Funkcije
  6. Vhod in izhod
  7. Knjižnice
	Students in this course will learn:
	1. Introduction to computers
	  1. Software
	  2. Algorithm
	2. Programming in Python
	  1. Basics of programming
	  2. Variables
	  3. Basic data types
	  4. Sentences (assignment, conditional, loops)
	  5. Functions
	  6. Input and output
	  7. Libraries

8. Datoteke 9. Analiza in vizualizacija podatkov 10. Iskanje in popravljanje napak	8. Files (read, write) 9. Data analysis and visualization 10. Debugging and handling errors

Temeljna literatura in viri/Readings:

- MOŠKON, Miha. Osnove programiranja v jeziku Python za neračunalničarje. Ljubljana: Fakulteta za računalništvo in informatiko, 2020. 206 str., ilustr. ISBN 978-961-7059-04-5. http://zalozba.fri.uni-lj.si/moskon2020.pdf. [COBISS.SI-ID 32096259]
- MOŠKON, Miha. Osnove programiranja v jeziku Python za neračunalničarje. Ljubljana: Fakulteta za računalništvo in informatiko, 2020. 1 spletni vir (1 datoteka PDF (VII, 206 str.)), ilustr. ISBN 978-961-7059-02-1. http://zalozba.fri.uni-lj.si/moskon2020.pdf. [COBISS.SI-ID 31230723]
- A. Sweigart, Automate the Boring Stuff with Python : Practical Programming for Total Beginners, 2015
- Zapiski s predavanj, vaje, zgledi in povezave objavljene na spletni strani predmeta. / Lecture notes, excercises, examples and links published on the home page of the course.

Dodatna literatura / Additional literature:

- M. Lutz, Learning Python, Fifth Edition, O'Reilly Media, 2013

Cilji in kompetence:	**Objectives and competences:**
Cilj predmeta je spoznati osnove algoritmičnega razmišljanja in kodiranja v izbranem programskem jeziku - Python. V okviru tega študenti spoznajo osnovne konstrukte programskega jezika.	The aim of this course is to learn the basics of algorithmic thinking and coding in the selected programming language - Python.

Predvideni študijski rezultati:	**Intended learning outcomes:**
Znanje in razumevanje Poznavanje osnovne zgradbe računalnika in njegovo delovanje. Poznavanje osnovnih programskih orodij. Poznavanje osnovnih programskih konstruktov (spremenljivke, stavki, zanke, podprogrami, ...) in njihova učinkovita uporaba za reševanje manjših programerskih problemov. Uporaba Snov predmeta predstavlja osnovno poznavanje računalniške tehnologije, ki se kot orodje uporablja na številnih področjih. Znanje programiranja je temelj za boljše razumevanje delovanja računalnika in programskih orodij, ki jih inženir uporablja pri svojem delu. Refleksija Spoznavanje osnov algoritmičnega razmišljanja in kodiranja računalniškega programa. Prenosljive spretnosti Poznavanje in uporaba računalniških orodij. Poznavanje in učinkovita uporaba osnovnih konceptov programiranja.	Knowledge and Comprehension Knowledge of basic computer building and its operation. Knowledge of basic software tools. Knowledge of basic programming constructs (variables, statements, loops, subroutines, ...) and their efficient use to solve small programming problems. Application Subject material represents a basic knowledge of computer technology, which is used as a tool in many areas. Programming knowledge is the basis for a better understanding of computer hardware and software tools that engineer uses in his work. Analysis Getting to know basic algorithmic thinking and coding of computer program. Skill-transference Ability Knowledge and use of computer tools. Knowledge and effective use of basic programming concepts.

Metode poučevanja in učenja:	**Learning and teaching methods:**
Predavanja s pomočjo razlage na šolski tabli in uporaba drugih AV sredstev (po potrebi). Praktične vaje potekajo v računalniških učilnicah, kjer študenti samostojno dopolnjujejo pridobljeno znanje. Predavanja s pomočjo različnih AV sredstev. Praktične vaje potekajo v računalniških učilnicah, kjer študenti samostojno dopolnjujejo pridobljeno znanje.	Lectures with the explanation on the blackboard and other audio video (AV) resources (as necessery). Practical exercises take place in computer labs where students independently upgrade achieved knowledge. Lectures with AV. Practical exercises take place in computer labs where students self-complementary knowledge.

Vsi koncepti so predstavljeni na nazoren in sistematski način s številnimi zgledi, poudarek je na njihovi uporabi na praktičnih primerih.	All concepts are presented in a vivid and systematic way with numerous examples, the emphasis is on their use in practical use cases.

Načini ocenjevanja:	**Delež/Weight**	**Assessment:**
Pisni (nadomestita ga lahko dva pozitivno ocenjena kolokvija) in ustni izpit. Opravljene vaje so pogoj za pristop k izpitu. Ocene: pozitivno 6-10; negativno: 1-5		Written (can be replaced by two positive colloquiums) and oral exam. Settled practical exercises are the prerequisite for the exam. Grades: 6-10 positive; 1-3 negative.

Reference nosilca/Lecturer's references:

Magdevska, Lidija, Mraz, Miha, Zimic, Nikolaj, Moškon, Miha. Initial state perturbations as a validation method for data-driven fuzzy models of cellular networks. BMC bioinformatics, ISSN 1471-2105, Sep. 2018, vol. 19, no. 333, doi: 10.1186/s12859-018-2366-0.

Cvitanović Tomaš, Tanja, Urlep, Žiga, Moškon, Miha, Mraz, Miha, Rozman, Damjana. LiverSex computational model : sexual aspects in hepatic metabolism and abnormalities. Frontiers in physiology, ISSN 1664-042X, Apr. 2018, vol. 9, doi: 10.3389/fphys.2018.00360.

Moškon, Miha, Zimic, Nikolaj, Mraz, Miha. Grohar : automated visualization of genome-scale metabolic models and their pathways. Journal of computational biology, ISSN 1066-5277, May 2018, vol. 25, no. 5, pp. 505-508, doi: 10.1089/cmb.2017.0209.

Vasylchenkova, Anastasiia, Mraz, Miha, Zimic, Nikolaj, Moškon, Miha. Classical mechanics approach applied to analysis of genetic oscillators. IEEE/ACM transactions on computational biology and bioinformatics, ISSN 1545-5963, May/Jun. 2017, vol. 14, no. 3, pp. 721-727, doi: 10.1109/TCBB.2016.2550456.

Cvitanović Tomaš, Tanja, Reichert, Matthias C., Moškon, Miha, Mraz, Miha, Lammert, Frank, Rozman, Damjana. Large-scale computational models of liver metabolism : how far from the clinics?. Hepatology, ISSN 0270-9139, 2017, vol. 66, no. 4, pp. 1323-1334, doi: 10.1002/hep.29268.

OSNOVE STRUKTURE BIOLOŠKIH MOLEKUL

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Osnove strukture bioloških molekul
Course title:	Introduction to biomolecular structure
Članica nosilka/UL Member:	UL FKKT

Študijski programi in stopnja	Študijska smer	Letnik	Semestri	Izbirnost
Biokemija, prva stopnja, univerzitetni	Ni členitve (študijski program)	2. letnik	2. semester	obvezni

Univerzitetna koda predmeta/University course code:	0119027
Koda učne enote na članici/UL Member course code:	BK118

Predavanja /Lectures	Seminar /Seminar	Vaje /Tutorials	Klinične vaje /Clinical tutorials	Druge oblike študija /Other forms of study	Samostojno delo /Individual student work	ECTS
45	30				75	5

Nosilec predmeta/Lecturer:	prof. dr. Barbara Hribar Lee
Vrsta predmeta/Course type:	obvezni/mandatory

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

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

Vsebina:	Content (Syllabus outline):
Uvod. Osnovni gradniki atomov. Poskusi, ki kažejo na kvantizacijo energije. Dvojnost narave snovi in princip nedoločljivosti. Razvoj modela atoma. Atomi v magnetnem polju. Valovna funkcija in Schrödingerjeva enačba za enostavne sisteme. Pomen tunelskega efekta v biokemiji. Sevanje in absorbcija svetlobe – izbirna pravila. **Atomi**. Opis vodikovega atoma z valovno funkcijo. Orbitalna in spinska vrtilna količina. Variacijska metoda in metoda motnje. Večelektronski atomi - Paulijev princip in Hundovo pravilo. Hartree-Fockova metoda za atome. **Molekule.** Metoda valenčnih vezi, molekula H2 z metodo valenčnih vezi. Metoda molekulskih orbital. Hibridne molekulske orbitale. Polarnost molekulskih orbital. Elektronegativnost.	**Introduction.** Fundamental particles in atom. Energy quantization experiments. Wave-particle experiments and Indeterminacy principle. Models of atoms. Atoms in magnetic field. Wave function and Schrödinger equation for simple model systems. The role of quantum tunneling in biochemistry. Radiation and absorption – selection rules. **Atoms.** Wave function for hydrogen atom. The orbital angular momentum and spin. Variational method and perturbation theory. Many-electron atoms – Pauli exclusion principle and Hund's rules. Hartree-Fock method for atoms. **Molecules.** Valence bond theory, application to H2 molecule. Molecular orbital method. Hybride

Hartree-Fockova metoda za molekule. Bazni seti. Grafična predstavitev biološko pomembnih molekul. Elektrostatski potencial in hidrofobnost. Semiempirične metode. Mehanski modeli in polja sil. Osnovne zakonitosti zvijanja proteinov.	molecular orbitals. The polarity of molecular orbitals. Electronegativity. Hartree-Fock method for molecules. Basis sets. Graphical representation of biologically important molecules. Electrostatic potential and hydrophobicity. Semiempirical methods. Molecular mechanics and force fields. The basic principles of protein folding.

Temeljna literatura in viri/Readings:

- J. Koller, Struktura atomov in molekul (bolonjski program), FKKT, Ljubljana 2010, 209 str., (90 %)
- P.W. Atkins, Physical Chemistry (šesta izdaja), Oxford University Press, Oxford 1998, 998 str., (15%)
- B. H. Bransden, C. J. Joachain, Physics of Atoms and Molecules, Addison-Wesley, 2003 (20%)
- A. R. Leach, Molecular Modelling, Principles and Applications, Longman, England, 1996 (10%)

Dopolnilna literatura:

- F.L. Pilar, Elementary Quantum Chemistry, McGraw-Hill, 1990, 599 str.
- J. Koller, Struktura atomov in molekul – zbirka nalog z rešitvami, FKKT, Ljubljana 2002, 121 str.
- M. Karplus in R.N. Porter, Atoms and Molecules, Benjamin, New York 1970, 620 str.
- K. A. Dill, S. Bromberg, Molecular Driving Forces, Garland Science, 2003, 666 str. (20%).

Cilji in kompetence:	**Objectives and competences:**
Predmet je del področja kvantna kemija, ki je uporaba metod kvantne fizike v kemiji in biokemiji. Cilj predmeta je, da se študent seznani z osnovnimi principi kvantne mehanike in uporabo le-teh ter novim načinom gledanja na svet mikrokozmosa. Specifične kompetence: osnovno znanje za samostojno teoretično delo na področju strukturne biokemije, strukture proteinov, membran itd.	**Learning outcomes**: Understanding the basic principles of quantum mechanics and the use of these principles in learning the new perspectives of looking at the micro cosmos. **Competence**s: Ability to interpret the atomic structure and the structure of simple molecules. Directing students to independent theoretical work.

Predvideni študijski rezultati:	**Intended learning outcomes:**
Znanje in razumevanje Študent se pri predmetu nauči osnov kvantne mehanike, navadi se na abstraktno razmišljanje (marsikateri pojav nima klasične razlage), spozna teoretično ozadje biokemijskih principov, nauči se vrednotiti rezultate teoretičnih računov. Spozna povezavo med klasično in kvantno fiziko in vzroke strukture biološko pomembnih molekul ter kje je potrebno uporabiti kvantno in kje je dovolj klasična fizika. Uporaba Poznavanje principov, ki jih posreduje ta predmet, je nujna osnova za vse teoretične študije v biokemiji. Študent se spozna z enačbami, s katerimi lahko obravnava atome, molekule in molekulske sisteme, rezultati katerih pa so fizikalno-kemijske količine, ki jih lahko izmerimo. Refleksija Študent si pridobi občutek, da se obnašanja zelo majhnih (kvantnih) delcev ne da vedno predstavljati s pojmi iz vsakodnevnega življenja in se navadi abstraktnega gledanja. Nauči se tudi, kje je dovoljeno obravnavanje sistemov s klasično fiziko. Prenosljive spretnosti	Knowledge and Comprehension The student learns the basics of quantum mechanics and abstract thinking, gets to know the theoretical basis for the biochemistry principles and learns to assess the theoretical results. The student discovers the correlation between classical and quantum physics, and the reasons for the structure of the biologically important molecules. Application The knowledge of the principles of this subject is the basics for all the theoretical studies in the biochemistry. The student gets familiar with the equations that describe the properties of atoms and molecules, resulting in the physical chemistry properties of the systems. Analysis The students learn the abstract thinking process, realizing that the quantum systems do not have an analogy in the everyday life. The students get to know where the quantum mechanics needs to be used in the place of classical physics. Skill-transference Ability The students learn to recognize the problem, to formulate it in the mathematical language, and to

Pri predmetu se študenti naučijo prepoznavati problem, ga rešiti s pomočjo katerega od komercialnih računalniških programov in na koncu interpretirati rezultate. Poseben poudarek je na kritičnem ovrednotenju dobljenih rezultatov. Naučijo se uporabe domače in tuje literature ter podajanja zaključenega dela v pisni obliki.	interpret the results. Special attention is paid to critical assessment of the obtained results. They learn how to use the literature and to present a written report.

Metode poučevanja in učenja:	**Learning and teaching methods:**
Predavanja Seminar (računske naloge iz predelane snovi)	- Lectures - Seminars (Problem solving)

Načini ocenjevanja:	**Delež/Weight**	**Assessment:**
Pisni (nadomestita ga lahko dva pozitivno ocenjena kolokvija) in ustni izpit.		Written (can be substituted with two positively graded partial tests) and oral exam.

Reference nosilca/Lecturer's references:

- **HRIBAR, Barbara**, DILL, Ken A., VLACHY, Vojko. Receptacle model of salting-in by tetramethylammonium ions. J. phys. chem., B Condens. mater. surf. interfaces biophys., 2010, vol. 114, no. 46, str. 15085-15091
- LUKŠIČ, Miha, URBIČ, Tomaž, **HRIBAR, Barbara**, DILL, Ken A. Simple model of hydrophobic hydration. J. phys. chem., B Condens. mater. surf. interfaces biophys., 2012, vol. 116, no. 21, str. 6177-6186
- JARDAT, Marie, **HRIBAR, Barbara**, DAHIREL, Vincent, VLACHY, Vojko. Self-diffusion and activity coefficients of ions in charged disordered media. J. chem. phys., 2012, vol. 137, no. 11, art. no. 114507 (9 str.)

PRAKTIČNO USPOSABLJANJE

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Praktično usposabljanje
Course title:	Industrial practice
Članica nosilka/UL Member:	UL FKKT

Študijski programi in stopnja	Študijska smer	Letnik	Semestri	Izbirnost
Biokemija, prva stopnja, univerzitetni	Ni členitve (študijski program)	3. letnik		izbirni
Kemija, prva stopnja, univerzitetni	Ni členitve (študijski program)	2. letnik, 3. letnik		izbirni

Univerzitetna koda predmeta/University course code:	0086921
Koda učne enote na članici/UL Member course code:	PRUSP

Predavanja /Lectures	Seminar /Seminar	Vaje /Tutorials	Klinične vaje /Clinical tutorials	Druge oblike študija /Other forms of study	Samostojno delo /Individual student work	ECTS
				150		5

Nosilec predmeta/Lecturer:	doc. dr. Martin Gazvoda
Vrsta predmeta/Course type:	izbirni/elective
Jeziki/Languages:	Predavanja/Lectures: Slovenščina; Vaje/Tutorial: Slovenščina

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

Vsebina:	Content (Syllabus outline):
Pri praksi se študenti seznanijo z zahtevnostjo in kompleksnostjo vodenja industrijskih procesov. Spoznajo, da je za uspešno in varno delo v industriji osnovni pogoj natančno poznavanje vseh faz procesa in podrobna kemijska analiza in druga karakterizacija surovin, intermediatov, procesnih tokov in končnih produktov, kot tudi celovita analiza njegovega delovanja. Uspešnost procesa je pogojena z mnogo dejavniki in za njegovo varno obratovanje je potrebno tako optimalno delovanje posameznih procesnih operacij kot tudi usklajeno delovanje sistema kot celote.	Through practical work students learn about the complexity of running a chemical process, the importance of thorough understanding of all phases of a process, detailed chemical analysis of raw materials, intermediates, process flows, and final products, and comprehensive analysis of production. Since a successful operation depends on numerous factors, it is necessary to provide optimal performance of process operations and the system as a whole. The program of practical training is adapted to a particular workplace or a job. Students can carry out practice in the following fields: • introduction to a job of a chemist,

Vsebina prakse se prilagaja konkretnemu mestu kjer se opravlja. Področja na katerih študent lahko opravlja prakso so: - uvajanje v delo na poklicnem področju, - spoznavanje s tehnološkim procesom in industrijsko proizvodnjo, - sodelovanje pri raziskovalno razvojnih nalogah in planiranju ter načrtovanju izdelkov, - nadzor proizvodnega procesa, - vhodna in izhodna kontrola kvalitete surovin in produktov, - instrumentalna analitika v raziskovalnem in kontrolnem laboratoriju, - aktivnosti v zvezi z varovanjem okolja in zagotavljanjem varnosti, - vzdrževanje aparatov, merilnih in regulacijskih sistemov.	• learning about a technological process or industrial production, • R&D projects and product planning, • production process control, • input and output quality control of raw materials and products, • instrumental analyses in a research or control laboratory, • environmental protection, safety at work. • maintenance of instruments, measuring and regulation systems.

Temeljna literatura in viri/Readings:

Nabor literature bo študent dobil na mestu opravljanja prakse oziroma jo lahko dobi tudi v knjižnici UL FKKT.

Since the practical training is individually orientated the literature will be provided on the site.

Cilji in kompetence:	**Objectives and competences:**
Namen prakse je omogočiti študentom preverjanje posredovanih teoretičnih znanj v okolju v katerem bodo delovali po zaključku študija ter jih nadgradili z znanji, ki so značilna za industrijsko tehnološko okolje in jih ni možno dobiti na šoli. Praksa poteka v povezavi študent – mentor v podjetju ali inštituciji – mentor na fakulteti. Praktično usposabljanje uvajanja študente v praktično delo in s tem spoznavanje strokovne narave dela ter aktualnih problematik v laboratoriju, industrijski proizvodnji in drugod.	The purpose is to verify theoretical knowledge in practice, and to gain experience by working in an industrial environment. Practical training will run under the mentorship of a company and university mentor. Competences: Acquisition of practical skills, training for independent work in genuine professional environment (laboratory, industry, etc.)

Predvideni študijski rezultati:	**Intended learning outcomes:**
Znanje in razumevanje Študent se pri opravljanju praktičnega dela usposobi za povezovanje teoretičnih in praktičnih znanj, ki jih je pridobil pri različnih predmetih med študijem z dejanskimi pogoji v praksi, tj. analiznih laboratorijih in laboratorijih za kontrolo kvalitete, industrijskih obratih. Študent spozna način reševanja posameznega problema, se seznani s tehnološko-tehničnimi parametri, se nauči strokovne komunikacije z drugim člani tima. Uporaba Praktično usposabljanje razvija pri študentu: sposobnost prenosa teoretičnih znanj na reševanje konkretnih problemov, predstavi sodoben pristop k reševanju inženirskih problemov, razvija sposobnost za vključevanje v skupinsko delo, sposobnost komuniciranja s sodelavci in strokovnjaki drugih disciplin, kar mu omogoča sodelovanje pri	Knowledge and Comprehension Experience and knowledge of real situations in industrial environment. Application and practice of gained theoretical knowledge in solving practical tasks. Gaining importance of safety measures in industrial environment. Becoming familiar with organization strategies and administration protocols in real working environment. Application Student can use and apply his practical knowledge and abilities during his further education and professional development. Analysis Student is capable critically compare and evaluate different approaches for problem solving in laboratory as well as in industrial on-line environment. Skill-transference Ability

multidisciplinar-nih projektih in mu razvija profesionalno etično in okoljsko odgovornost. Refleksija Študent je sposoben kritično analizirati in primerjati različne pristope pri reševanju problemov tako na laboratorijskem kot tudi industrijskem nivoju. Prenosljive spretnosti Usposabljanje v konkretnem delovnem okolju mu razvija sposobnost za analitično naravoslovno tehnično vrednotenje dogajanj v praksi.	Mastered practical abilities can student use in further professional activities. He is capable of transferring his theoretical knowledge to new working environments. Student develops analytical approach to solve individual problems.

Metode poučevanja in učenja:	**Learning and teaching methods:**
Praksa poteka v izbranem podjetju oziroma drugi inštituciji s katerim je vnaprej podpisana tripartitna pogodba, ki določa pogoje usposabljanja. V podjetju vodi delo študenta delovni mentor, ki mora imeti najmanj stopnjo izobrazbe SOK 7 kemijske ali sorodne smeri in vsaj dve leti delovnih izkušenj.	Practical training is taking place in selected corporations or related working environments and is organised individually. For each student is provided industrial tutor. Tutor responsibility and obligation are to guide the student during the practical training.

Načini ocenjevanja:	**Delež/Weight**	**Assessment:**
Študent odda dnevnik in sumarno poročilo o praksi. Potrdilo o opravljenem praktičnem usposabljanju z oceno delovnega mentorja v podjetju in fakultetnega mentorja je osnova za oblikovanje ocene. Ocenjevalna lestvica: opravljeno - neopravljeno		Pass/Fail

Reference nosilca/Lecturer's references:

M. Gazvoda, M. Virant, B. Pinter, J. Košmrlj: Mechanism of copper-free Sonogashira reaction operates through palladium-palladium transmetallation. Nature Communications 2018, 9:4814.
M. Gazvoda, M. Krivec, Z. Časar, J. Košmrlj: En route to 2-(cyclobuten-1-yl)-3-(trifluoromethyl)-1H-indole. J. Org. Chem. 2018, 83, 2486–2493.
M. Gazvoda, M. Virant, A. Pevec, D. Urankar, A. Bolje, M. Kočevar, J. Košmrlj: A mesoionic bis(Py-tzNHC) palladium(II) complex catalyses "green" Sonogashira reaction through an unprecedented mechanism. Chem. Commun. 2016, 52, 1571−1574.
D. Hirose, M. Gazvoda, J. Košmrlj, T. Taniguchi: Advances and mechanistic insight on catalytic Mitsunobu reaction using recyclable azo reagents. Chem. Sci. 2016, 7, 5148−5159.
M. Gazvoda, K. Höferl-Prantz, R. Barth, W. Felzmann, A. Pevec, J. Košmrlj: Completely stereocontrolled aldol reaction of chiral ß-amino acids. Org. Lett. 2015, 17, 512−515.

RASTLINSKA BIOKEMIJA

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Rastlinska biokemija
Course title:	Plant Biochemistry
Članica nosilka/UL Member:	UL FKKT

Študijski programi in stopnja	Študijska smer	Letnik	Semestri	Izbirnost
Biokemija, prva stopnja, univerzitetni (od študijskega leta 2023/2024 dalje)	Ni členitve (študijski program)	3. letnik		izbirni

Univerzitetna koda predmeta/University course code:	0088101
Koda učne enote na članici/UL Member course code:	BKSI3

Predavanja /Lectures	Seminar /Seminar	Vaje /Tutorials	Klinične vaje /Clinical tutorials	Druge oblike študija /Other forms of study	Samostojno delo /Individual student work	ECTS
30	15	30 LV			75	5

Nosilec predmeta/Lecturer:	prof. dr. Kristina Gruden
Vrsta predmeta/Course type:	izbirni strokovni/elective professional
Jeziki/Languages:	Predavanja/Lectures: Angleščina, Slovenščina Vaje/Tutorial: Angleščina, Slovenščina

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

Vsebina:	Content (Syllabus outline):
Uvod (Rastlinski sistem, morfologija rastlin, rast. celica). Posebnosti rastlinskega metabolizma: Glioksilatni ciklus, glukoneogeneza. Na cianid rezistentna dihalna veriga. Fotosinteza Ogljikovi hidrati. Monosaharidi, sladkorni alkoholi, kisline, polisaharidi (heteroglikani, homoglikani): škrob, komponente in zgradba celične stene. Prehranski vidiki rastlinskih OH: vlaknine (pektini, inulin, celuloza), rezistentni škrob. Zdravilne rastline s sluzmi. Tehnološko pomembni OH iz rastlin (agar, alginska kislina, celuloza) Lipidi, derivati maščobnih kislin (trigliceridi, fosfolipidi, voski, suberin), kemizem, fiziologija, metabolizem, biokemija, esencielne maščobne kisline, prehranski viri lipidov, vrste lipidov v rastlinah. Vpliv	Introduction (Plant systematics, plant morphology, plant cell). Special features of plant metabolism: Glioksilatn cycle, gluconeogenesis. cyanide resistant respiratory chain. Photosynthesis Carbon hydrates. Monosaccharides, sugar alcohols, acids, polysaccharides (heteroglikans, homoglikans): starch, components and structure of cell wall. Nutritional aspects of vegetable carbon hydrates: fibers (pectin, inulin, cellulose), resistant starch. Lipids, fatty acid derivatives (triglycerides, phospholipids, waxes, suberin), physiology, metabolism, biochemistry, essential fatty acid, nutritional sources of lipids, types of lipids in plants. Influence of lipids (with saturated, mono unsaturated, poly unsaturated, omega-3, omega-6) on health.

lipidov (z nasičenimi, enkrat nenasičenimi, večkrat nenasičenimi, omega-3, omega-6) na zdravje Fenoli: fenilpropanoidi, lignani, lignin, flavonoidi: biosintezne poti (šikimatna pot), glavne skupine, biološka aktivnost tanini, poliketidi (antrakinoni, benzodiantroni), Spojine z žveplom: česen, hren Terpeni: eterična olja, steroidi, saponini; biosintezne poti (mevalonatna in Rohmerjeva biosintezna pot), glavne skupine, biološka aktivnost Spojine z dušikom, alkaloidi: biosintezne poti, glavne skupine, biološka aktivnost. Prehrambeni vidiki rastlin: metabolizem dušika, aminokislin in proteinov, ostale komponente prehrane bodo predstavljene v zadnjem sklopu Rastlinski hormoni in tkivne kulture: metabolizem rastlinskih hormonov, ki je ena od bistvenih drugačnosti rastlin glede na živali. Seznanili se bodo s tehnologijo rastlinskih tkivnih kultur, katere bistvo je poznavanje hormonalnega metabolizma rastlin in primeri uporabe v rastlinskih tkivnih kultur biotehnologiji. Interakcije med organizmi in odgovor rastline na stres: Rastline kot sesilni organizmi imajo razvite specifične mehanizme obrambe pred napadalci. Seznanili se bomo s simbiontskimi reakcijami, patogenimi interakcijami, inkompatibilnimi interakcijami in s pojavom alelopatije, vsa prepoznavanja na molekularno biokemijskem nivoju. Transgene rastline in njihova uporaba: Seznanili se bomo s tehnologijo priprave transgenih rastlin, možnimi načini uporabe tehnologije in diskutirali o prednostih in slabostih uporabe ter kako ocenimo varnost transgenih rastlin.	Phenols: phenilpropanoids, lignans, lignin, flavonoids: biosynthetic pathway (shikimatna pathway), main groups, biological activity tanins, poliketids (antracinons, bensodiantrons), Compounds with sulphur: garlic, horseradish Terpenes: essential oils, steroids, saponins; biosynthtic pathway (mevalonat and Rohmers biosynthtic pathway), main groups, biological activity Compounds with nitrogen, alkaloids: biosynthtic pathway, main groups, biological activity. Nutritional value of plants: metabolism of nitrogen, amino acids and proteins, the other nutritional aspects will be presented in last part of the course. Plant hormones and plant tissue cultures: Students will get acquainted with the metabolism of plant hormones, one of substantially different aspects of plant biochemistry compared to animal one. The technique of plant tissue cultures, which is closely connected with the knowledge of the metabolism of hormones, and different aspect of its application in biotechnology will be discussed. Interactions and defense response: Plants have developed specific mechanisms for communication with other organisms and environment. Symbiotic, pathological and incompatible interactions will be discussed from biochemical point of view as well as some examples of allelopathy. Transgenic plants: Technology of plant transformation and regeneration, example of transgenic plants approved for use on the market and the future use of the technology, pros and cons of technology, risk assessment of transgenic plant.

Temeljna literatura in viri/Readings:

- J. Bruneton: Pharmacognosy, phytochemistry, medicinal plants, Lavoisier publishing 1999.

Dodatna literatura:

- T.W.Goodwin, E.Mercer: Introduction to plant biochemistry, 2nd ed. Pergamon Press, Oxford, 1988
- Jones,Ougham, Thomas, Waaland: The molecular life of plants, 2013
- Chrispeels, Sadava: Plants, Genes and Crop Biotechnology 2003

Cilji in kompetence:	**Objectives and competences:**
Predmet razširja znanje splošne biokemije na procese izgradnje in metabolizna snovi, ki so specifične za rastline ter pojasnjuje vlogo teh snovi pri odzivu rastline na stresne dejavnike; nakazuje pa tudi možnosti uporabe tega znanja v farmaciji in moderni biotehnologiji. Sposobnost uporabe znanj, zlasti sposobnost reševanja problemov; ter sposobnost analize gradiva in oblikovanje koncepta.	The course extends the previous knowledge of biochemistry to plant specific metabolic processes. Explains the role of plant secondary metabolites in interactions with other organisms. The applicability of this knowledge in pharmacy and biotechnology is presented. The competencies of the students completing this course successfully would include understanding of basic concepts n plant biochemistry, application of knowledge in case studies, ability to study related literature and form basic conclusions.

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

Znanje in razumevanje Poznavanje biosinteze rastlinskih metabolitov in njihove biološke funkcije, ter uporabnosti v farmaciji in biotehnologiji. Uporaba Reševanje praktičnih nalog. Refleksija Zahteva se razumevanje teorije in izkušenj v praksi, kritično ovrednotenje skladnosti med teoretičnimi načeli in praktičnim ravnanjem. Prenosljive spretnosti Prepoznavanje funkcionalnih skupin v formulah spojin. Samostojna uporaba literature in interneta za reševanje strokovnih nalog.	Knowledge and Comprehension Understanding of plant metabolism with applications in pharmacy and biotechnology Application Solving practical problems Analysis Understanding of theory and praxis is required, together with critical thinking when solving practical problems Skill-transference Ability Ability to recognise functional groups in plant specific compounds. Independent problem oriented literature and web search

Metode poučevanja in učenja:	**Learning and teaching methods:**
predavanja, vaje, vodene individualne naloge, sodelovalno učenje / poučevanje.	lectures, lab practice, individual

Načini ocenjevanja:	**Delež/Weight**	**Assessment:**
Pisni izpit Ocene: pozitivno 6-10; negativno 1-5.		Written assessment Grades: positive 6-10,negative 1-5

Reference nosilca/Lecturer's references:

TAVČAR BENKOVIĆ, Eva, ŽIGON, Dušan, FRIEDRICH, Miha, PLAVEC, Janez, **KREFT, Samo**. Isolation, analysis and structures of phototoxic fagopyrins from buckwheat. Food chemistry, vol. 143, 2014, str. 432-439

TAVČAR BENKOVIĆ, Eva, GROHAR, Tina, ŽIGON, Dušan, ŠVAJGER, Urban, JANEŠ, Damjan, **KREFT, Samo**, ŠTRUKELJ, Borut. Chemical composition of the silver fir (Abies alba) bark extract Abigenol and its antioxidant activity. Industrial crops and products, vol. 52, 2014, str. 23-28,

KOČEVAR GLAVAČ, Nina, **KREFT, Samo**. Excretion profile of glycyrrhizin metabolite in human urine. Food chemistry, 2012, vol. 131, str. 305-308.

BAEBLER, Špela, KREČIČ STRES, Hana, ROTTER, Ana, KOGOVŠEK, Polona, CANKAR, Katarina, KOK, Esther, **GRUDEN, Kristina**, KOVAČ, Maja, ŽEL, Jana, POMPE NOVAK, Maruša, RAVNIKAR, Maja. PVY[supra]NTN elicits a diverse gene expression response in different potato genotypes in the first 12 h after inoculation.Molecular plant pathology, ISSN 1464-6722, 2009, vol. 10, no. 2, str. 263-275.

BAEBLER, Špela, STARE, Katja, KOVAČ, Maja, BLEJEC, Andrej, PREZELJ, Nina, STARE, Tjaša, KOGOVŠEK, Polona, POMPE NOVAK, Maruša, ROSAHL, S., RAVNIKAR, Maja, **GRUDEN, Kristina**. Dynamics of responses in compatible potato - potato virus Y interaction are modulated by salicylic acid. PloS one, ISSN 1932-6203, 2011, vol. 6, issue 12, str. 1-12

MILJKOVIĆ, Dragana, STARE, Tjaša, MOZETIČ, Igor, PODPEČAN, Vid, PETEK, Marko, WITEK, Kamil, DERMASTIA, Marina, LAVRAČ, Nada, **GRUDEN, Kristina**. Signalling network construction for modelling plant defence response. PloS one, ISSN 1932-6203, 2012, vol. 7, no. 12, str. e51822-1e51822-18.

SPEKTROSKOPSKE METODE V BIOKEMIJI

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Spektroskopske metode v biokemiji
Course title:	Spectroscopic Methods in Biochemistry
Članica nosilka/UL Member:	UL FKKT

Študijski programi in stopnja	Študijska smer	Letnik	Semestri	Izbirnost
Biokemija, prva stopnja, univerzitetni	Ni členitve (študijski program)	3. letnik	1. semester	obvezni

Univerzitetna koda predmeta/University course code:	0072093
Koda učne enote na članici/UL Member course code:	BK130

Predavanja /Lectures	Seminar /Seminar	Vaje /Tutorials	Klinične vaje /Clinical tutorials	Druge oblike študija /Other forms of study	Samostojno delo /Individual student work	ECTS
30	10	35 LV			75	5

Nosilec predmeta/Lecturer:	prof. dr. Janez Košmrlj
Vrsta predmeta/Course type:	obvezni/mandatory
Jeziki/Languages:	Predavanja/Lectures: Slovenščina Vaje/Tutorial: Slovenščina

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

Vsebina:	Content (Syllabus outline):
Splošen uvod v spektroskopijo: elektromagnetno valovanje in interakcija z materijo, energetska stanja, prehodi med njimi, resonančni pogoj, absorpcija in emisija energije. Masna spektrometrija: princip delovanja masnega spektrometra, izotopska sestava, fragmentacije, ionizacijske metode, MS visoke ločljivosti, masni spektri spojin z velikimi molekulskimi masami. UV/Vis spektroskopija: vibracijski in elektronski nivoji molekule, prehodi med njimi, UV/Vis spektroskopija, polarimetrija, kirooptične metode (optična rotacijska disperzija (ORD) in cirkularni dihronizem (CD)), fluorescenca (emisijski, ekscitacijski spekter, korekcija spektra, Stokesov premik, absolutni in relativni kvantni izkoristek).	General introduction to spectroscopy: Physical background of spectroscopic methods (electromagnetic radiation, interaction of light with matter, energy levels and transitions between them, absorption and emission of energy). Mass spectrometry (principles of measuring molecular mass, ionization techniques, ion mass analysis, low- and high-resolution MS, mass spectra of molecules with high molecular weight). UV/Vis spectroscopy: vibration and electron levels, transitions, UV/Vis spectroscopy, polarimetry, optical rotary dispersion (ORD) and circular dichroism (CD), fluorescence (emission, excitation spectrum, correction for PMT response, Stokes shift, absolute and relative quantum yield.

Vibracijska in rotacijska spektroskopija: Ramanska, IR in mikrovalovna spektroskopija, uporaba. Nuklearna magnetna resonanca (NMR): Osnove NMR eksperimenta, kemijski premik, multipliciteta in sklopitvena konstanta, integral, primerjava zveznega in pulznega načina snemanja NMR spektrov, osnove modernih 1D in 2D NMR tehnik. Elektronska paramagnetna resonanca (EPR): Principi EPR, hiperfina struktura, primeri uporabe EPR. Metode strukturnega in funkcionalnega slikanja: MRI (Magnetic Resonance Imaging), slikanje strukture organov in tkiv, principi delovanja, pozitronska emisijska tomografija (PET), principi metode, uporaba PET v raziskavah biokemijskih procesov v živih organizmih, konfokalna mikroskopija, principi, uporaba. Vaje: Urjenje v uporabi spektrometrov in interpretaciji spektrov za določanju struktur modelnih molekul in pri vsakodnevnem delu v (biokemijskem) laboratoriju.	Vibration and rotation spectroscopy: Raman, IR and microwave spectroscopy, application in biochemistry. Nuclear magnetic resonance (NMR): basics of NMR experiments, chemical shift, homonuclear and heteronuclear coupling, integration, continuous wave versus pulse experiments, basics of modern 1D and 2D NMR methods. Electron paramagnetic resonance (EPR): principles of EPR experiments, hyperfine splitting, application. Methods of structural and functional imaging: Magnetic Resonance Imaging (MRI), imaging of tissues and organs, principles and application, positron emission tomography (PET), principles and application, confocal optical fluorescence microscopy, principles and application. Practical spectroscopy: sample preparation, basic instrumental procedures, one-dimensional experiments (1H, 13C, X), two-dimensional experiments (COSY, TOCSY, HMQC, HMBC).

Temeljna literatura in viri/Readings:

- M. Hesse, H. Meier, B. Zeeh, Spectroscopic Methods in Organic Chemistry, Thieme, 2008; 453 str.

Dodatna literatura / Additional reading:

- G.M. Lampman, D. L. Pavia, G. S. Kriz, J. R. Vyvyan, Spectroscopy, Brooks/Cole 2010 Int. Ed.; 656 str.
- A. Petrič, Spektroskopske metode v biokemiji (interno študijsko gradivo), UL FKKT, Ljubljana, 2012 (167 str.).

Cilji in kompetence:	**Objectives and competences:**
Cilji: Namen predmeta je posredovati študentu osnove in ga izuriti v uporabi spektroskopskih metod s posebnim poudarkom na uporabi v biokemiji. Absolvent predmeta je sposoben načrtovati uporabo in izbiro ter interpretirati rezultate spektroskopskih metod pri reševanju strokovnih problemov na področju biokemije. **Kompetence:** Sposobnost načrtovanja, izvedbe in interpretacije spektroskopskih eksperimentov za uporabo v biokemiji.	**Objectives**: To teach students theory and practice of spectroscopic methods with the emphasis on the application in biochemistry. After the course, the student is capable of designing and selection of appropriate experiments in solving spectroscopic problems in the field of biochemistry. **Competences**: Ability to design, perform, and interpret spectroscopic experiments for biochemical applications.

Predvideni študijski rezultati:	**Intended learning outcomes:**
Znanje in razumevanje Razumevanje osnovnih principov spektroskopskih in spektrometričnih tehnik, prenosa energije elektromagnetnega valovanja na materijo in izkoriščanja tega efekta za določanje strukture molekul. Uporaba Uporaba naučenih principov oziroma zakonitosti za analizo oziroma določanje strukture molekul s pomočjo spektroskopskih in spektrometričnih tehnik. Refleksija	Knowledge and Comprehension Understanding the basic principles of spectroscopic methods, interaction of matter and electromagnetic waves, and utilization of this interaction in molecular structure elucidation. Application Student will be able to apply the acquired knowledge in solving analytical problems. Analysis Being aware that data, acquired by spectroscopic methods contain information on molecular structure but they must be critically evaluated. All measured

Zavedanje, da sicer podatki, pridobljeni s spektroskopskimi ali spektrometričnimi metodami, vsebujejo informacije o strukturi molekul, da pa je potrebno te podatke kritično uporabiti. Rezultat spektroskopske analize mora ustrezati vsem pridobljenim spektroskopskim lastnostim hkrati. Prenosljive spretnosti Pri predmetu se študenti z reševanjem znanih in neznanih problemov izurijo v uporabi spektroskopskih in spektrometričnih tehnik, analitičnega mišljenja in uporabe literaturnih virov.	spectroscopic characteristics must uniformly support the proposed solution of the problem. Skill-transference Ability Using known and unknown examples the student is trained in utilization of spectroscopic methods, analytical thinking and using literature sources.

Metode poučevanja in učenja:	**Learning and teaching methods:**
Predavanja, seminarske in laboratorijske vaje.	Lectures and problem solving seminars.

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

Reference nosilca/Lecturer's references:

1) A. Demšar, **J. Košmrlj**, S. Petriček: Variable-temperature nuclear magnetic resonance spectroscopy allows direct observation of carboxylate shift in zinc carboxylate complexes. J. Am. Chem. Soc. 2002, 124, 3951–3958.
2) J. Košmrlj, S. Kafka, I. Leban, M. Grad: Formation and Structure Elucidation of Two Novel Spiro[2H-indol]-3(1H)-ones, Magn. Reson. Chem. 2007, 45, 700–704.
2) B. Pinter, A. Demšar, D. Urankar, F. De Proft, **J. Košmrlj**: Conformational Fluxionality in a Palladium(II) Complex of Flexible Click Chelator 4-phenyl-1-(2-picolyl)-1,2,3-triazole. A dynamic NMR and DFT study. Polyhedron 2011, 30, 2368–2373.
4) K. Proisl, S. Kafka, D. Urankar, M. Gazvoda, R. Kimmel, **J. Košmrlj**: Fischer indolisation of N-(α-ketoacyl)anthranilic acids into 2-(indol-2-carboxamido)benzoic acids and 2-indolyl-3,1-benzoxazin-4-ones and their NMR study. Org. Biomol. Chem. 2014, 12, 9650–9664.
5) M. G. Sommer, P. Kureljak, D. Urankar, D. Schweinfurth, N. Stojanović, M. Bubrin, M. Gazvoda, M. Osmak, B. Sarkar, **J. Košmrlj**: Combining [Arene–Ru] with Azocarboxamide to Generate a Complex with Cytotoxic Properties. Chem. Eur. J. 2014, 20, 17296–17299.

SPLOŠNA BIOLOGIJA

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Splošna biologija
Course title:	General biology
Članica nosilka/UL Member:	UL FKKT

Študijski programi in stopnja	Študijska smer	Letnik	Semestri	Izbirnost
Biokemija, prva stopnja, univerzitetni	Ni členitve (študijski program)	1. letnik	1. semester	obvezni

Univerzitetna koda predmeta/University course code:	0072065
Koda učne enote na članici/UL Member course code:	BK105

Predavanja /Lectures	Seminar /Seminar	Vaje /Tutorials	Klinične vaje /Clinical tutorials	Druge oblike študija /Other forms of study	Samostojno delo /Individual student work	ECTS
40	15	20 LV			75	5

Nosilec predmeta/Lecturer:	doc. dr. Nada Žnidaršič
Vrsta predmeta/Course type:	obvezni/mandatory
Jeziki/Languages:	Predavanja/Lectures: Slovenščina Vaje/Tutorial: Slovenščina

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

Vsebina:	Content (Syllabus outline):
Biologija – veda o življenju, veda o živih organizmih, osnove zgradbe celic: značilnosti živih organizmov; kemijska sestava in zgradba prokariontskih in evkariontskih celic (rastline, glive, živali); osnove ultrastrukture in funkcij celic; osnove mikroskopskih tehnik v biologiji. **Tkiva in organi živali in rastlin:** raznolikost celic; povezovanje celic v tkiva; osnove histološke zgradbe in funkcij tkiv živali – epitelna tkiva, vezivna tkiva, mišična tkiva in živčno tkivo. Organski sistemi živali. Rastlinska tkiva in organi. **Osnovni mehanizmi razmnoževanja, razvoja in rasti živali in rastlin:** razmnoževanje in razvoj živali; primarna in sekundarna rast rastlin; razmnoževanje rastlin.	**Biology – science that studies life and living organisms, basics of cell structure:** characteristics of living organisms; composition and structure of prokaryotic and eukaryotic cells (animal, plant and fungi); basic concepts of cell ultrastructure and function; fundamentals of microscopic techniques in biology. **Tissues and organs of animals and plants:** diversity of cells; organisation of tissues; basic histological characteristics and functions of animal tissues – epithelia, connective tissues, muscle tissues and nerve tissue. Animal organ systems. Plant tissues and plant organs. **Basic mechanisms of reproduction, growth and development of animals and plants:** reproduction and development of animals; primary and secondary

Organizmi in okolje: interakcije mikroorganizmov, rastlin in živali med seboj in z okoljem ter antropogeni vplivi na okolje.	growth in plants; plants reproduction. **Organisms and environment: i**nteractions of microorganisms, plants and animals with environment and anthropogenic influences.

Temeljna literatura in viri/Readings:

- Splošna zoologija (Štrus, J., Študentska založba, Ljubljana)
- Biologija živalske celice (Štrus, J., Kostanjšek, R., Študentska založba, Ljubljana)
- Histology: A text and atlas (Ross, M.H., Pawlina, W., Lippincot Williams & Wilkins) (samo izbrani odseki) ali primerljiv histološki učbenik (atlas)
- Essential cell biology (Alberts in sod., Garland Science, Taylor & Francis group) (samo izbrani odseki)
- Dermastia M. (2007). Pogled v rastline. NIB. ISBN 978-961-90363-7-2
- Intergated Principles of Zoology – izbrana poglavja (Hickman in sod., McGrew-Hill Education, New York)
- Campbell, N.A, J.B. Reece, E.J. Simon. Essential biology with physiology (Pearson International Edition, San Francisco)
- izročki predavanj za pregled vsebine
- izbrana aktualna poglavja in pregledni znanstveni članki s področja biologije za seminarje

Cilji in kompetence:	**Objectives and competences:**
Cilj predmeta je poznavanje osnovnih zakonitosti življenja, načel in pojmov v biologiji. Študent spozna osnovne značilnosti živih sistemov, zgradbo in delovanje celic, tkiv, organov in povezovanje v organizem. Spozna enotnost in raznolikost živega sveta, interakcije med organizmi in njihovo povezanost z neživim svetom. Študent pridobi osnovne spretnosti za delo z organizmi in se seznani z osnovnimi metodami dela v biologiji. Spoznava strokovno terminologijo in je zmožen iskati in uporabljati ustrezne vire za pridobivanje in poglabljanje biološkega znanja. Na osnovi poznavanja zgradbe je študent zmožen primerjati in razložiti delovanje različnih organizmov.	Students will get basic knowledge on structure and dynamics of animal and plant cells, tissues and organs. Students get practical skills in light microscopy and methods of samples preparation. They will understand the importance of cell biology and histology in research and applications in diagnostics and industry, understand the importance of cell and tissue cultures in research and applications. They will be able to use and combine different informational sources. Students will understand basic concepts and principles in biology. They become familiar with structure of main organic systems in animals and plants and can interpret their function. They get insight into inheritance, reproductive and developmental processes of animals and plants and master basic concepts in ecology. The students get basic on animal reproduction and development and are able to link different levels of biological organization.

Predvideni študijski rezultati:	**Intended learning outcomes:**
Znanje in razumevanje Razumevanje osnovnih bioloških procesov, ki vzdržujejo življenje. Poznavanje zgradbe in delovanja celic enoceličnih organizmov ter celic, tkiv in organov večceličnih organizmov. Poznavanje osnovne zgradbe in delovanja človeškega organizma. Razumevanje interakcij med organizmi in okoljem ter poznavanje vplivov na okolje. Razumevanje pomena raznolikosti živih bitij za ohranjanje naravnega okolja. Uporaba Razlikovanje različnih tipov celic in tkiv. Vzdrževanje celic in tkiv v kulturi. Zmožnost uporabe metod za ločevanje, analizo in identifikacijo celic in tkiv. Poznavanje biologije osnovnih skupin rastlin in živali	Knowledge and Comprehension Basic knowledge on animal cell and tissue structure and understanding of basic biological concepts and principles of life. Understanding interactions between organisms and their environment. The significance of maintenance of biological diversity and nature conservation. Application Preparation of animal and plant cell and tissue samples for microscopy. Differentiation between different animal cell and tissue types. Knowledge of biology of different organisms and their interactions. Identification of basic animal types and their reproductive and developmental stages. Biology of

in njihove povezanosti. Poznavanje zgradbe in delovanja človeškega organizma, ki je osnova za razumevanje bolezenskih procesov. Zmožnost uporabe strokovne terminologije. Refleksija Na osnovi pridobljenih znanj o zgradbi in delovanju modelnih organizmov bo študent zmožen primerjati različne tipe organizmov in interpretirati njihove značilnosti ter medsebojno povezanost. Študent bo razumel osnovne genetske mehanizme in pomen spolnega razmnoževanja za raznolikost živih bitij. Spoznal bo občutljivost okolja za antropogene vplive in znal predvideti škodljive posledice. Prenosljive spretnosti Študent bo obvladal osnovne tehnike priprave bioloških preparatov za opazovanje zgradbe z različnimi tipi mikroskopov. Znal bo določiti osnovne tipe rastlinskih in živalskih organizmov. Poznal bo osnovno anatomijo človeka.	different animal groups and their role in different environments. Learning and usage of biological terminology. Analysis Understanding and comparing life at cellular and tissue levels; interpretation of cell structure of different organic systems in lower and higher animals and plants. Basic reproductive mechanisms and significance of sexuality for biodiversity. Understanding the sensitivity of the environment for anthropogenic influences and prediction of possible harmful effects. Skill-transference Ability Preparation of animal tissues for microscopy, observations by light microscopy, imaging and documenting histological samples, interpretation of cell ultrastructure, histology and organ structure in animals and plants; preparation of reports and proper use of literature and biological terminology.

Metode poučevanja in učenja:	**Learning and teaching methods:**
Predavanja, laboratorijske vaje, seminarji kot skupinsko in problemsko zasnovano delo. Študent pridobi praktične izkušnje pri laboratorijskem delu in jih dopolni s teoretičnim znanjem pri predavanjih in skupinsko predstavitvijo seminarjev iz aktualnih bioloških tem povezanih s teoretičnimi znanji pri predmetu. Znanje nadgrajuje s samostojnim študijem in z uporabo ustreznih študijskih in informacijskih virov.	Lectures, practical courses, seminars as team work and project based learning. Prevailing experience during practical work is upgraded by theoretical basis from lectures and presentation of seminars based on up-to date topics in biology. Upgrading knowledge in biology through individual student work using different study and information sources.

Načini ocenjevanja:	**Delež/Weight**	**Assessment:**
Opravljene vaje so pogoj za pristop k izpitu. Kolokvij iz laboratorijskih vaj 30 %	30,00 %	Practical work is prerequisite for written exam. Colloquium from practical work
Seminarska naloga	10,00 %	Seminar
Pisni izpit Ocene: pozitivno 6-10; negativno 1-5.	60,00 %	Written exam Grades: passed:6-10, failed 1-5

Reference nosilca/Lecturer's references:

ADEN, Saša, KOZOROG, Mirijam, ŠVIGELJ, Tomaž, POKLAR ULRIH, Nataša, ŽNIDARŠIČ, Nada, PODOBNIK, Marjetka, ANDERLUH, Gregor. Cholesterol enriched archaeosomes as a molecular system for studying interactions of cholesterol-dependent cytolysins with membranes. *The journal of membrane biology*, ISSN 0022-2631, 2018, vol. 251, iss. 3, str. 491-505, ilustr., doi: 10.1007/s00232-018-0018-y. [COBISS.SI-ID 4885880

BOGATAJ, Urban, MRAK, Polona, ŠTRUS, Jasna, ŽNIDARŠIČ, Nada. Ultrastructural differentiation of plasma membrane and cell junctions in the hindgut cells is synchronized with key developmental transitions in Porcellio scaber. *Arthropod structure & development*, ISSN 1467-8039, 2019, vol. 50, str. 78-93, ilustr., doi: 10.1016/j.asd.2019.04.004. [COBISS.SI-ID 5071439]

ŽNIDARŠIČ, Nada, MRAK, Polona, RAJH, Eva, ŽAGAR, Kristina, ČEH, Miran, ŠTRUS, Jasna. Cuticle matrix imaging by histochemistry, fluorescence, and electron microscopy. *Resolution & discovery : new beacon for the microscopy community*, ISSN 2498-8707, 2018, 8 str., [in press].https://akademiai.com/doi/abs/10.1556/2051.2017.00045, doi: 10.1556/2051.2018.00052. [COBISS.SI-ID 4679503]

SPLOŠNA KEMIJA

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Splošna kemija
Course title:	General chemistry
Članica nosilka/UL Member:	UL FKKT

Študijski programi in stopnja	Študijska smer	Letnik	Semestri	Izbirnost
Biokemija, prva stopnja, univerzitetni	Ni členitve (študijski program)	1. letnik	1. semester	obvezni

Univerzitetna koda predmeta/University course code:	0072066
Koda učne enote na članici/UL Member course code:	BK103

Predavanja /Lectures	Seminar /Seminar	Vaje /Tutorials	Klinične vaje /Clinical tutorials	Druge oblike študija /Other forms of study	Samostojno delo /Individual student work	ECTS
45	30				75	5

Nosilec predmeta/Lecturer:	prof. dr. Anton Meden, prof. dr. Iztok Turel
Vrsta predmeta/Course type:	obvezni/mandatory
Jeziki/Languages:	Predavanja/Lectures: Slovenščina Vaje/Tutorial: Slovenščina

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

Vsebina:	Content (Syllabus outline):
Uvod: utrjevanje in nadgradnja srednješolskega znanja – osnovne kemijske zakonitosti in njihova uporaba. **Zgradba atomov:** osnovni delci atoma, izotopi; model atoma vodika (kvalitativno): orbitale (kvantna števila, oblika, meje, orientiranost v prostoru); večelektronski atomi, izgradnja elektronske ovojnice (Hundovo pravilo, Paulijev princip); periodni sistem: lastnosti elementov v periodnem sistemu (radiji atomov in ionov, ionizacijske energije, elektronska afiniteta). **Kemijska vez:** ionska vez; kovalentna vez (nepolarna, polarna vez, dipolni moment, teorija valenčne vezi: principi teorije, resonanca, hibridizacija, geometrija molekul; teorija molekulskih orbital: principi teorije, delokalizirane MO);	**Introduction:** consolidation and upgrade of the secondary school knowledge – basic chemical principles and application thereof. **Structure of atoms:** atomic particles, isotopes; model of hydrogen atom (qualitative level): orbitals (quantum numbers, shapes, boundaries, orientation in space); multi-electron atoms, building of the electron shell (Hund rule, Pauli principle); Periodic Table, atomic properties (atomic radii, ionization energies, electron affinity). **Chemical bonding:** ionic bond, covalent bond (non-polar, polar, dipolar momentum, valence bond theory: principles, resonance, hybridization, molecular geometry; molecular orbital theory: principles, delocalized MO); electronegativity, structures of

elektronegativnost; strukture anorganskih molekul (strukturne formule in nomenklatura anorganskih spojin) **Agregatna stanja snovi in medmolekulske vezi:** plini, tekočine, trdne snovi; interakcije med molekulami (Van der Waalsove in vodikove vezi, vpliv teh vezi na lastnosti snovi). Struktura amorfnih in kristaliničnih trdnih snovi: ionski, kovalentni, kovinski in molekulski kristali, polprevodniki, tekoči kristali. **Disperzni sistemi:** prave in koloidne raztopine ter njihove lastnosti. **Kemijske reakcije:** kemijske reakcije in kemijske enačbe; energijske spremembe pri kemijskih reakcijah (standardne tvorbene in standardne reakcijske entalpije, Hessov zakon); ravnotežje kemijskih reakcij, Le Chatelierovo načelo; vplivi na hitrost kemijske reakcije, kataliza; ionske reakcije (ionska ravnotežja, topnost, topnostni produkt); protolitske reakcije (Brønstedova teorija kislin in baz, pH, indikatorji, titracija, vpliv ionov na protolitska ravnotežja); redoks reakcije(oksidacijsko število in urejanje redoks reakcij, galvanski členi, elektroliza). **Koordinacijske spojine:** stereokemijske značilnosti koordinacijskih spojin (izomerija); kemijska vez v koordinacijskih spojinah; vpliv elektronske konfiguracije na magnetne in optične lastnosti koordinacijskih ionov (kvalitativno).	inorganic compounds (structural formulas and nomenclature of inorganic compounds). **States of matter and intermolecular bonds:** gases, liquids, solids, intermolecular interactions (Van der Waals and hydrogen bonds, influence of these bonds on properties of matter). Structure of amorphous and crystalline compounds: ionic, covalent and molecular crystals, semiconductors, liquid crystals. **Disperse systems:** true and colloidal solutions and their properties. **Chemical reactions:** chemical reactions and chemical equations: energy changes at chemical reactions (standard enthalpies of formation and standard reaction enthalpies, Hess law); chemical equilibrium, Le Chatelier`s principle; the influences on the rate of the chemical reactions, catalysis; ionic reactions (ionic equilibria, solubility, solubility product); protolytic reactions (Brønsted theory of acids and bases, pH, indicators, titration. Influence of ions on protolytic equilibria). Redox reactions (oxidation number and balancing of redox reactions, galvanic cells, electrolysis). **Basics of coordination chemistry:** stereochemical properties of coordination compounds, chemical bond in coordination compounds, the influence of the electronic structure on the magnetic and optical properties of coordination ions (qualitative basis).

Temeljna literatura in viri/Readings:

Osnovni učbenik:

- F. Lazarini, J. Brenčič, Splošna in anorganska kemija, Založba FKKT, Ljubljana 2004, str. 1-261.

Dodatna literatura:

- R.H. Petrucci, W.S.Harwood, F.G. Herring, General Chemistry, Principles and modern applications, osma izdaja, Prentice Hall New Jersey, 2002, 1150 str. (40%) glede na interes študenta
- Erwin Riedel, Allgemeine und Anorganische Chemie, osma izdaja,Walter de Gruyter, Berlin, 2004, 380 str. (60%) glede na interes študenta
- A. Burrows, J. Holman, A. Parsons, G. Pilling, G. Price, Chemistry³: Introducing inorganic, organic and physical chemistry (Second Edition), Oxford University Press, Oxford, 2013 (1440 pages). (20 %).

Cilji in kompetence:	**Objectives and competences:**
Cilji: Poglobiti in nadgraditi znanje splošne in anorganske kemije, pridobljeno na srednji šoli, ki je potrebno za nadaljnji študij. Poudarek je na poznavanju in pravilnim razumevanjem osnovnih kemijskih zakonitosti ter poznavanju zgradbe snovi in njenega vpliva na kemijske lastnosti snovi. **Kompetence:** Študent pozna in razume osnovne kemijske zakonitosti, principe in teorije ter jih zna uporabiti pri reševanju preprostih problemov (kvalitativno ali kvantitativno). Je sposoben poiskati in ovrednotiti določene podatke o snoveh in jih zna povezati z njihovimi lastnostmi.	**Objectives:** Deepening and upgrading the knowledge of general and inorganic chemistry, acquired in the secondary school, which is necessary for further study. Emphasis is given to knowledge and correct understanding basic chemical principles and knowledge on the constitution of matter and its influence on chemical properties of matter. **Competences:** student knows and understands basic chemical principles and theories and knows how to use them for solving simple problems (qualitative or quantitative).He is able to find and evaluate given data about substances and is able to relate them to the properties of the substances.

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

Znanje in razumevanje Študent pozna in razume osnovne kemijske zakonitosti ter jih zna povezati z zgradbo in lastnostmi snovi in kemijskimi reakcijami. Uporaba Znanje in razumevanje osnovnih kemijskih zakonitosti so temelji predmetom pri nadaljnjem študiju. Refleksija Študent je sposoben oceniti pomen osnovnih kemijskih zakonitosti in teoretskega znanja za razlago eksperimentalnih dejstev in lastnosti snovi. Prenosljive spretnosti Študent zna poiskati podatke iz strokovne literature, podatke iz virov medmrežja pa zna kritično oceniti; zna uporabljati strokovni jezik (pisno in ustno).	Knowledge and Comprehension Student knows and understands basic chemical principles and is able to relate them to the structure and properties of matter and chemical reactions. Application Knowledge and understanding of basic chemical principles are the basis of subjects for further study. Analysis Student is able to asses the meaning of basic chemical principles and theoretical knowledge for an explanation of experimental facts and properties of compounds. Skill-transference Ability Student is able to find data from professional literature and is able to critically evaluate the data from the internet; he is able to use the professional language (written and spoken).

Metode poučevanja in učenja:	**Learning and teaching methods:**
Eksperimentalna predavanja z uporabo IKT; seminarji: sodelovalno učenje/ poučevanje ter problemsko delo; sprotno preverjanje znanja s testi.	Experimental lectures using the ICT; seminars: cooperative learning/teaching and problem work; regular knowledge assessment using tests.

Načini ocenjevanja:	**Delež/Weight**	**Assessment:**
2 testa za sprotno preverjanje znanja in pisni izpit. Če študent na vsakem od obeh testov zbere najmanj 51 % točk je lahko oproščen opravljanja izpita. Ocenjevalna lestvica v skladu z enotno lestvico na Univerzi v Ljubljani: 6 – 10 opravil izpit, 1 – 5 ni opravil izpita.		2 test for during the semester and written exam. If the student collects at least 51 % of points at each of the tests, he can be excused from the exam. Grades according to the standard levels of the University of Ljubljana: 6-10 passed, 1-5 insufficient.

Reference nosilca/Lecturer's references:

- ZUPANIČ, Franc, MARKOLI, Boštjan, NAGLIČ, Iztok, WEINGÄRTNER, Tobias, **MEDEN, Anton**, BONČINA, Tonica. Phases in the Al-corner of the Al-Mn-Be system. *Microscopy and microanalysis*, ISSN 1431-9276. [Print ed.], FirstView Article, online: 18 June 2013, doi: 10.1017/S1431927613001852. [COBISS.SI-ID 16956694]
- IPAVEC, Andrej, GABROVŠEK, Roman, VUK, Tomaž, KAUČIČ, Venčeslav, MAČEK, Jadran, **MEDEN, Anton**. Carboaluminate phases formation during the hydration of calcite-containing Portland cement. *Journal of the American Ceramic Society*, ISSN 0002-7820, 2011, vol. 94, no. 3, str. 1238-1242, doi: 10.1111/j.1551-2916.2010.04201.x. [COBISS.SI-ID 34764037]
- MALI, Gregor, **MEDEN, Anton**, DOMINKO, Robert. [sup] 6 Li MAS NMR spectroscopy and first-principles calculations as a combined tool for the investigation of Li [sub] 2 MnSiO [sub] 4 polymorphs. *Chemical communications*, ISSN 1359-7345, 2010, issue 19, str.3306-8, doi: 10.1039/c003065a. [COBISS.SI-ID 4386074]

1. P. Živec, F. Perdih, **I. Turel**, G. Giester, G. Psomas, Different types of copper complexes with the quinolone antimicrobial drugs ofloxacin and norfloxacin: Structure, DNA- and albumin-binding, J. Inorg. Biochem., 117, 35–47 (2012).
2. D. Čurman, P. Živec, I. Leban, **I. Turel**, A. Polishchuk, K. D. Klika, E. Karaseva, V. Karasev, Spectral properties of Eu(III) compounds with antibacterial agent ciprofloxacin (cfqH). Crystal structure of [Eu(cfqH)(cfq)(H2O)4]Cl2.4.55 H2O, Polyhedron, 27, 1489-1496 (2008).
3. P. Drevenšek, J. Košmrlj, G. Giester, T. Skauge, E. Sletten, K. Sepčić, **I. Turel**, X-Ray Crystallographic, NMR and Antimicrobial Activity Studies of Magnesium Complexes of Fluoroquinolones - Racemic Ofloxacin and Its S-form, Levofloxacin, J. Inorg. Biochem., 100, 1755-1763 (2006).

STRUKTURA PROTEINOV

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Struktura proteinov
Course title:	Structure of Proteins
Članica nosilka/UL Member:	UL FKKT

Študijski programi in stopnja	Študijska smer	Letnik	Semestri	Izbirnost
Biokemija, prva stopnja, univerzitetni (od študijskega leta 2023/2024 dalje)	Ni členitve (študijski program)	2. letnik	2. semester	obvezni

Univerzitetna koda predmeta/University course code:	0072078
Koda učne enote na članici/UL Member course code:	BK135

Predavanja /Lectures	Seminar /Seminar	Vaje /Tutorials	Klinične vaje /Clinical tutorials	Druge oblike študija /Other forms of study	Samostojno delo /Individual student work	ECTS
30	30	15 LV			75	5

Nosilec predmeta/Lecturer:	doc. dr. Miha Pavšič
Vrsta predmeta/Course type:	obvezni/mandatory
Jeziki/Languages:	Predavanja/Lectures: Slovenščina Vaje/Tutorial: Slovenščina

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

Vsebina:	Content (Syllabus outline):
Aminokisline kot osnovni gradniki proteinov, nivoji proteinske strukture, motivi in zvitja, klasifikacija struktur. Metode za določanje strukture proteinov s poudarkom na 3D strukturi (makromolekulska kristalografija, krio-elektronska mikroskopija, NMR spektroskopija) ter komplementarne eksperimentalne in računalniške metode. Povezava med strukturo in funkcijo na izbranih primerih proteinov: membranski proteini, fibrilarni proteini, DNA- in RNA-vezavni proteini, encimi idr. Drugi vidiki strukture proteinov: evolucija in modularnost, zvijanje, fleksibilnost in dinamika, oligomerizacija, interakcije in makromolekulski kompleksi. Proteinski inženiring.	Amino acids as protein building blocks, levels of protein structure, motifs and folds, structure classification. Methods for determining protein structure with emphasis on 3D structure (macromolecular crystallography, cryo-electron microscopy, NMR spectroscopy) plus complementary experimental and computational methods. Structure–function relationship demonstrated on selected examples: membrane proteins, fibrilar proteins, DNA- and RNA-binding proteins, enzymes etc. Other aspects of protein structure: evolution and modularity, folding, flexibility and dynamics, oligomerization, interactions and macromolecular complexes.

	Protein engineering.

Temeljna literatura in viri/Readings:

- Branden & Tooze: Introduction to Protein Structure. 2nd ed. 1999. 393 str. (30%)
- tekoča znanstvena literatura (pregledni in raziskovalni članki; 30 %)
- Arthur M. Lesk: Introduction to Protein Science: Architecture, Function, and Genomics. 3rd ed. 2010. 430 str. (20 %)
- Williamson: How Proteins Work. 1st ed. 2012. 464 str. (20 %)

Cilji in kompetence:	**Objectives and competences:**
Cilji: študenti spoznajo strukturno raznolikost proteinov in njihovo klasifikacijo, metode za analizo proteinov ter strukturno podlago interakcij proteinov z drugimi molekulami. Kompetence: študenti se naučijo povezovati strukturo proteinov z njihovo biološko funkcijo.	Objectives: students learn about with the structural diversity of proteins and their classification, methods used in protein analysis and the structural basis of protein interactions. Competences: students learn to link the structure of proteins with their biological function.

Predvideni študijski rezultati:	**Intended learning outcomes:**
Znanje in razumevanje Študenti pri predmetu pridobijo znanje o strukturi proteinov in njihovih interakcijah z drugimi molekulami, seznanijo se z najpogostejšimi raziskovalnimi metodami analize struktur proteinov in spoznajo pomembnost povezave med strukturo in funkcijo proteinov v bioloških sistemih. Uporaba Razumevanje strukture proteinov in njene povezave s njihovo funkcijo je ključnega pomena za razumevanje delovanja bioloških sistemov na molekulskem nivoju. Refleksija Študentje pridobijo način razmišljanja o funkciji proteinov z vidika njihove strukture. 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.	Knowledge and Comprehension Students gain knowledge of protein structure and the interactions of protein with other molecules, they become familiar with the most common research methods for protein structure analysis and learn the importance of the relationship between protein structure and function in biological systems. Application Understanding protein structure and its connection to protein function is critical for the understanding of biological systems at the molecular level. Analysis Students gain the ability to evaluate protein function from the structural perspective. Skill-transference Ability Problem-solving experience. Team work (seminar work and laboratory course). Collection, interpretation and critical assessment of results. Use of domestic and foreign literature. Writing laboratory reports.

Metode poučevanja in učenja:	**Learning and teaching methods:**
Predavanja, seminarji. Seminarske in laboratorijske vaje.	Lectures, seminars Seminar and laboratory tutorial.

Načini ocenjevanja:	**Delež/Weight**	**Assessment:**
Opravljene vaje so pogoj za pristop k izpitu.		Completed laboratory tutorial is a prerequisite for admission to the examination.
Seminarska naloga		Seminar work
Pisni izpit		Written examination

Reference nosilca/Lecturer's references:

PAVŠIČ, Miha. Trop2 Forms a Stable Dimer with Significant Structural Differences within the Membrane-Distal Region as Compared to EpCAM. International Journal of Molecular Sciences, 2021, 22, 19, 10640.

PAVŠIČ, Miha, ILC, Gregor, VIDMAR, Tilen, PLAVEC, Janez, LENARČIČ, Brigita. The Cytosolic Tail of the Tumor Marker Protein Trop2–a Structural Switch Triggered by Phosphorylation. Scientific Reports, 2015, 5, 10324.
VIDMAR, Tilen, **PAVŠIČ, Miha**, LENARČIČ, Brigita. Biochemical and Preliminary X-Ray Characterization of the Tumor-Associated Calcium Signal Transducer 2 (Trop2) Ectodomain. Protein Expression and Purification, 2013, 91, 1, 69–76.

TEMELJI BIOKEMIJE

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Temelji biokemije
Course title:	Fundamentals of biochemistry
Članica nosilka/UL Member:	UL FKKT

Študijski programi in stopnja	Študijska smer	Letnik	Semestri	Izbirnost
Biokemija, prva stopnja, univerzitetni	Ni členitve (študijski program)	1. letnik	2. semester	obvezni

Univerzitetna koda predmeta/University course code:	0072067
Koda učne enote na članici/UL Member course code:	BK110

Predavanja /Lectures	Seminar /Seminar	Vaje /Tutorials	Klinične vaje /Clinical tutorials	Druge oblike študija /Other forms of study	Samostojno delo /Individual student work	ECTS
45	30				75	5

Nosilec predmeta/Lecturer:	doc. dr. Miha Pavšič
Vrsta predmeta/Course type:	obvezni/mandatory
Jeziki/Languages:	Predavanja/Lectures: Slovenščina Vaje/Tutorial: Slovenščina

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

Vsebina:	Content (Syllabus outline):
Molekule in življenje. Aminokisline, peptidi in proteini. 3D zgradba proteinov in njihova biološka vloga. Encimi: reakcije, kinetika, inhibicija, koencimi. Ogljikovi hidrati: zgradba in biološka vloga. Lipidi, biološke membrane, transport. DNA in RNA: zgradba in vloga. Ohranjanje in prenos biološke informacije. Rekombinantna DNA in biotehnologija. Osnove celičnega metabolizma in bioenergetike. Glikoliza in glukoneogeneza. Nastanek NADH, NADPH. Verige za prenos elektronov in nastanek ATP. Katabolizem maščobnih kislin in dušikovih spojin.	Molecules and life. Amino acids, peptides and proteins. 3D structures of proteins and biological function. Enzymes: reactions, kinetics, inhibition, coenzymes. Carbohydrates: structure and biological function. Lipids, biological membrane, cellular transport. DNA and RNA: structure and function. Storage and transfer of biological information. Recombinant DNA and biotechnology. Basic concepts of cellular metabolism and bioenergetics. Glycolysis and gluconeogenesis. NADH, NADPH formation. Electron-transport chain and ATP formation. Catabolism of fatty acids and nitrogenous compounds.

Temeljna literatura in viri/Readings:

- Temelji biokemije, Boyer (Študentska založba, 2005) strani 630 (50%)

Cilji in kompetence:	**Objectives and competences:**
Namen predmeta je, da študentje pridobijo biokemijske osnove (zgradba in vloga bioloških makromolekul in njihova regulacija, celični metabolizem). Po opravljenih obveznostih bo študent sposoben razumeti razlago osnovnih biokemijskih in fizioloških procesov.	The objective of the course is to provide students with the basic biochemical knowledge (structure and function of biological macromolecules and their regulation, cellular metabolism). After completing the course, students will be able to understand the basic biochemical and physiological processes.

Predvideni študijski rezultati:	**Intended learning outcomes:**
Znanje in razumevanje Znanje: poznavanje zgradbe in biološke vloge makromolekul. Energetske molekule in njihove pretvorbe. Razumevanje: delovanje encimov in inhibitorjev, princip ohranjanja in prenosa genetske informacije, metabolizem. **Uporaba** Predmet daje znanja, ki so nujno potrebna za nadaljevanje študija. **Refleksija** Študent bo razmišljal o povezavi med strukturo makromolekul in njihovo biološko vlogo. **Prenosljive spretnosti** Samostojno in skupinsko delo za pripravo seminarjev, sposobnost uporabe literature in drugih virov, ustno in pisno in poročanje.	**Knowledge and Comprehension** Knowledge of the structure and biological function of macromolecules. High energy molecules and their interconversion. Function of enzymes and their inhibitors, principles of the storage and transfer of biological information, metabolism **Application** The course provides knowledge essential for a successful continuation of the study programme. **Analysis** Students will reflect on the connection between structure and biological function of macromolecules. **Skill-transference Ability** Individual and group work in preparing seminars, the ability to use literature and other sources, oral and written reporting.

Metode poučevanja in učenja:	**Learning and teaching methods:**
Predavanja, individualni in skupinski seminarji.	Lectures and individual seminars.

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

Reference nosilca/Lecturer's references:

KOSTAN, Julius, **PAVŠIČ, Miha**, PUŽ, Vid, SCHWARZ, Thomas C., DREPPER, Friedel, MOLT, Sibylle, GRAEWERT, Melissa Ann, SCHREINER, Claudia, SAJKO, Sara, van der VEN, Peter F. M., ONIPE, Adekunle, SVERGUN, Dmitri I., WARSCHEID, Bettina, KONRAT, Robert, FÜRST, Dieter O., LENARČIČ, Brigita, DJINOVIĆ-CARUGO, Kristina. Molecular Basis of F-Actin Regulation and Sarcomere Assembly via Myotilin. PLoS Biology, 2021, 19, 4, e3001148.

KRAJNC, Anja, GABER, Aljaž, LENARČIČ, Brigita, **PAVŠIČ, Miha**. The Central Region of Testican-2 Forms a Compact Core and Promotes Cell Migration. International Journal of Molecular Sciences, 2020, 21, 17, 9413.

GABER, Aljaž, KIM, Seung Joong, KAAKE, Robyn M., BENČINA, Mojca, KROGAN, Nevan, ŠALI, Andrej, **PAVŠIČ, Miha**, LENARČIČ, Brigita. EpCAM Homo-Oligomerization Is Not the Basis for Its Role in Cell-Cell Adhesion. Scientific Reports, 2018, 8, 1, 13269.

TEMELJI FIZIOLOGIJE

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Temelji fiziologije
Course title:	Fundamentals of physiology
Članica nosilka/UL Member:	UL FKKT

Študijski programi in stopnja	Študijska smer	Letnik	Semestri	Izbirnost
Biokemija, prva stopnja, univerzitetni	Ni členitve (študijski program)	3. letnik	2. semester	obvezni

Univerzitetna koda predmeta/University course code:	0072081
Koda učne enote na članici/UL Member course code:	BK121

Predavanja /Lectures	Seminar /Seminar	Vaje /Tutorials	Klinične vaje /Clinical tutorials	Druge oblike študija /Other forms of study	Samostojno delo /Individual student work	ECTS
30	15	30 LV			75	5

Nosilec predmeta/Lecturer:	prof. dr. Robert Zorec
Vrsta predmeta/Course type:	obvezni/mandatory
Jeziki/Languages:	Predavanja/Lectures: Slovenščina Vaje/Tutorial: Slovenščina

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

Vsebina:	Content (Syllabus outline):
Pri predmetu Temeljna fiziologija študent spozna 1) temelje fizioloških procesov metazojskih evkariontov s poudarkom predstavitve integrativnih mehanizmov. Pridobljeno znanje mu omogoča razumevanje temeljnih življenjskih procesov na ravni molekularnih funkcionalnih modulov v celici, na ravni delovanja posamezne celice, na ravni tkiv, organov in na sistemski ravni. 2) Spozna tudi načela in nekatere tehnologije meritev fizioloških količin, ki prispevajo k homeostazi v organizmu. Predavanja obravnavajo teme od molekulske in celične ravni, do ravni organov in sistemov. Študenti spoznajo mehanizme homeostaze, zgodovinski vidik fiziologije, temelje transportnih mehanizmov na ravni celice in sistema, nato pa sistematično še mehanizme,	At the course Fundamental Physiology the student will learn: 1) basic principles of the physiological processes of the metazoan eukaryotic organism, with the emphasis on the integrative mechanisms. The acquired knowledge will enable students to understand the processes in live matter on the level of the molecular modules in the cell, on the level of the tissue, organs, and on the systemic level. 2) The student will also learn the principles of experimentation and measurement of physiological parameters. The lectures will cover a broad spectrum of topics from molecular and cellular level, to organs and the systemic level. Students will learn mechanisms of homeostasis, historical aspect of physiology, transport mechanisms, nervous and endocrine system, muscles,

ki prispevajo k homeostazi fizioloških količin z obravnavanjem živčnega in endokrinega sistema, mišičja, srca in obtočil, pljuč in pljučnih obtočil, ledvic in uravnavanja telesnih tekočin, acido-baznega ravnotežja, gastrointestinalnega trakta, uravnavanja telesne temperature, procesov staranja na molekularni, celični in sistemski ravni Na vajah se študenti seznanijo z meritvami nekaterih fizioloških količin in pojavov (transmembranska napetost, akcijski potencial, krvni tlak, kontrakcija mišic, ...) hkrati spoznajo nekatere metode pri fiziološkem raziskovalnem delu. Pri vajah uporabljamo metode, ki so alternativa delu s poskusnimi živalmi (delo na rastlinskih celicah, samostojno delo z računalniško simulacijo poskusov na živalih, posnetki poskusov, preproste neinvazivne metode na človeku).	heart and vasculature, kidney, gastrointestinal tract, control of the body temperature, aging on the molecular, cellular and systemic level. The practical training will be focused on measurements of selected physiological parameters and processes (e.g.: trans-membrane potential, action potential, blood pressure, muscle contraction). Students will learn selected methods in physiology research. The practical training will be performed using approaches, which are the alternative to the experimental animals, i.e. the use of plant cells, work in silico, video demonstrations, non-invasive measurements on human.

Temeljna literatura in viri/Readings:

- R. Rhoades in R. Pflanzer. Human Physiology, fourth edition, Saunders College Publishing, Harcourt College Publishers, 2003. (30%) ISBN-10: 0534462510
- Optional in Slovenian language: »Temelji fiziologije – Navodila za vaje, 2. popravljena in dopolnjena izd. 2012« authors, Marko Kreft, Helena Chowdhury in Robert Zorec. ISBN 978-961-91257-7-9

Cilji in kompetence:	**Objectives and competences:**
Cilji predmeta so naučiti študente temeljev procesov v metazojskih evkariontskih organizmih, ki prispevajo k homeostazi. Kompetence študenta bodo poznavanje načel in nekaterih tehnologij meritev fizioloških količin, ki prispevajo k homeostazi v organizmu.	Students will learn the principles and selected methodologies in physiology. Competences will include principles of measurement in physiology, and understanding of homeostasis.

Predvideni študijski rezultati:	**Intended learning outcomes:**
razumevanje Pri predmetu Temelji fiziologije študent spozna temelje fizioloških procesov metazojskih evkariontov. Spozna tudi načela in nekatere tehnologije meritev fizioloških količin. Pridobljeno znanje mu omogoča razumevanje temeljnih življenjskih procesov na ravni molekularnih funkcionalnih modulov v celici, na ravni delovanja posamezne celice, na ravni tkiv, organov in na sistemski ravni. Uporaba Študij predmeta Temelji fiziologije je nujna podlaga za razumevanje procesov v organizmih, ti pa so ključni za bioinženirstvo in mnoga druga strokovna področja biomedicine in biotehnologije. Refleksija Študent pridobi vpogled v procese v bioloških organizmih in pridobi razumevanje homeostaze. Prenosljive spretnosti Študent spozna temelje eksperimentalnega dela v fiziologiji in bioloških znanostih, spozna različne fiziološke količine, ki jih lahko merimo, analiziramo in interpretiramo rezultate.	Knowledge and Comprehension The outcome of the course will be acquired knowledge of the fundamental processes in the metazoan eukaryotic organism, which are essential in homeostasis in the level of molecular functional modules in the cell, the level of cellular processes and processes in tissue, organ and organism. Application The course is essential background for understanding processes in living organisms, which are critical in bioengineering, biomedicine and biotechnology. Analysis Student will learn principles of physiology in all living organisms and will understand homeostasis. Skill-transference Ability Student will learn basics of experimental work in physiology, biosciences. They will learn measurements of biological variables, analysis and interpretation of data.

Metode poučevanja in učenja:	Learning and teaching methods:
Predavanja, laboratorijske vaje, seminarji, simulacije eksperimentov.	Lectures, seminars, practical training.

Načini ocenjevanja:	Delež/Weight	Assessment:
Izpit (ustni in pisni) (ocena > 6)		Oral and written exam
Seminarska naloga.	70,00 %	Seminar work.
Kolokvij iz vaj.	30,00 %	Practical courses.

Reference nosilca/Lecturer's references:

- RITUPER, Boštjan, CHOWDHURY HAQUE, Helena, JORGAČEVSKI, Jernej, COORSSEN, Jens R., KREFT, Marko, **ZOREC, Robert**. Cholesterol-mediated membrane surface area dynamics in neuroendocrine cells. Biochimica et biophysica acta. Molecular and cell biology of lipids, ISSN 1388-1981, Jul. 2013, vol. 1831, iss. 7, str. 1228-1238
- MILOŠEVIĆ, Milena, STENOVEC, Matjaž, KREFT, Marko, PETRUŠIĆ, Vladimir, STEVIĆ, Zorica, TRKOV, Saša, ANDJUS, Pavle, **ZOREC, Robert**. Immunoglobulins G from patients with sporadic amyotrophic lateral sclerosis affects cytosolic Ca2+ homeostasis in cultured rat astrocytes. Cell calcium, ISSN 0143-4160, Jul. 2013, vol. 54, iss. 1, str. 17-25.
- POTOKAR, Maja, STENOVEC, Matjaž, JORGAČEVSKI, Jernej, HOLEN, Torgeir, KREFT, Marko, OTTERSEN, Ole Petter, **ZOREC, Robert**. Regulation of AQP4 surface expression via vesicle mobility in astrocytes. Glia, ISSN 0894-1491, Jun. 2013, vol. 61, iss. 6, str. 917-928, ilustr., doi: 10.1002/glia.22485.
- COSTA CALEJO, Ana-Isabel, JORGAČEVSKI, Jernej, KUCKA, Marek, KREFT, Marko, GONÇALVES, Paula P., STOJILKOVIĆ, Stanko, **ZOREC, Robert**. cAMP-mediated stabilization of fusion pores in cultured rat pituitary lactotrophs. The Journal of neuroscience, ISSN 0270-6474, May 2013, vol. 33, iss. 18, str. 8068-8078, ilustr., doi:10.1523/JNEUROSCI.5351-12.2013.
- FLAŠKER, Ajda, JORGAČEVSKI, Jernej, COSTA CALEJO, Ana-Isabel, KREFT, Marko, **ZOREC, Robert**. Vesicle size determines unitary exocytic properties and their sensitivity to sphingosine. Molecular and cellular endocrinology, ISSN 0303-7207. [Print ed.], 2013, vol. 376, iss. 1/2, str. 136-147,
- RITUPER, Boštjan, GUČEK, Alenka, JORGAČEVSKI, Jernej, FLAŠKER, Ajda, KREFT, Marko, **ZOREC, Robert**. High-resolution membrane capacitance measurements for the study of exocytosis and endocytosis. Nature protocols, ISSN 1754-2189, 2013, vol. 8, no. 6, str. 1169-1183, ilustr., doi: 10.1038/nprot.2013.069.
- JORGAČEVSKI, Jernej, KREFT, Marko, VARDJAN, Nina, **ZOREC, Robert**. Fusion pore regulation in peptidergic vesicles. Cell calcium, ISSN 0143-4160, 2012, vol. 52, iss. 3/4, str. 270-276, doi: 10.1016/j.ceca.2012.04.008.
- JORGAČEVSKI, Jernej, POTOKAR, Maja, GRILC, Sonja, KREFT, Marko, **ZOREC, Robert**, et al. Munc 18-1 tuning of vesicle merger and fusion pore properties. The Journal of neuroscience, ISSN 0270-6474, 2011, vol. 31, issue 24, str. 9055-9066, doi: 10.1523/JNEUROSCI.0185-11.2011.
- VELEBIT MARKOVIĆ, Jelena, CHOWDHURY HAQUE, Helena, KREFT, Marko, **ZOREC, Robert**. Rosiglitazone balances insulin-induced exo- and endocytosis in single 3T3-L1 adipocytes. Molecular and cellular endocrinology, ISSN 0303-7207. [Print ed.], 2011, vol. 333, issue 1, str. 70-77, doi: 10.1016/j.mce.2010.12.014.
- JORGAČEVSKI, Jernej, FOŠNARIČ, Miha, VARDJAN, Nina, STENOVEC, Matjaž, POTOKAR, Maja, KREFT, Marko, KRALJ-IGLIČ, Veronika, IGLIČ, Aleš, **ZOREC, Robert**. Fusion pore stability of peptidergic vesicles. Molecular membrane biology, ISSN 0968-7688, 2010, letn. 27, št. 2/3, str. 65-80, doi: 10.3109/09687681003597104.

VIROLOGIJA

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Virologija
Course title:	Virology
Članica nosilka/UL Member:	UL FKKT

Študijski programi in stopnja	Študijska smer	Letnik	Semestri	Izbirnost
Biokemija, prva stopnja, univerzitetni	Ni členitve (študijski program)	3. letnik		izbirni

Univerzitetna koda predmeta/University course code:	0088099
Koda učne enote na članici/UL Member course code:	BKSI5

Predavanja /Lectures	Seminar /Seminar	Vaje /Tutorials	Klinične vaje /Clinical tutorials	Druge oblike študija /Other forms of study	Samostojno delo /Individual student work	ECTS
30	15	30 SV			75	5

Nosilec predmeta/Lecturer:	doc. dr. Korva Miša
Vrsta predmeta/Course type:	izbirni strokovni/elective professional
Jeziki/Languages:	Predavanja/Lectures: Angleščina, Slovenščina Vaje/Tutorial: Angleščina, Slovenščina

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

Vsebina:	Content (Syllabus outline):
Predmet obravnava temeljne lastnosti virusov, zgradbo in pomen posameznih virusnih struktur (beljakovine). Poimenovanje in razvrstitev virusov. Razmnoževanje virusov s posebnim povdarkom na vstopu virusov v celico, virusnim združevanjem, translacijskim nadzornim mehanizmom in virusno transformacijo. Virusna genetika. Osnove patogeneze virusnih okužb. Virusi in tumorji. Imunski protivirusni odziv. Virusni kemoterapevtiki in cepiva ter imunski serumi. Pregled pomembnih družin virusov z DNA in RNA. Rastilnski virusi, prioni in bakteriofagi. Posredne in neposredne klasične in molekularne tehnike za proučevanje virusov in njihova praktična uporaba za diagnostiko virusnih okužb.	Basic characteristics of viral structure, morphology, proteins and their functions. Overview of viral taxonomy and replication with the emphasis on virus entry, transcription, maturation and viral protein processing. Introduction into basic concepts of viral genetics, pathogenesis and viral oncogenesis. Basic principles of viruses interacting with host immune mechanisms, effects of antiviral drugs and vaccines. Overview of important RNA and DNA virus families. Application of specific techniques in virology.

Temeljna literatura in viri/Readings:

- Brooks GF, Butel JS, Morse SA. Jawetz, Melnick & Adelberg's Medical Microbiology. Stamford: Appleton & Lange (all chapters on virology), latest edition.
- Koren S, Avšič-Županc T, Drinovec B, Marin J, Poljak M. Splošna medicinska virologija. Ljubljana: Medicinski razgledi, 2002.
- Poljak M, Petrovec M. Medicinska virologija. Medicinski razgledi, Ljubljana 2011.

Review articles.

Cilji in kompetence:	**Objectives and competences:**
Glavni cilj predmeta Virologija je, da študent spozna viruse kot najmanjše mikroorganizme, ki so brez sistema za sintezo lastnih sestavin. Študent se bo seznanil z zgradbo, razmnoževanjem, medsebojnim vplivom virusov in celic, virusno genetiko in patogenezo, virusno onkogenezo, protivirusnimi kemoterapevtiki in cepivi ter temeljnimi in diagnostičnimi virološkimi tehnikami. Študent bo tako spoznal temeljne zakonitosti virusov in se hkrati seznanil z uporabno razsežnostjo področja virologije.	Understanding the life of viruses as the smallest microorganisms which do not have their own protein synthesis system. Knowledge of the viral morphology, replication, interaction with the host cells, viral genetics and pathogenesis and antiviral therapy and vaccines. Knowledge of the basic principles of viral diagnostic techniques which can be applied to many other fields.

Predvideni študijski rezultati:	**Intended learning outcomes:**
Znanje in razumevanje Predmet Virologija bo dovoljeval študentu razumevanje osnovnih pojmov, ki so za to skupino mikroorganizmov specifični. Uporaba Predmet Virologija bo predstavljal podlago za nadaljni magistrski študij Biokemija in molekularna biologija. Refleksija Predmet bo dovoljeval študentom razumevanje teorije in bo hkrati nakazal praktično uporabo specifičnih metod virologije. Prenosljive spretnosti Z izvajanjem skupinskih seminarjev se bodo študenti urili v iskanju literature, pripravi pismenih izdelkov, ustnih predstavitvah, diskusiji in debatah.	Knowledge and Comprehension Ability to understand basic concepts that are specific for this group of microorganisms. Application The course is fundamental for further PhD degree studies in Biochemistry and molecular biology. Analysis Ability to understand theory and further indicate practical use of specific methods of virology. Skill-transference Ability Group seminar work will allow students to practice literature search, written skills, oral presentations and discussions and debates.

Metode poučevanja in učenja:	**Learning and teaching methods:**
Predavanja (nosilec predmeta povabi k sodelovanju za določena poglavja strokovnjake iz posameznega ožjega področja). Skupinski seminarji (vsako seminarsko uro bo obravnavana specifične tema v skupinah) z vodeno diskusijo. Pogovori in konzultacija študentov z učiteljem in asistenti.	Lectures (invited specialists from particular filed). Group seminars with discussion. Consultations with the course holder.

Načini ocenjevanja:	**Delež/Weight**	**Assessment:**
Seminarska naloga		Seminary work
Seminarska naloga Ustni izpit Ocene: 6-10 (pozitivno), 1-5 (negativno).		Oral exam Grades: positive (6-10); negative (1-5)

Reference nosilca/Lecturer's references:

1. Knap N, **Korva M**, Ivović V, Kalan K, Jelovšek M, Sagadin M, Zakotnik S, Strašek Smrdel K, Slunečko J, Avšič-Županc T. West Nile Virus in Slovenia. Viruses. 2020; 12(7):720.
2. Tavčar Verdev P, Potokar M, **Korva M**, Resman Rus K, Kolenc M, Avšič Županc T, Zorec R, Jorgačevski J. In human astrocytes neurotropic flaviviruses increase autophagy, yet their replication is autophagy-independent. Cell Mol Life Sci. 2022; 79(11):566.
3. Mlakar J, **Korva M**, Tul N, Popović M, Poljšak-Prijatelj M, Mraz J, Kolenc M, Resman Rus K, Vesnaver Vipotnik T, Fabjan Vodušek V, Vizjak A, Pižem J, Petrovec M, Avšič Županc T. Zika Virus Associated with Microcephaly. N Engl J Med. 2016; 374(10):951-8.